CNT4406/5412 Network Security

IPsec

Zhi Wang

Florida State University

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Introduction

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- IPsec is implemented in the kernel, applications may remain unchanged
- IPsec can be configured to be transparent to users

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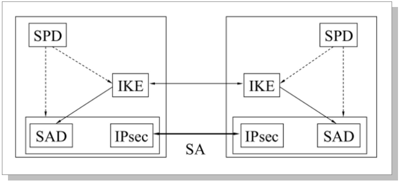
  ➠ IP spoofing, payload modification, lack of accountability
- IPv4 has no confidentiality protection
  ➠ eavesdropping

IPsec Architecture

- SPD: Security Policy Database



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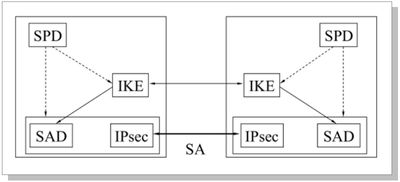
- IKE: Internet Key Exchange ➠ to negotiate security parameters



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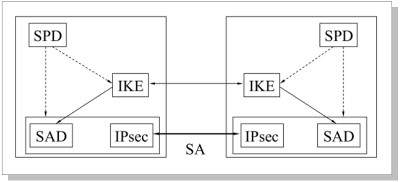

IPsec Architecture

- SPD: Security Policy Database
- IKE: Internet Key Exchange ➠ to negotiate security parameters
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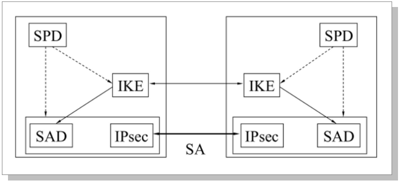
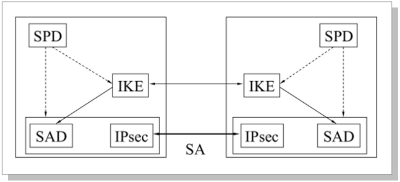
- IPsec: Authentication Header/Encapsulating Security Payload
  ➠ AH $\rightarrow$ authentication
  ➠ ESP $\rightarrow$ encryption and/or authentication



Security Association

A IPsec **security association** is a cryptographically protected connection



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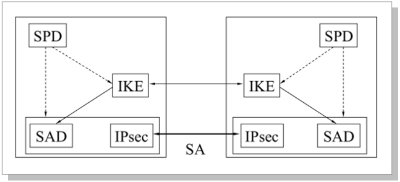
- A SA has a set of security parameters (attributes)
  - ➠ e.g., identities, algorithms, keys, sequence number
  - ➠ SA specifies how to process IPsec packets



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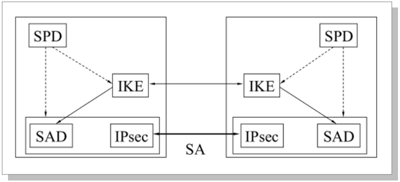

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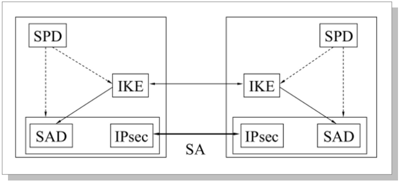
- SA may be changed during the conversation (IKE rekeying)



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- SPI is carried in each AH and ESP header
  - ➠ the receiver can look up the SA for the packet in its SAD
  - ➠ the SA determines how to process the packet

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- Each host/gateway participating in IPsec maintains its own SAD

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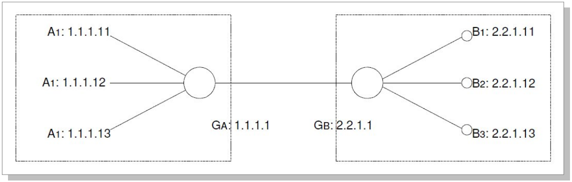
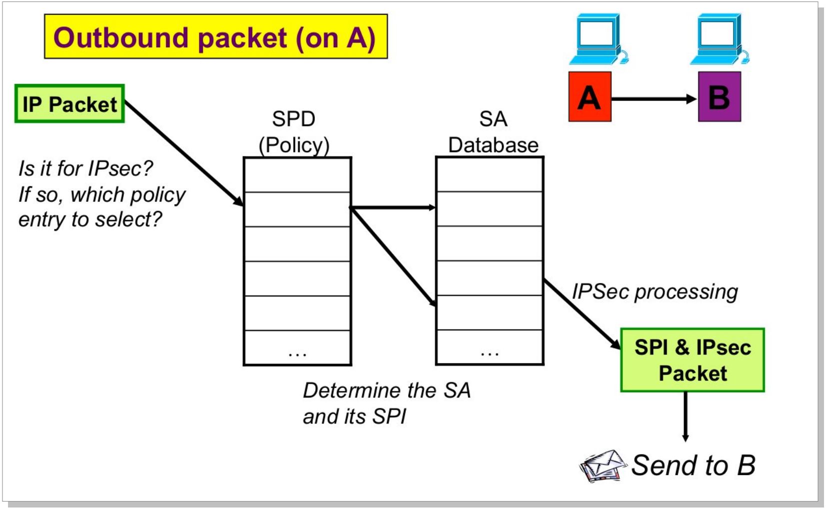
Index	Local	Remote	Proto	Dir	Action	SA In/Out
9	1.1.1.12:80	2.2.1.0/24:any	TCP	I/O	IPsec	sa15/sa25
8	1.1.1.0/24:any	2.2.1.0/24:any	any	I/O	IPsec	sa10/sa20
			...			
...	...			I		
...	...			O	drop	null
0	any	any	any	I/O	bypass	null



IPsec Outbound Processing



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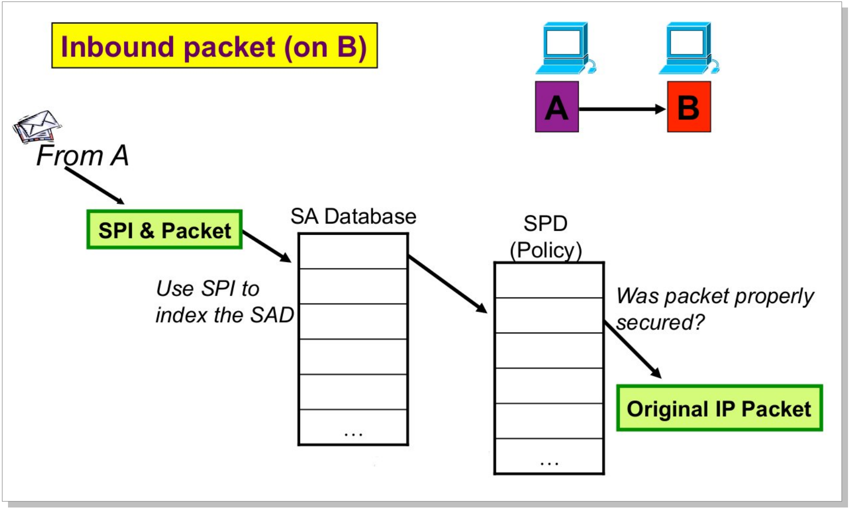
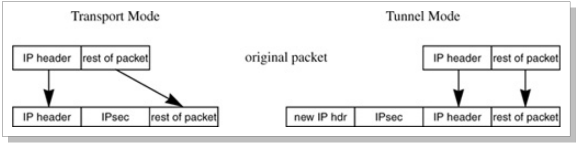


Tunnel Mode

IPsec can operate in **tunnel mode** and **transport mode**



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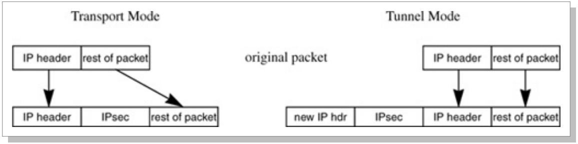

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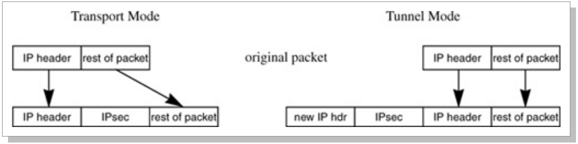

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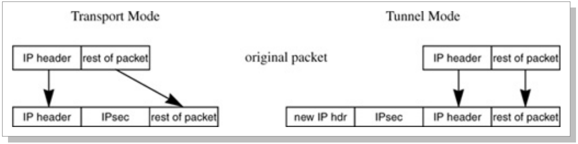
  ➠ data is only protected inside the tunnel (not end-to-end)



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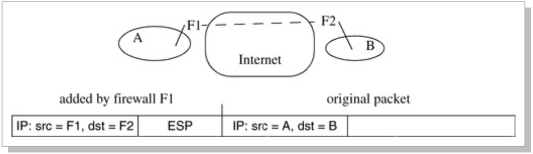
- Two firewalls establish an encrypted tunnel across the Internet



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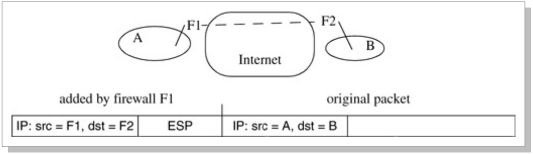

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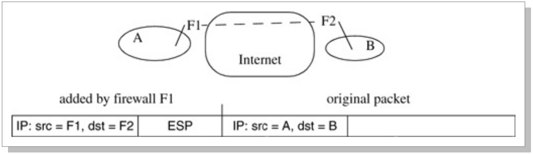
  ➠ the inner IP packet is not changed



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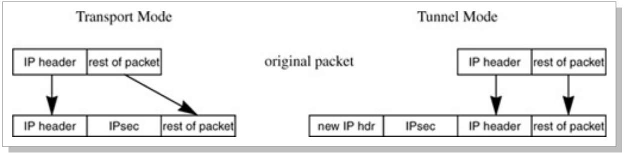

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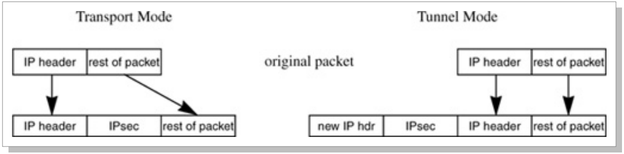

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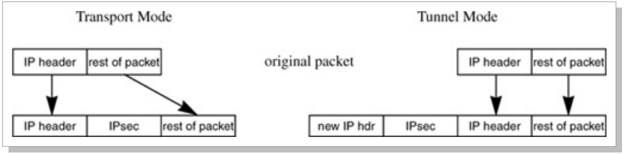

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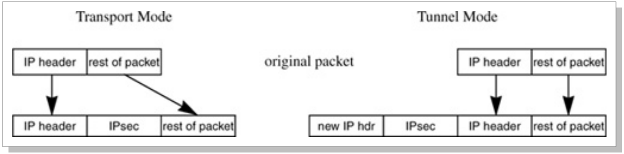

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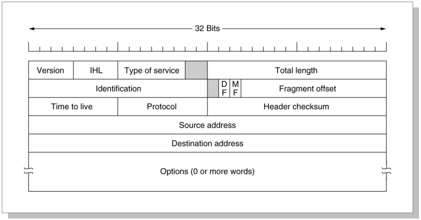

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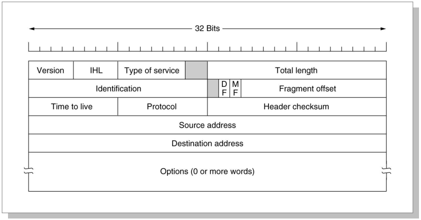

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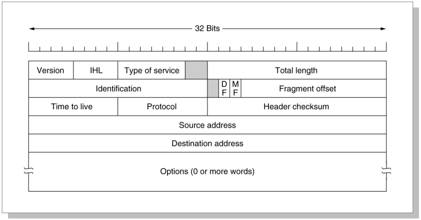
  - ➠ protocol headers in IPv6 are TLV-encoded



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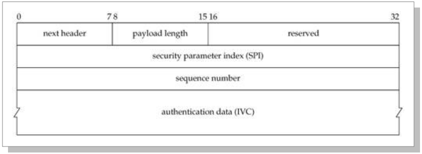

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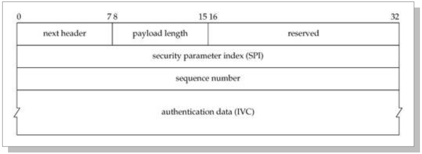

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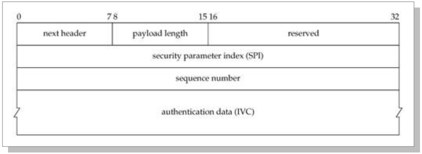

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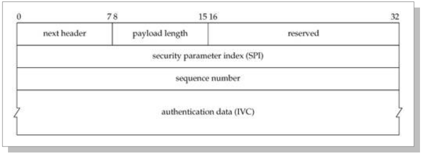

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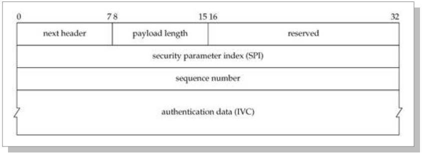
  - immutable fields: version, total length (what if fragmented?)...



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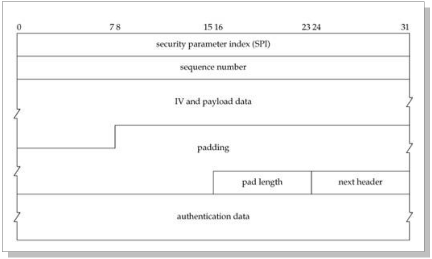
- AH can only do authentication and it duplicates functionality in ESP

Encapsulating Security Payload

ESP always has an encryption operation, and also supports authentication



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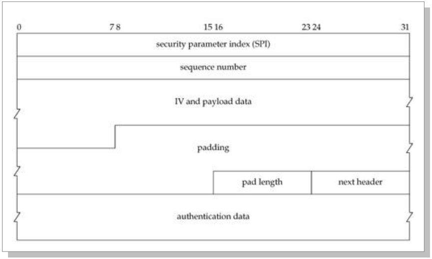

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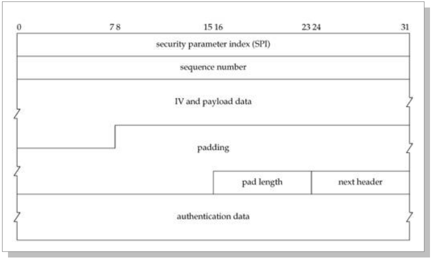

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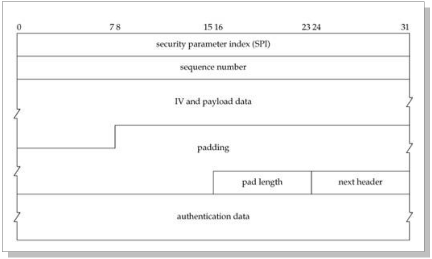
- Data is padded to fit the cipher's block size



Summary

- IPsec Architecture
- IPsec Modes
- AH and ESP

- Next lecture: IPsec/IKE