



## Encryption Protocols

### SSL/TLS

<b>Purpose:</b>	Secures communication over network by encrypts data between client and server.
<b>Function:</b>	Uses certificates to authenticate the server; negotiates encryption algorithms and certificates.
<b>Configuration:</b>	Configured on web servers; requires a valid SSL/TLS certificate obtained from a Certificate Authority (CA).
<b>Cipher Suites:</b>	Negotiate encryption algorithm. Examples: TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256, TLS_AES_256_GCM_SHA384.
<b>Common Issues:</b>	Certificate expiration, weak cipher suites, protocol downgrade attacks (e.g., POODLE, BEAST).
<b>Best Practices:</b>	Regularly update certificates, use strong cipher suites, disable SSLv3/TLS 1.0, enforce HTTPS with HSTS.

### IPsec

<b>Purpose:</b>	Secures IP communications by authenticating and encrypting each IP packet.
<b>Function:</b>	Operates at the network layer; provides security for VPNs and other network connections.
<b>Configuration:</b>	Configured on routers, firewalls, and servers; involves setting up Security Associations (SAs) using IKE.
<b>Protocols:</b>	Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange (IKE).
<b>Common Issues:</b>	NAT traversal issues, incorrect SA configuration, key management complexities.
<b>Best Practices:</b>	Use strong encryption algorithms (e.g., AES), implement perfect forward secrecy (PFS), regularly update keys.

### SSH

<b>Purpose:</b>	Provides secure remote access to systems; encrypts communication channels.
<b>Function:</b>	Uses public-key cryptography to authenticate clients and encrypt data; replaces insecure protocols like Telnet and FTP.
<b>Configuration:</b>	Configured on servers; involves setting up SSH keys and configuring SSH daemon (sshd).
<b>Authentication Methods:</b>	Password authentication, public-key authentication, Kerberos, GSSAPI.
<b>Common Issues:</b>	Weak password policies, insecure SSH configurations, brute-force attacks.
<b>Best Practices:</b>	Disable password authentication, use public-key authentication, regularly update SSH server, use fail2ban to block brute-force attacks.

## Authentication Protocols

### Kerberos

<b>Purpose:</b>	Provides strong authentication for client/server applications using secret-key cryptography.
<b>Function:</b>	Relies on a trusted third party (Key Distribution Center - KDC) to authenticate users and issue tickets.
<b>Configuration:</b>	Configured on domain controllers; involves setting up realms and registering services.
<b>Components:</b>	Authentication Server (AS), Ticket Granting Server (TGS), Kerberos clients.
<b>Common Issues:</b>	Clock synchronization issues, KDC compromise, replay attacks.
<b>Best Practices:</b>	Maintain clock synchronization, secure KDC, regularly update Kerberos software, monitor for suspicious activity.

### RADIUS

<b>Purpose:</b>	Provides centralized authentication, authorization, and accounting (AAA) for network access.
<b>Function:</b>	Authenticates users connecting to network devices (e.g., routers, switches, wireless access points).
<b>Configuration:</b>	Configured on RADIUS servers; involves setting up clients (network devices) and user accounts.
<b>Attributes:</b>	Username, password, service type, Framed-IP-Address, NAS-IP-Address.
<b>Common Issues:</b>	Shared secret compromise, dictionary attacks, denial-of-service attacks.
<b>Best Practices:</b>	Use strong shared secrets, implement rate limiting, monitor for suspicious activity, use RADIUS over IPsec.

### LDAP

<b>Purpose:</b>	Provides directory services for managing user accounts, resources, and policies.
<b>Function:</b>	Allows applications to authenticate users and retrieve information from a directory.
<b>Configuration:</b>	Configured on LDAP servers; involves setting up directory structure and user accounts.
<b>Operations:</b>	Bind, search, add, modify, delete.
<b>Common Issues:</b>	LDAP injection, anonymous binds, weak access controls.
<b>Best Practices:</b>	Disable anonymous binds, enforce strong access controls, sanitize user inputs, use LDAP over TLS (LDAPS).

Network Security Protocols

DNSSEC

<b>Purpose:</b>	Secures the Domain Name System (DNS) by adding cryptographic signatures to DNS records.
<b>Function:</b>	Prevents DNS spoofing and cache poisoning attacks by verifying the authenticity of DNS data.
<b>Configuration:</b>	Configured on DNS servers; involves generating and managing cryptographic keys and signing DNS zones.
<b>Record Types:</b>	RRSIG, DNSKEY, DS, NSEC.
<b>Common Issues:</b>	Key management complexities, zone signing errors, algorithm vulnerabilities.
<b>Best Practices:</b>	Regularly rotate keys, use strong cryptographic algorithms, monitor for DNSSEC validation failures, implement NSEC3 for zone enumeration protection.

HTTPS

<b>Purpose:</b>	Secure version of HTTP which enables encrypted communication with Transport Layer Security (TLS) or Secure Sockets Layer (SSL)
<b>Function:</b>	Protects the integrity and confidentiality of data transmitted between web browsers and web servers
<b>Configuration:</b>	Requires an SSL/TLS certificate to be installed on the web server. The server is configured to listen for incoming connections on port 443
<b>Protocols:</b>	TLS (Transport Layer Security) and SSL (Secure Sockets Layer)
<b>Common Issues:</b>	Weak cipher suites, mixed content warnings, and vulnerabilities related to SSL/TLS protocols (e.g., Heartbleed, POODLE).
<b>Best Practices:</b>	Always use HTTPS, enforce HTTP Strict Transport Security (HSTS) to prevent protocol downgrade attacks, regularly update SSL/TLS certificates.

SFTP

<b>Purpose:</b>	Secure File Transfer Protocol. Provides secure file transfer over a reliable data stream. Uses SSH to establish secure connections
<b>Function:</b>	Performs all operations over an encrypted SSH transport.
<b>Configuration:</b>	SFTP server is part of SSH server package.
<b>Common Issues:</b>	Man-in-the-middle attacks, brute force attacks.
<b>Best Practices:</b>	Enforce strong password policies, monitor SFTP activity, use key-based authentication, disable password-based authentication.

Wireless Security Protocols

WPA3

<b>Purpose:</b>	Latest wireless security protocol to replace WPA2.
<b>Function:</b>	Offers improved encryption and authentication compared to WPA2.
<b>Configuration:</b>	Configure on wireless routers and devices. Requires compatible hardware.
<b>Key Features:</b>	Simultaneous Authentication of Equals (SAE) - protects against dictionary attacks, enhanced encryption.
<b>Common Issues:</b>	Compatibility issues with older devices, configuration errors.
<b>Best Practices:</b>	Use WPA3 where possible, update firmware regularly, use strong passwords.

WPA2

<b>Purpose:</b>	Wireless security protocol to secure Wi-Fi networks.
<b>Function:</b>	Uses Advanced Encryption Standard (AES) with Counter Mode Cipher Block Chaining Message Authentication Code Protocol (CCMP).
<b>Configuration:</b>	Configured on wireless routers and devices. Choose WPA2-Personal (PSK) or WPA2-Enterprise (802.1X).
<b>Key Features:</b>	CCMP encryption, stronger than WEP and WPA.
<b>Common Issues:</b>	PSK cracking, vulnerabilities like KRACK attack.
<b>Best Practices:</b>	Use strong passwords, update firmware regularly, consider WPA3 if available.

WEP

<b>Purpose:</b>	Legacy wireless security protocol. Obsolete and insecure.
<b>Function:</b>	Uses RC4 encryption with a 40-bit or 104-bit key.
<b>Configuration:</b>	Avoid using WEP. If unavoidable, change the WEP key frequently.
<b>Key Features:</b>	Simple to configure, but easily cracked.
<b>Common Issues:</b>	Easily cracked using readily available tools.
<b>Best Practices:</b>	Do not use WEP. Upgrade to WPA2 or WPA3 immediately.