

SSH (Secure Shell)

SSH Protocol · SSH to RPi

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Introduction to SSH

- SSH (Secure Shell) is a protocol that provides a secure way to access a remote computer or server.
- It encrypts the communication between your device and the remote device, ensuring data security.
- SSH is widely used for
 - Accessing remote hosts/servers
 - Secure File Transfer (SCP and SFTP)
 - Access to Cloud Services and Virtual Machines
 - Tunneling and Port Forwarding

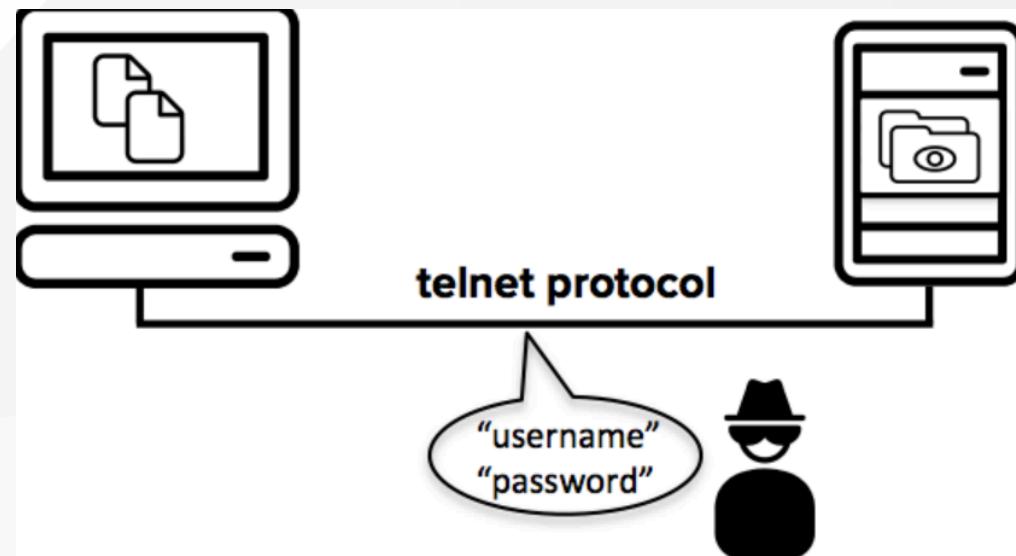
Internet protocol suite

Application layer

BGP · DHCP (v6) · DNS · FTP ·
HTTP (HTTP/3) · HTTPS · IMAP · IRC · LDAP
· MGCP · MQTT · NNTP · NTP · OSPF · POP
· PTP · ONC/RPC · RTP · RTSP · RIP · SIP ·
SMTP · SNMP · **SSH** · Telnet · TLS/SSL ·
XMPP · more...

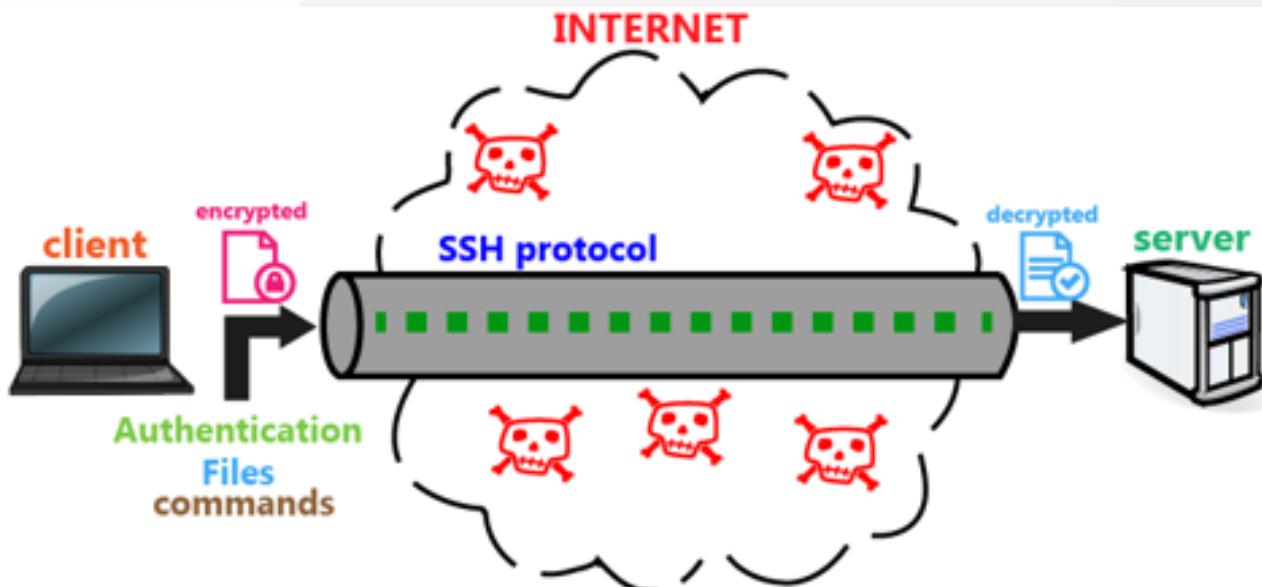
Why SSH is Important

- Need for security in remote communication
 - Telnet was its predecessor. Not good enough for today
- Vulnerability of unencrypted protocols(last lab - UDP payload unencrypted)
- SSH allow you to:
 - protecting sensitive data
 - ensure authentication
 - preventing unauthorized access.



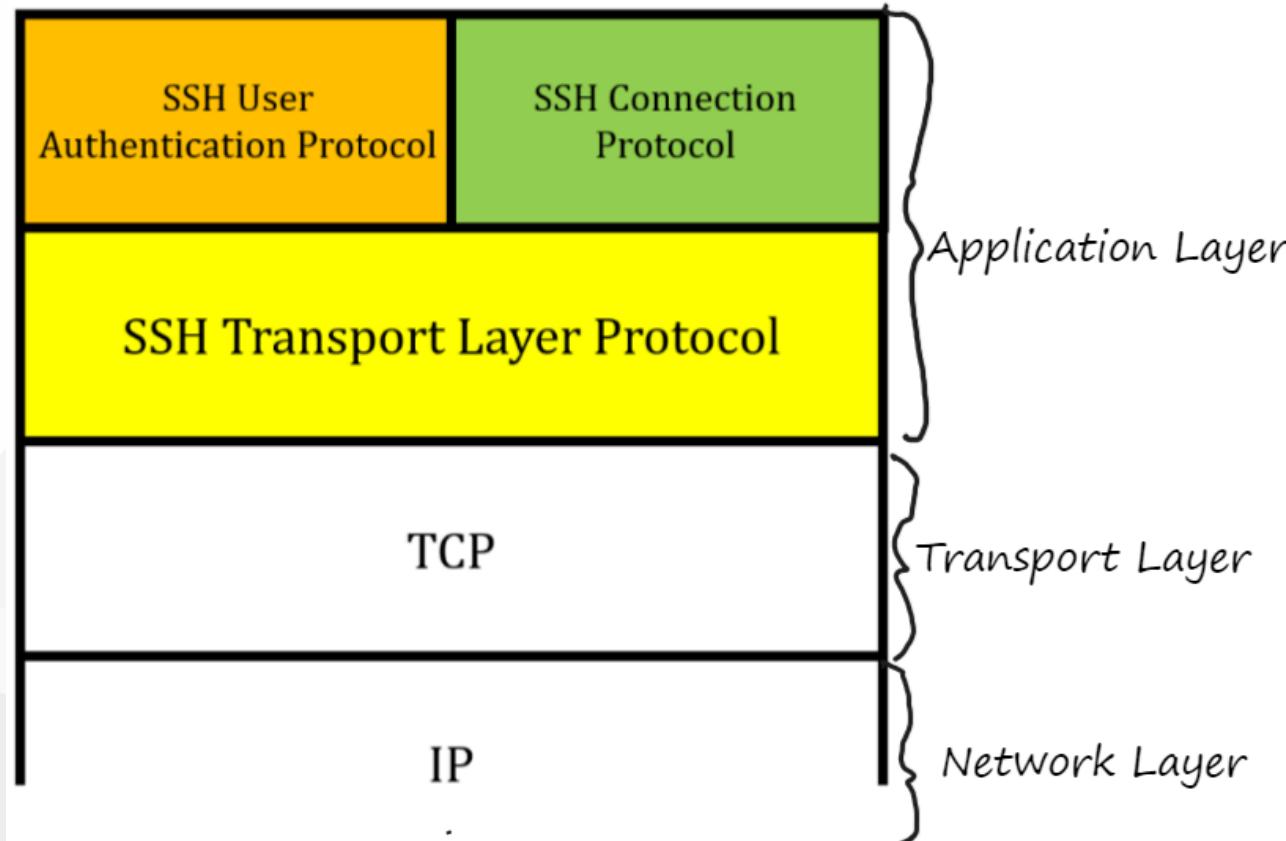
How SSH Works

- Client-Server model
- SSH operates over TCP, typically using port 22
- Components:
 - SSH client
 - SSH server



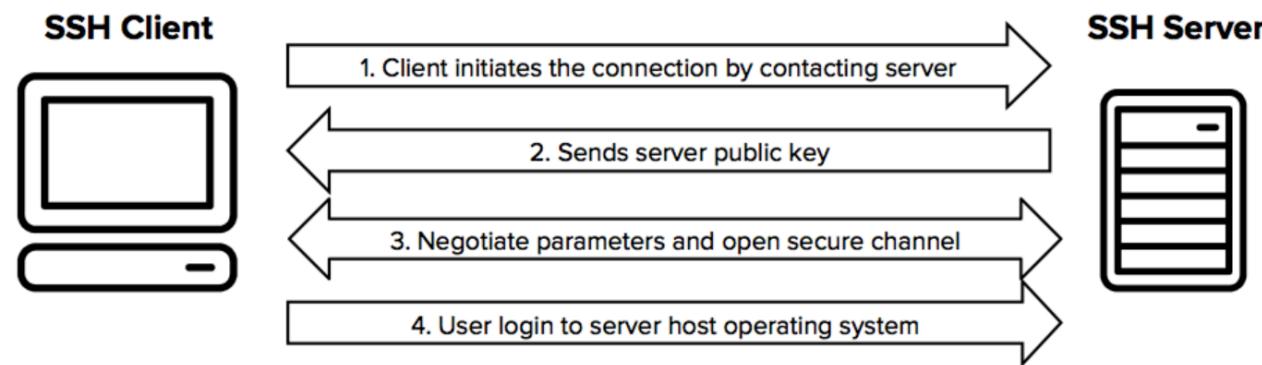
SSH Protocol

- Transport layer Protocol: Handles encryption
- User authentication protocol: Verifies the client's identity
- Connection protocol: Manages channels for services like shell, SFTP, port forwarding



How SSH Works - Encryption

- SSH uses **public-key cryptography** for authentication and **encryption**
 - **Encryption:** SSH encrypts data transmitted over a network, making it unreadable to unauthorised entities
 - **Authentication:** SSH verifies the identity of both the client and the server, including password or public-key authentication



SSH Authentication Protocols

- Password-based authentication
 - You start an SSH connection using a command like `ssh user@hostname`, the SSH client sends a connection request to the server
 - The server responds by asking for the user's identity, which, in this case, is verified with a password.
- Public key authentication:
 - SSH uses a **key pair**: a public key and a private key.
 - The **public key** is stored on the server; the **private key** stays with the client.
 - When connecting, the server verifies the private key without transmitting it, ensuring security.

SSH Availability

- SSH is present on most Operating Systems
 - MAC, Linux, Windows 10+
- SSH widely used in Cloud Computing

Access remote VMs in the cloud using SSH

- You will see it again in Dev Ops

[https://www.youtube.com/watch?
v=Atbl7D_yPug](https://www.youtube.com/watch?v=Atbl7D_yPug)

www.brianlinkletter.com

**Control an Amazon
EC2 server from an
Apple iPad using
SSH and VNC |
Open-Source
Routing and Netw...**



Advantages of Using SSH

- **Security:** SSH encrypts data to protect it from eavesdropping.
- **Authentication:** Uses key-based authentication, reducing reliance on passwords.
- **Convenience:** Provides command-line access and allows file transfers.
- **Port Forwarding:** Enables secure tunneling for other applications (e.g., databases).

Setting Up SSH on Raspberry Pi

- Do it when you install the OS ([see Lab](#))
- If using RPi as Desktop:
 - Open **Raspberry Pi Configuration** and enable SSH in the **Interfaces** tab.
 - Alternatively, use the command: `sudo systemctl enable ssh` and `sudo systemctl start ssh`.
- Note the IP address of your Raspberry Pi, which you'll need to connect via SSH.

Connecting to Raspberry Pi via SSH (Command Line)

- Open the terminal on your computer.
- Use the SSH command: `ssh pi@<RaspberryPi_IP>` , replacing `<RaspberryPi_IP>` with your Pi's IP address.
- Accept the SSH key fingerprint the first time you connect.
- Enter your **password** when prompted. You are now connected to the Raspberry Pi.

Using Secure Shell

At command line, connect to remote server using ssh command with user name and address(either IP or Domain Address) of remote server:

```
ssh UserName@SSHserver.com  
ssh pi@10.1.1.234
```

If it's the first connection between the host and the server, you will be prompted with the remote host's public key fingerprint and prompted to connect, despite there having been no prior connection:

```
compsys@compsys-virtualbox:~$ ssh pi@192.168.1.153  
The authenticity of host '192.168.1.153 (192.168.1.153)' can't be established.  
ECDSA key fingerprint is SHA256:0BDXaffVubs34ZAfSSMwCn8tUJpvfWWLlbCcDluewc.  
Are you sure you want to continue connecting (yes/no/[fingerprint])? y  
Please type 'yes', 'no' or the fingerprint: yes  
Warning: Permanently added '192.168.1.153' (ECDSA) to the list of known hosts.  
pi@192.168.1.153's password:  
Linux sensePi 5.10.63-v7+ #1457 SMP Tue Sep 28 11:25:31 BST 2021 armv7l
```

The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.

Last login: Tue Oct 12 16:09:30 2021 from 192.168.1.104

```
pi@sensePi:~ $
```

Connecting to Raspberry Pi Using SSH in VS Code

- Open Visual Studio Code.
- Install the **Remote - SSH** extension from the Extensions Marketplace.
- Click on **Remote Explorer** in the sidebar, then click **SSH Targets** and **Add New SSH Host**.
- Enter `ssh pi@<RaspberryPi_IP>` to connect to your Raspberry Pi, replacing `<RaspberryPi_IP>` with the actual IP address.

Using SSH with VS Code

- After adding the SSH host, select it from the **Remote Explorer** sidebar.
- VS Code will open a terminal and authenticate via SSH to your Raspberry Pi.
- You can now access files, run scripts, and use a full development environment on your Raspberry Pi.

SSH Best Practices

- Use **SSH keys** instead of passwords for enhanced security
 - OK to use passwords for now
- Change the default SSH port from **22** to reduce unauthorised access attempts.
- Regularly update SSH software on both client and server.
- Disable root login over SSH to prevent potential security breaches.

End of Presentation