Erlangen Regional Computing Center

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Secure system access

HPC Café, 9. Juni 2020

High Performance Computing

Secure authentication

- Authentication factors
  - **Knowledge factors**: e.g. Password, Passphrase, PIN
  - **Ownership factors: e.g.** ID card, cell phone, hardware token, software token
  - **Inherence factors:** Fingerprint, signature, retinal pattern, face, location
- **Multi-factor** authentication is mandatory
- Compromise between **security** and **convenience**

- In HPC environments **secure shell (SSH)** is the de-facto **standard for authentication** of access to remote systems

Common security guidelines

- **Never share** a **password** or key for **different hosts**/systems
- Do **not store** passwords **clear text** anywhere in any form
- Use **strong passwords** (15-20 characters, can contain all character classes, can include words and sentences)

If you want to stay sane you need a **password manager**:

- **Manages** large number of **passwords**
- Can **generate** long **secure passwords** for you
- **Prevents** to **enter passwords** all over again
- **SSO password** to password manager is **single point of failure!**

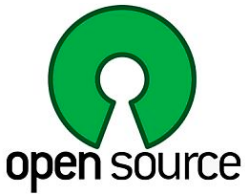
Password manager options

- Built-in solutions:
  - Google Password manager
  - Apple Keychain
  - Firefox Password manager
- Commercial offerings:
  - 1Password (3.15 Euro per month)
  - LastPass (free option, 2.67 Euro per month)
  - Bitwarden (Open Source with commercial support)
- Open Source
  - KeePass (portable, cross platform, with GUI)
  - Pass and clones (CLI based, the hackers choice, based on GPG for encryption, can use git for synchronization)

It is difficult to give a recommendation!

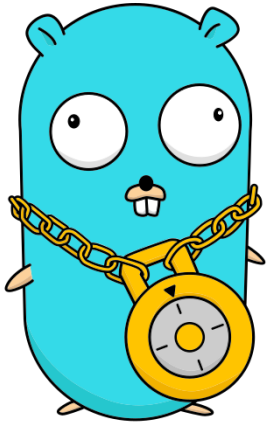
Who do you trust?

$



What do I use? gopass

- **Gopass** - The slightly more awesome standard unix password manager



- Improved **reimplementation** of pass in **Golang**
- **GPG** for **encryption** and **git** for **synchronization**
- Support for **password sharing** (teams)
- **Clean** and accessible **CLI interface**
- Very **good support** and **large active community**
- **Cross platform** (Linux, Apple Mac, BSD, Windows)

Websites: https://www.gopass.pw/
https://github.com/gopasspw/gopass

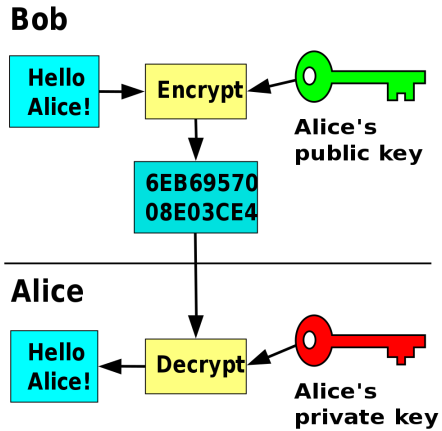
SSH overview

SSH is a cryptographic **network protocol**

- Designed in 1995 by **Tatu Ylönen** (researcher at Helsinki University of Technology, Finland)
- SSH is standardized by an **Internet Engineering Task Force** (**IETF**) working group
- OpenSSH (an OpenBSD project) is the most common Open Source implementation

SSH: How does it work?

- "Secure" means
  - **User is authenticated** to the system
  - **System is authenticated** to the user
  - All transmitted **data is encrypted**
- Technology
  - **Asymmetric encryption** algorithm („Public Key") for **authentication** and determination of a **Session Key**
  - **Symmetric encryption** of data transfer using **Session Key**

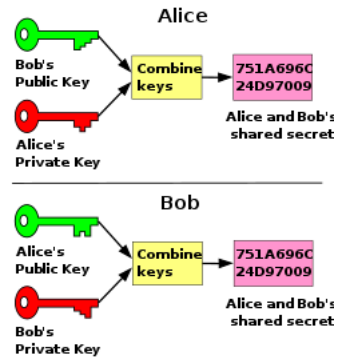


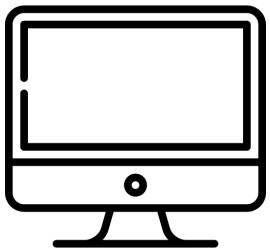
SSH: How does it work?

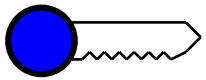
connects to server

sends servers public key

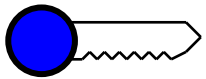
negotiate and open secure channel





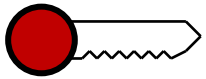


Symmetric encryption with session key



User authentication

Client

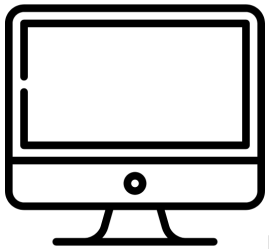


Asymmetric encryption with public key algorithm

Server

Public key authentication

- Use a cryptographic **key-pair** as **password**
- Keys are **not used** for **encryption**
- Was initially intended for **automation**
- Provides **two-factor** authentication if used with **passphrase**
- Implements **SSO solution** if using **ssh-agent**

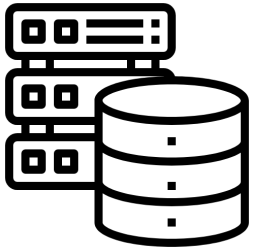


Encrypted private key

decrypt with passphrase

Optional: ssh-agent holds decrypted key in memory

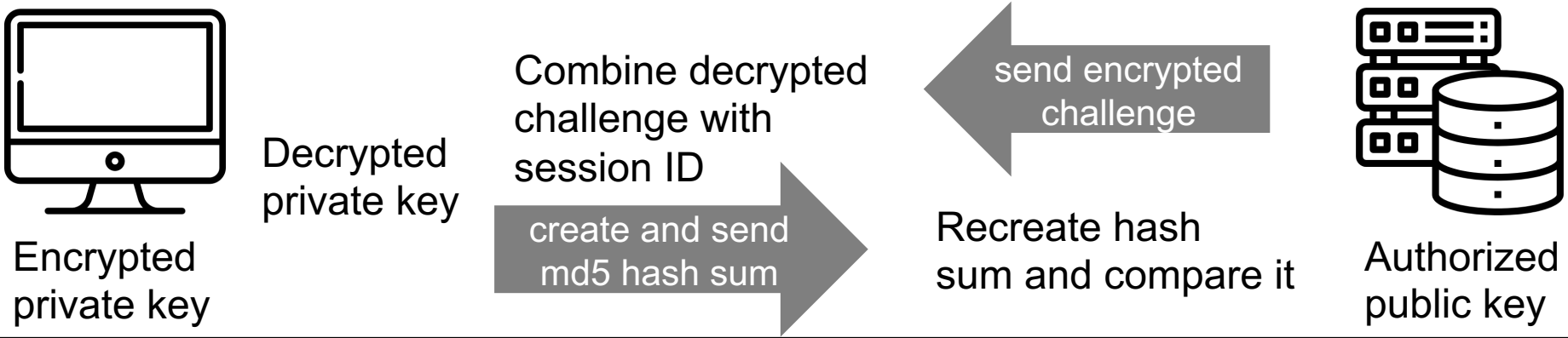
Decrypted private key



Authorized public key

Public key authentication

- Use a cryptographic **key-pair** as **password**
- Keys are **not used** for **encryption**
- Was initially intended for **automation**
- Provides **two-factor** authentication if used with **passphrase**
- Implements **SSO solution** if using **ssh-agent**



Agent-forwarding

- Default a ssh-agent does not provide **single-sign-on (SSO)** on remote host

User perspective:

- **Agent-forwarding** enables **SSO** also on **remote hosts**
- **Private keys** do **not** need to be **deployed** on remote hosts

Admin perspective:

- **Authentication** can be hijacked and is **forwarded** to a potentially **untrusted** remote environment

Our advice: Do not use agent-forwarding!

Tips and tricks

- Recommended options for key generation:

```
$ ssh-keygen -t rsa -b 4096 [-f outfile]
```

- Command to transfer public keys to server:

```
$ ssh-copy-id -i ~/.ssh/mykey user@host
```

- Configure per host settings in `~/.ssh/config` file.

See next slide for details.

- **Keychain** persistent frontend for ssh-agent (use on Client)

More Information: https://www.funtoo.org/Keychain

ssh config file

- Location: **`~/.ssh/config`**
- Allows to **create shortcuts** to hosts and **adjust ssh settings** on a per host base (**Caveat**: Settings are implicit!)
- Documentation: **`$ man ssh_config`**
- Example entry:

```
Host rrze
  ForwardAgent no
  ForwardX11 no
  HostName cshpc.rrze.fau.de
  User unrz999
  IdentityFile /home/john/.ssh/id_rsa_rrze
```

Security hints for ssh clients

- Keep the **private key files** secret!
- The following files should be read-only:
  - authorized_keys, known hosts file and config file
- Use a **4096bit RSA key** protected by a **passphrase**
- Use a **strong passphrase** (at least 15 characters long)
- Use a **separate key** for every client
- Disable **agentForwarding** and **X11Forwarding** in config
- Do not leave **open external logins** in running **Tmux/screen**
- **Keep** your ssh client installation **up to date**

Consequences

Private keys should be only placed on **single-user systems**, best using an **encrypted harddisk**

A **multi-user terminal server** is an **untrusted host**

- **NO private keys** on **untrusted hosts**
- **NO ssh-agent** on **untrusted hosts**
- **NO agent forwarding** to **untrusted hosts**

Use-case for RRZE HPC systems

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Home directory is NFS share

- If **one system** is hacked **all systems** are hacked
- Use a **RRZE only keypair** for internal logins

Recommendations:

- Use **separate keypair** on every client (Laptop, Desktop)
- Create single **keypair** for internal RRZE use
- This key **may** be also used to access **external systems**

Welcome to ProxyJump

- To **access hosts** behind a **terminal server** (bastion host) since OpenSSH 7.3 the **ProxyJump** functionality was added
- The connection is **tunneled** through the bastion host but the connection to final target host is made by the initial client
- ssh will give warning if a **man in the middle attack** occurs

Add this to `~/.ssh/config`

```
Host emmy
HostName emmy
User unrz999
IdentityFile ~/.ssh/id_rsa_rrze
ProxyJump cshpc
```

All Keys have to be on originating host

```
Host cshpc
Hostname cshpc.rrze.uni-erlangen.de
ForwardAgent no
User unrz999
```

Use case: Automated file synchronization

- **Automated rsync over ssh** is a common use case
- If using **passphrase less keys** you should **restrict access** in authorized keys
- There is a **dedicated script** for this: **`rrsync`**

In **`.ssh/authorized_keys`** add:

```
command="rrsync /rsync/base/path",no-agent-forwarding,no-port-forwarding,no-pty,no-user-rc,no-X11-forwarding ssh-rsa AAAA[...]
```

Path below server base path

Config entry:

```
Host rrze-sync
Hostname cshpc.rrze.uni-erlangen.de
IdentityFile ~/.ssh/id_rsa_sync
User unrz999
```

Calling rsync on client:

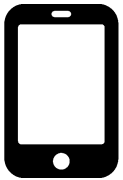
```
$ rsync -e ssh  -av path/ rrze-sync:subdir/
```

New developments in ssh security

- As we learned to **increase security** you have to **increase factors** involved

- Add **hardware token**: e.g. FIDO keys, **YubiKey**, can be subkey of GPG key
- Use **One Time Passwords (OTP)** as second factor to extend passphrase, e.g. generated by YubiKey

- Send **additional pin** per text message to **mobile device**



DEMO

- Use **`gopass`** password manager
- Create ssh key-pair
- Transfer public key to remote host
- Setup secure file sync
- Create ProxyJump entry in .ssh/config