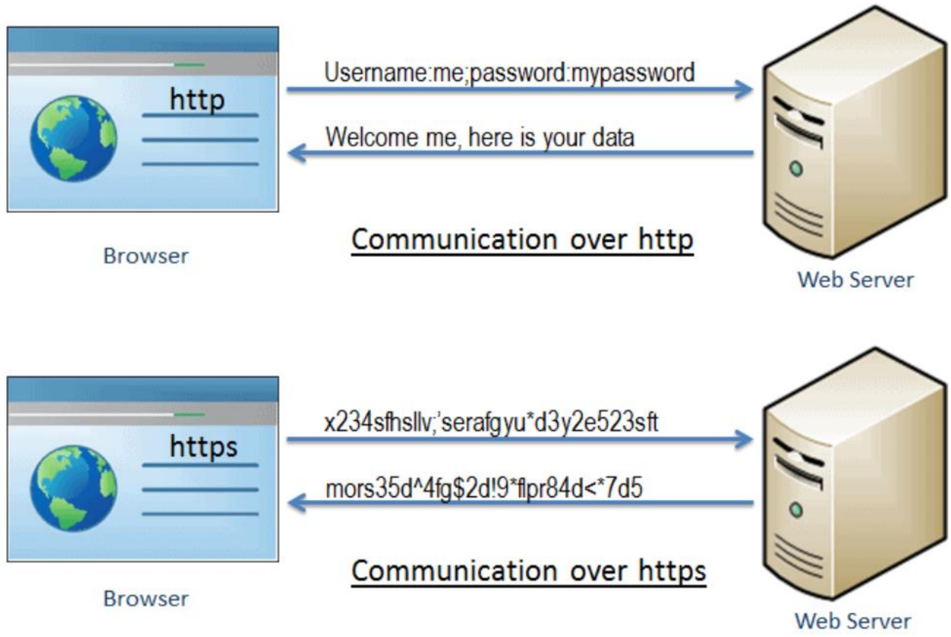
What is https?

HTTPS stands for Hyper Text Transfer Protocol Secure. It is a protocol for securing the communication between two systems e.g. the browser and the web server.

The following figure illustrates the difference between communication over http and https:


http
Username:me;password:mypassword
Welcome me, here is your data
Communication over http
Browser
Web Server
https
x234sfhsllv;'serafgyu*d3y2e523sft
mors35d^4fg$2d!9*flpr84d<*7d5
Communication over https
Browser
Web Server

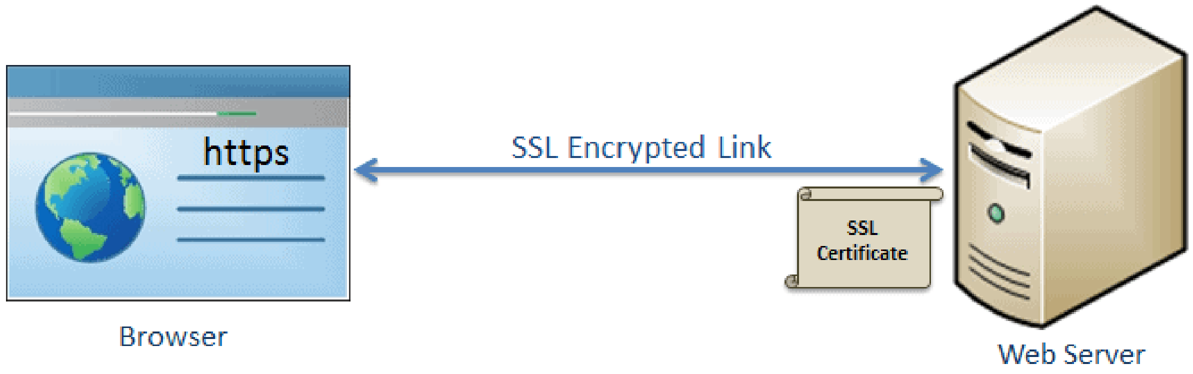
As you can see in the above figure, http transfers data between the browser and the web server in the hypertext format, whereas https transfers data in the encrypted format. Thus, https prevents hackers from reading and modifying the data during the transfer between the browser and the web server. Even if hackers manage to intercept the communication, they will not be able to use it because the message is encrypted.

HTTPS established an encrypted link between the browser and the web server using the Secure Socket Layer (SSL) or Transport Layer Security (TLS) protocols. TLS is the new version of SSL.

Secure Socket Layer (SSL)

SSL is the standard security technology for establishing an encrypted link between the two systems. These can be browser to server, server to server or client to server. Basically, SSL ensures that the data transfer between the two systems remains encrypted and private.

The https is essentially http over SSL. SSL establishes an encrypted link using an SSL certificate which is also known as a digital certificate.



SSL

http vs https

http	https
Transfers data in hypertext (structured text) format	Transfers data in encrypted format
Uses port 80 by default	Uses port 443 by default
Not secure	Secured using SSL technology
Starts with http://	Starts with https://

Advantage of https

- **Secure Communication:** https makes a secure connection by establishing an encrypted link between the browser and the server or any two systems.
- **Data Integrity:** https provides data integrity by encrypting the data and so, even if hackers manage to trap the data, they cannot read or modify it.
- **Privacy and Security:** https protects the privacy and security of website users by preventing hackers to passively listen to communication between the browser and the server.

- **Faster Performance:** https increases the speed of data transfer compared to http by encrypting and reducing the size of the data.
- **SEO:** Use of https increases SEO ranking. In Google Chrome, Google shows the Not Secure label in the browser if users' data is collected over http.
- **Future:** https represents the future of the web by making internet safe for users and website owners.

Virtual Private Network (VPN)

VPN stands for Virtual Private Network (VPN), that allows a user to connect to a private network over the Internet securely and privately. VPN creates an encrypted connection that is called VPN tunnel, and all Internet traffic and communication is passed through this secure tunnel.

Virtual Private Network (VPN) is basically of 2 types:

1. **RemoteAccessVPN:**

   Remote Access VPN permits a user to connect to a private network and access all its services and resources remotely. The connection between the user and the private network occurs through the Internet and the connection is secure and private. Remote Access VPN is useful for home users and business users both.

   An employee of a company, while he/she is out of station, uses a VPN to connect to his/her company's private network and remotely access files and resources on the private network. Private users or home users of VPN, primarily use VPN services to bypass regional restrictions on the Internet and access blocked websites. Users aware of Internet security also use VPN services to enhance their Internet security and privacy.

2. **SitetoSiteVPN:**

   A Site-to-Site VPN is also called as Router-to-Router VPN and is commonly used in the large companies. Companies or organizations, with branch offices in different locations, use Site-to-site VPN to connect the network of one office location to the network at another office location.

- **Intranet based VPN:** When several offices of the same company are connected using Site-to-Site VPN type, it is called as Intranet based VPN.
- **Extranet based VPN:** When companies use Site-to-site VPN type to connect to the office of another company, it is called as Extranet based VPN.

Basically, Site-to-site VPN create a imaginary bridge between the networks at geographically distant offices and connect them through the Internet and sustain a secure and private communication between the networks. In Site-to-site VPN one router acts as a VPN Client and another router as a VPN Server as it is based on Router-to-Router communication. When the authentication is validated between the two routers only then the communication starts.

Types of Virtual Private Network (VPN) Protocols:

1. **InternetProtocolSecurity(IPSec):**

   Internet Protocol Security, known as IPSec, is used to secure Internet communication across an IP network. IPSec secures Internet Protocol communication by verifying the session and encrypts each data packet during the connection.

   IPSec runs in 2 modes:

   - (i) Transport mode
   - (ii) Tunneling mode

   The work of transport mode is to encrypt the message in the data packet and the tunneling mode encrypts the whole data packet. IPSec can also be used with other security protocols to improve the security system.

2. **Layer2TunnelingProtocol(L2TP):**

   L2TP or Layer 2 Tunneling Protocol is a tunneling protocol that is often combined with another VPN security protocol like IPSec to establish a highly secure VPN connection. L2TP generates a tunnel between two L2TP connection points and IPSec protocol encrypts the data and maintains secure communication between the tunnel.

3. **Point–to–PointTunnelingProtocol(PPTP):**
   PPTP or Point-to-Point Tunneling Protocol generates a tunnel and confines the data packet. Point-to-Point Protocol (PPP) is used to encrypt the data between the connection. PPTP is one of the most widely used VPN protocol and has been in use since the early release of Windows. PPTP is also used on Mac and Linux apart from Windows.

4. **SSLandTLS:**
   SSL (Secure Sockets Layer) and TLS (Transport Layer Security) generate a VPN connection where the web browser acts as the client and user access is prohibited to specific applications instead of entire network. Online shopping websites commonly uses SSL and TLS protocol. It is easy to switch to SSL by web browsers and with almost no action required from the user as web browsers come integrated with SSL and TLS. SSL connections have “https” in the initial of the URL instead of “http”.

5. **OpenVPN:**
   OpenVPN is an open-source VPN that is commonly used for creating Point-to-Point and Site-to-Site connections. It uses a traditional security protocol based on SSL and TLS protocol.
6. **SecureShell(SSH):**
   Secure Shell or SSH generates the VPN tunnel through which the data transfer occurs and also ensures that the tunnel is encrypted. SSH connections are generated by a SSH client and data is transferred from a local port on to the remote server through the encrypted tunnel.

Telnet

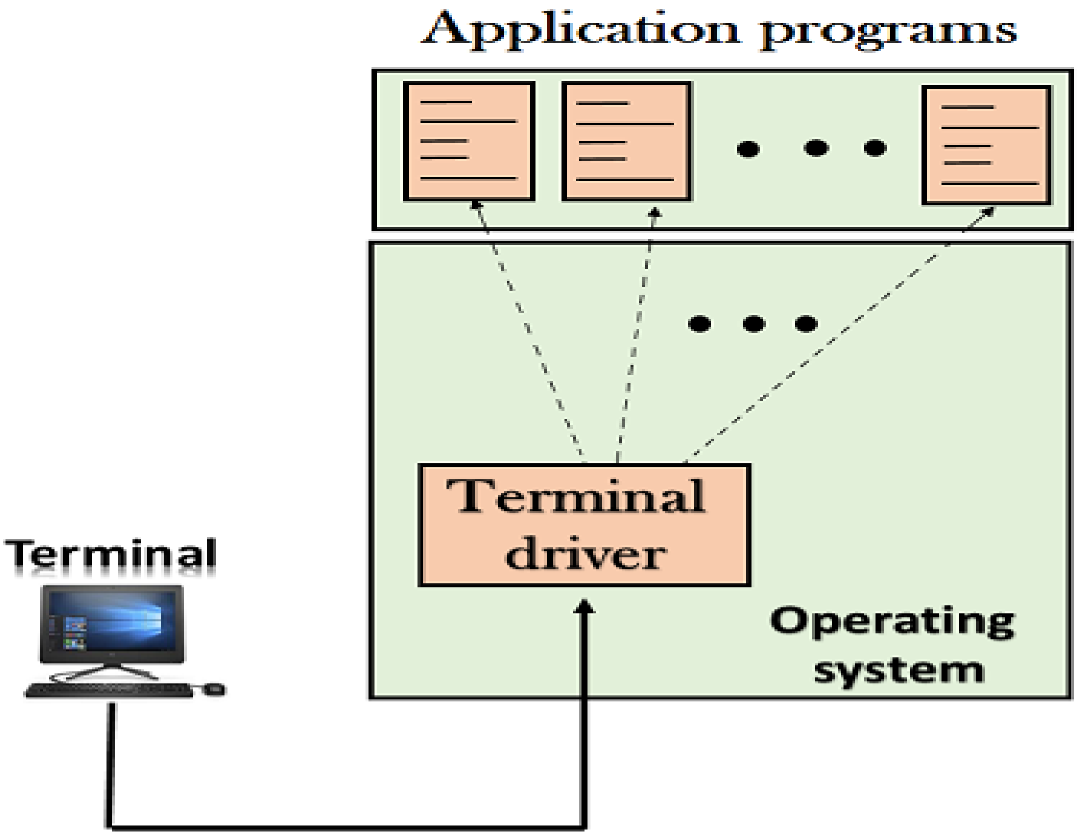
- The main task of the internet is to provide services to users. For example, users want to run different application programs at the remote site and transfers a result to the local site. This requires a client-server program such as FTP, SMTP. But this would not allow us to create a specific program for each demand.
- The better solution is to provide a general client-server program that lets the user access any application program on a remote computer. Therefore, a program that allows a user

to log on to a remote computer. A popular client-server program Telnet is used to meet such demands. Telnet is an abbreviation for **Terminal Network**.

- Telnet provides a connection to the remote computer in such a way that a local terminal appears to be at the remote side.

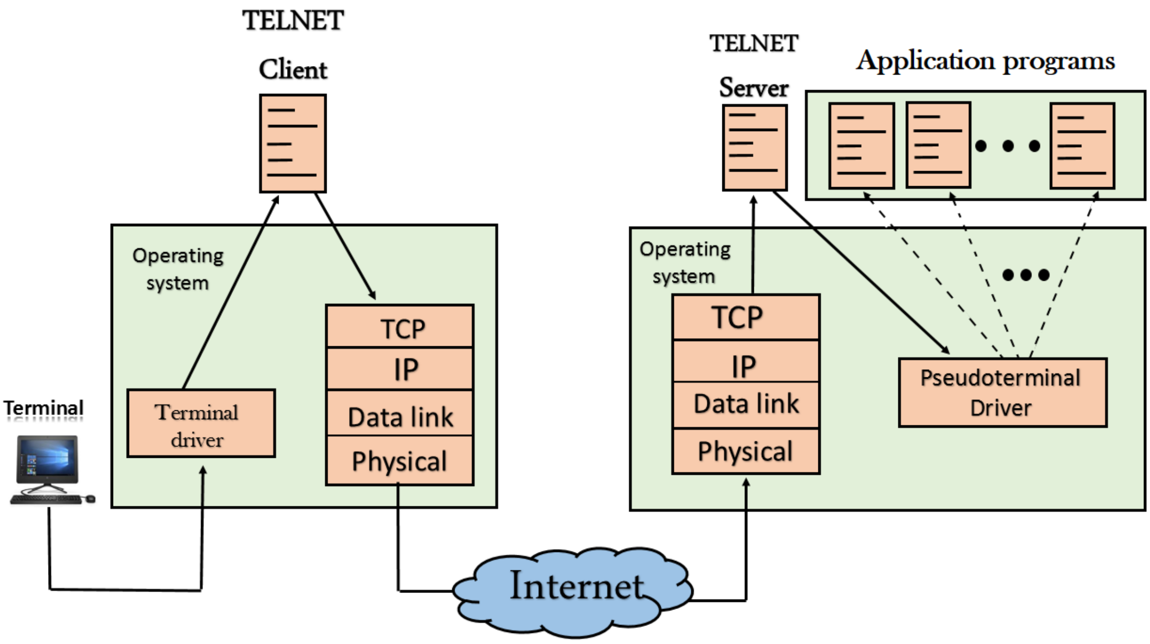
There are two types of login:

Local Login



- When a user logs into a local computer, then it is known as local login.
- When the workstation running terminal emulator, the keystrokes entered by the user are accepted by the terminal driver. The terminal driver then passes these characters to the operating system which in turn, invokes the desired application program.
- However, the operating system has special meaning to special characters. For example, in UNIX some combination of characters have special meanings such as control character with "z" means suspend. Such situations do not create any problem as the terminal driver knows the meaning of such characters. But, it can cause the problems in remote login.

Remote login



- When the user wants to access an application program on a remote computer, then the user must perform remote login.

How remote login occurs

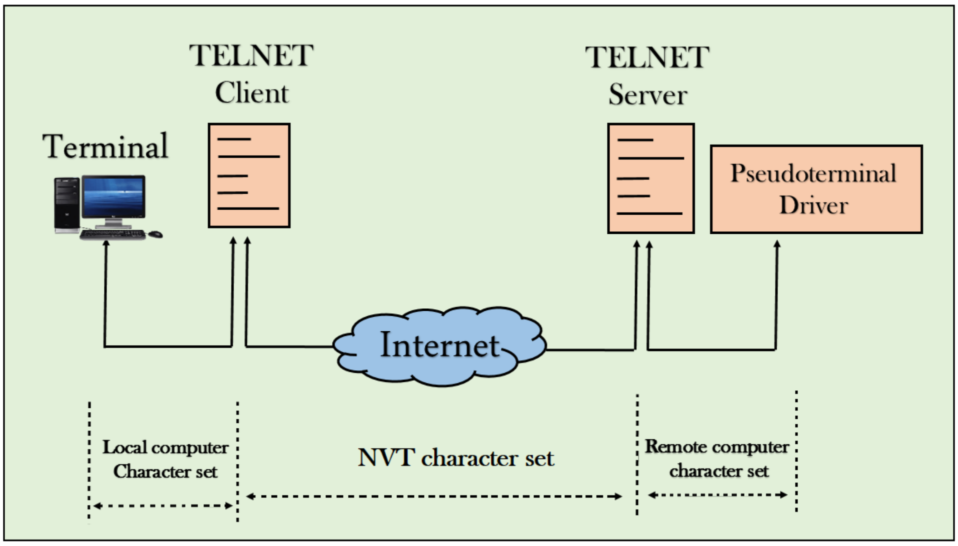
At the local site

The user sends the keystrokes to the terminal driver, the characters are then sent to the TELNET client. The TELNET client which in turn, transforms the characters to a universal character set known as network virtual terminal characters and delivers them to the local TCP/IP stack

At the remote site

The commands in NVT forms are transmitted to the TCP/IP at the remote machine. Here, the characters are delivered to the operating system and then pass to the TELNET server. The TELNET server transforms the characters which can be understandable by a remote computer. However, the characters cannot be directly passed to the operating system as a remote operating system does not receive the characters from the TELNET server. Therefore, it requires some piece of software that can accept the characters from the TELNET server. The operating system then passes these characters to the appropriate application program.

Network Virtual Terminal (NVT)



- The network virtual terminal is an interface that defines how data and commands are sent across the network.
- In today's world, systems are heterogeneous. For example, the operating system accepts a special combination of characters such as end-of-file token running a DOS operating system *ctrl+z* while the token running a UNIX operating system is *ctrl+d*.
- TELNET solves this issue by defining a universal interface known as network virtual interface.

- The TELNET client translates the characters that come from the local terminal into NVT form and then delivers them to the network. The Telnet server then translates the data from NVT form into a form which can be understandable by a remote computer.