Outline

Firewalls

Attack detection

Attack attraction

Building in security
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4. **Circuit relays**, e.g., SOCKS. Generic circuit-passing for TCP connections. Middle ground between 1 and 3. Drawbacks: poor for outgoing traffic (can even tunnel IP).
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  - Clearly can’t prevent inside attacks, or protect apps that must be exposed (web servers). Growth of web-services: “Internet interprets censorship as damage and routes around it.”
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Logging, Auditing and Forensics

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- Forensics: the art of reading other less obvious, incidental trails. E.g., shell, editor, application history/lock files; secret key files; outgoing mail drops, firewall and web cache logs; ultimately file system block level or hard-drive data recovery.
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- Issues: difficult problem; Internet is noisy medium; too few attacks so more false alarms than real ones; maintaining library of attack signatures; encryption can conceal signatures.
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Production honeypots configured identically to corresponding machines. No DNS entries.
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- Advanced attackers (as opposed to script kiddies) may still be difficult to detect/attract.
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CDROM *Roo*, boots into a Linux-based Honeynet gateway, or “Honeywall”. Target systems placed behind the gateway; the gateway performs all Data Capture (i.e., logging) and Data Control (i.e., containment; firewalling).
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- Again, needs carefully designed resilient architecture.
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  - E.g., for the Internet, **IPsec**.
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  - Examples include **ssh** for remote login, **SSL/TLS** designed for secure web transactions, and **S/MIME** or **PGP** for secured email.
IPsec and IPv6

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    - Uses Diffie-Hellman (i.e., key agreement of fresh shared key without authentication).
IPsec: Security Associations

- The Internet Security Association and Key Management Protocol (ISAKMP) [RFC2408], describes negotiating a *security association* (SA), which defines:
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- IKE is rather complicated (allows for extending SAs, deleting SAs, detecting dead peers), which has raised interoperability problems. A Kerberos-based protocol and simplified version, IKEv2 (2005), may replace it.
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- There is much flexibility over where IPsec is placed: encryption may occur at hosts or routers; packets may be sent in a transport or tunneled mode.
IPsec in Transport mode

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- ESP in transport mode similar, except a trailer is added to user data (including encryption padding) before encrypting. Encryption applies to TCP header, user data, and trailer. Authentication field is added at the end. Minor difference: no authentication of IP header.
In tunnel mode, the “inner” IP header carries the ultimate source and destination addresses, whereas an “outer” IP header may contain other addresses, e.g., addresses of security gateways.
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  \text{User Data}
  \end{array}
  \]

  and after:

  \[
  \begin{array}{cccc}
  \text{new IP hdr} & \text{AH hdr} & \text{old IP hdr} & \text{TCP hdr} & \text{User Data} \\
  \hline
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- An IPv4 packet before:

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  and after:

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- Authentication doesn’t apply to mutable fields of new IP header.

- ESP in tunnel mode encrypts the original IP header, TCP header, user data, and the ESP trailer (padding). An extra authentication field is appended. Again, authentication of the new IP header is omitted with ESP.
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  - Does not prevent traffic analysis or covert channels.
DNS Security

- DNS Security design dates back to 1993; deployment increasing now. DNS data (RRsets, Resource Record sets) is considered public, so no confidentiality provision; security mechanisms add authentication and integrity by digital signatures.
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- Disadvantages: need to carry private key around; still vulnerable to DoS attacks (connection terminations) by injected IP packets.
Virtual Private Networks

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- Security by encapsulation in the network level, using e.g. IPsec, L2TPv3+IPsec, SSL/TLS.
Other defences, mechanisms and tools

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- SSL/TLS-enhanced protocols e.g., **SSLtelnet**, **SSLftp**, **stunnel**.
References


Recommended Reading

Part II of Cheswick (1st edition available online).