IP SECURITY

- IP security (IPsec) is a capability that can be added to either current version of the Internet Protocol (IPv4 or IPv6) by means of additional headers.
- IPsec encompasses three functional areas: authentication, confidentiality, and key management.
- Authentication makes use of the HMAC message authentication code. Authentication can be applied to the entire original IP packet (tunnel mode) or to all of the packet except for the IP header (transport mode).
- Confidentiality is provided by an encryption format known as encapsulating security payload. Both tunnel and transport modes can be accommodated.
- IKE defines a number of techniques for key management.

IP SECURITY OVERVIEW

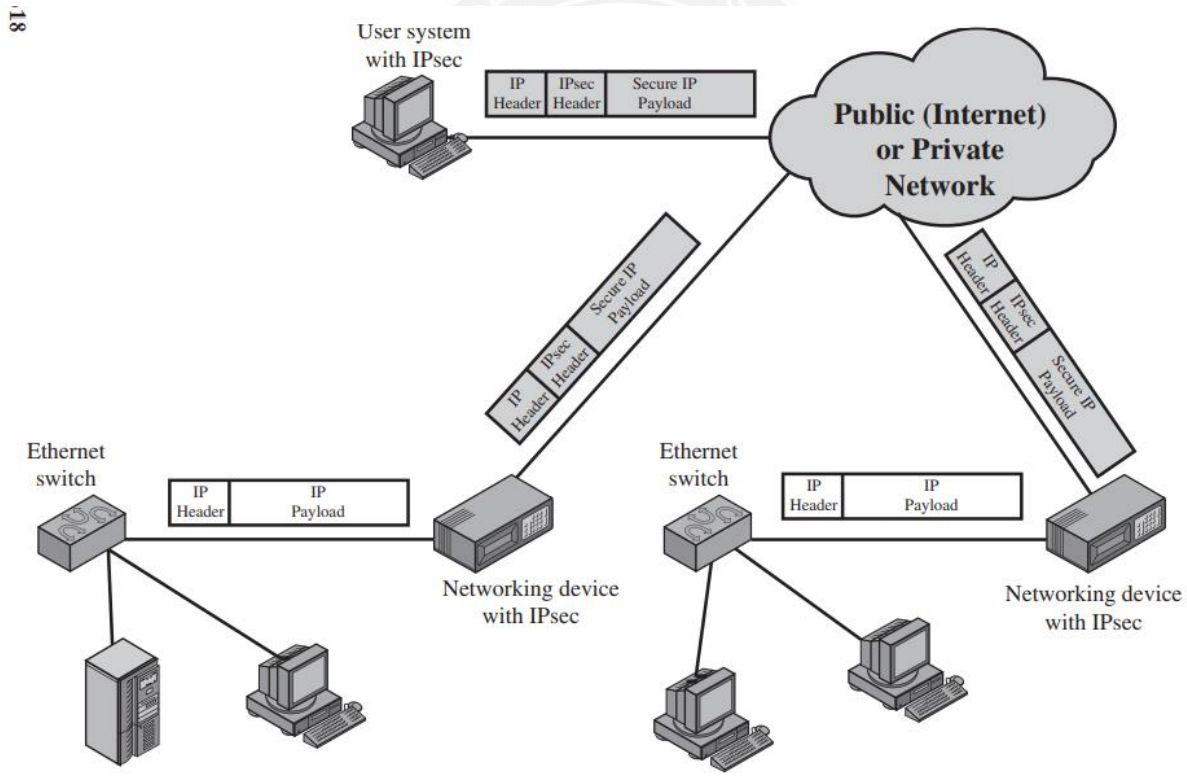
- In 1994, the Internet Architecture Board (IAB) issued a report titled "Security in the Internet Architecture" (RFC 1636).
- The report identified key areas for security mechanisms.
- Among these were the need to secure the network infrastructure from unauthorized monitoring and control of network traffic and the need to secure end-user-to-end-user traffic using authentication and encryption mechanisms.
- To provide security, the IAB included authentication and encryption as necessary security features in the next-generation IP, which has been issued as IPv6.
- Fortunately, these security capabilities were designed to be usable both with the current IPv4 and the future IPv6.
- This means that vendors can begin offering these features now, and many vendors now do have some IPsec capability in their products. The IPsec specification now exists as a set of Internet standards.

APPLICATIONS OF IPSEC

- IPsec provides the capability to secure communications across a LAN, across private and public WANs, and across the Internet.
- Examples of its use include:
- Secure branch office connectivity over the Internet: A company can build a secure virtual private network over the Internet or over a public WAN. This enables a business to rely heavily on the Internet and reduce its need for private networks, saving costs and network management overhead.

- Secure remote access over the Internet: An end user whose system is equipped with IP security protocols can make a local call to an Internet Service Provider (ISP) and gain secure access to a company network.This reduces the cost of toll charges for traveling employees and telecommuters.
- Establishing extranet and intranet connectivity with partners: IPsec can be used to secure communication with other organizations, ensuring authentication and confidentiality and providing a key exchange mechanism.
- Enhancing electronic commerce security: Even though some Web and electronic commerce applications have built-in security protocols, the use of IPsec enhances that security. IPsec guarantees that all traffic designated by the network administrator is both encrypted and authenticated, adding an additional layer of security to whatever is provided at the application layer.

AN IP SECURITY SCENARIO



Reference :William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006

BENEFITS OF IPSEC

- Some of the benefits of IPsec:

- When IPsec is implemented in a firewall or router, it provides strong security that can be applied to all traffic crossing the perimeter. Traffic within a company or workgroup does not incur the overhead of security-related processing.
- IPsec in a firewall is resistant to bypass if all traffic from the outside must use IP and the firewall is the only means of entrance from the Internet into the organization.
- IPsec is below the transport layer (TCP, UDP) and so is transparent to applications. There is no need to change software on a user or server system when IPsec is implemented in the firewall or router. Even if IPsec is implemented in end systems, upper-layer software, including applications, is not affected.
- IPsec can be transparent to end users. There is no need to train users on security mechanisms, issue keying material on a per-user basis, or revoke keying material when users leave the organization.

IPsec can provide security for individual users if needed. This is useful for offsite workers and for setting up a secure virtual subnetwork within an organization for sensitive applications.

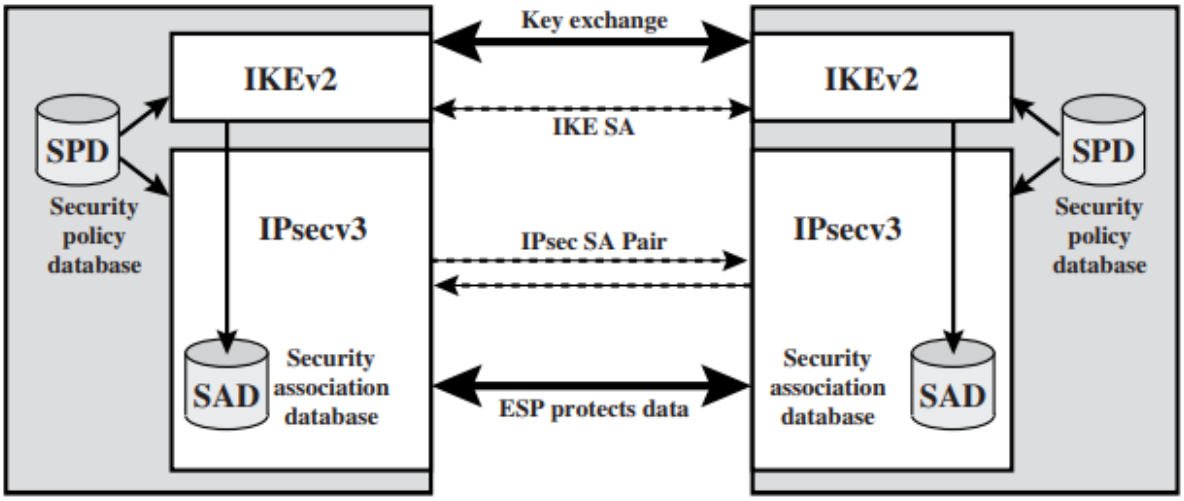
IPSEC DOCUMENTS

- Architecture: Covers the general concepts, security requirements, definitions, and mechanisms defining IPsec technology. The current specification is RFC 4301, Security Architecture for the Internet Protocol.
- Authentication Header (AH): AH is an extension header to provide message authentication. The current specification is RFC 4302, IP Authentication Header. Because message authentication is provided by ESP, the use of AH is deprecated. It is included in IPsecv3 for backward compatibility but should not be used in new applications. We do not discuss AH in this chapter.
- Encapsulating Security Payload (ESP): ESP consists of an encapsulating header and trailer used to provide encryption or combined encryption/authentication. The current specification is RFC 4303,IP Encapsulating Security Payload (ESP).
- Internet Key Exchange (IKE): This is a collection of documents describing the key management schemes for use with IPsec. The main specification is RFC 4306,Internet Key Exchange (IKEv2) Protocol, but there are a number of related RFCs.
- Cryptographic algorithms: This category encompasses a large set of documents that define and describe cryptographic algorithms for encryption, message authentication, pseudorandom functions (PRFs), and cryptographic key exchange.
- Other: There are a variety of other IPsec-related RFCs, including those dealing with security policy and management information base (MIB) content.

IPSEC SERVICES

- Access control
- Connectionless integrity
- Data origin authentication
- Rejection of replayed packets (a form of partial sequence integrity)
- Confidentiality (encryption)
- Limited traffic flow confidentiality

IP SECURITY POLICY



Reference :William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006

- A security association is uniquely identified by three parameters.
- Security Parameters Index (SPI): A bit string assigned to this SA and having local significance only. The SPI is carried in AH and ESP headers to enable the receiving system to select the SA under which a received packet will be processed.
- IP Destination Address: This is the address of the destination endpoint of the SA, which may be an end-user system or a network system such as a firewall or router.
- Security Protocol Identifier: This field from the outer IP header indicates whether the association is an AH or ESP security association. Hence, in any IP packet, the security association is uniquely identified by the Destination Address in the IPv4 or IPv6 header and the SPI in the enclosed extension header (AH or ESP).