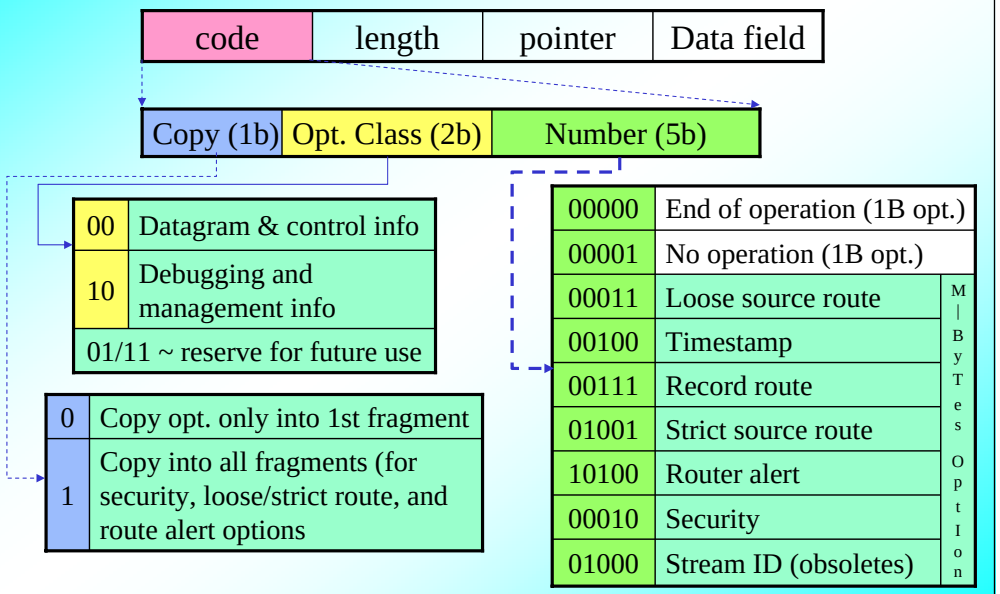
IPv4 Options

IPv4 Options (Samples) - I

- ☑ **Security labeling** ~ for military applications (RFC 1108)
- ☑ **Source routing** ~ Sender specifies the route (a list of IP address that DG must traverse)
  - Strict source routing: specifies the exact path (gateways) that IP DG must follow (code = 0x89) **Ex., ping -k . . .**
  - Loose source routing: intermediate gateways may be visited (0x83) **Ex., tracert -j ...; ping -j ...**
- ☑ **Route recording** ~ have each router record its IP address (0x07) **Ex., ping -r cnt**
- ☑ **Time stamping** ~ The sending user may request one of the three options: (code = 0x44 plus flag = 0,1, or 3) **Ex., ping -s cnt**
  - Each gateway visited records the time it received the datagram
  - Records both the time and its internet address
  - Only prespecified gateways record the time

IP Options - II

- "length" is variable; max. (39 + 1) = ***40*** bytes (1 byte for "code")



- Type (code): 0, 1, 131, 68, 7, 137, 148, 130, 8

IP Options - III

- **NOP** ~ a padding character to align the next option on a 32-bit boundary.

Ex 1:

NOP 00000001	First 3 bytes of an option (say 11B)
Middle 4 bytes of an option (say 11B)	
Last 4 bytes of an option (say 11B)	

Ex 2:

First 4 bytes of an option (say 7B)	
Last 3 bytes of an option (say 7B)	**NOP** 00000001
first 4 bytes of an option (say 8B)	
Last 4 bytes of an option (say 8B)	

IP Options - IV

- **EOP** ~ end of option list; used at the end; of ***all*** options can be used only once.

Ex 1:

4 bytes (say 7B)	
3 bytes	EOP 00000000

Ex 2:

First 4 bytes of an option (say 14B)		
4 bytes of an option		
4 bytes of an option		
Last 2 bytes of an option	NOP 00000001	**EOP** 00000000

IP Options - V

- **Record Route** ~ record the routers an IP packet takes as it propagates from SRC to DEST device/host

Format:

Code (1B)	length (1B)	pointer (1B)	Data field

an offset indicating the next empty space (byte location) in data field that can store IP address; initial = 4

Alignment:

00000111	Total length	pointer
1st IP address (empty at beginning, all "0")		
2nd IP address (empty at beginning)		
⋮ Other IP addresses (if any)		
Last IP address (empty at beginning)		

9 IP addr. maximum

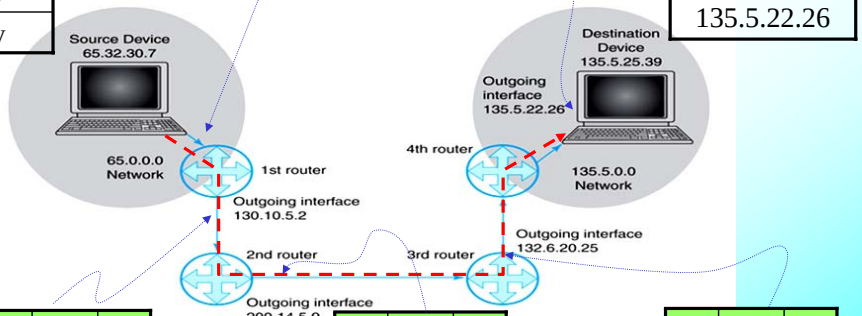
√

IP Options - VI

Example: RR option

7	19	4
empty		
empty		
empty		
empty		

7	19	20
130.10.5.2		
200.14.5.9		
132.6.20.25		
135.5.22.26		



7	19	8
130.10.5.2		
empty		
empty		
empty		

7	19	12
130.10.5.2		
200.14.5.9		
empty		
empty		

7	19	16
130.10.5.2		
200.14.5.9		
132.6.20.25		
empty		

IP Options - VII

- **Strict source route** (code = 137)
  - The SRC provides a list of hops (router interfaces) to specify the exact path the packet must take to reach its DEST host
- **Loose source route** (code = 131)
  - Similar to SSR, but more forgiving
- **Router alert**
  - Specify a router that it should pay more attention to the packet

SSR/LSR

137/131	Total length	pointer
1st Dest IP address = DIP in IP header		
2nd Dest IP address		
Other Dest IP addresses		
Last Dest IP address (the Dest host)		

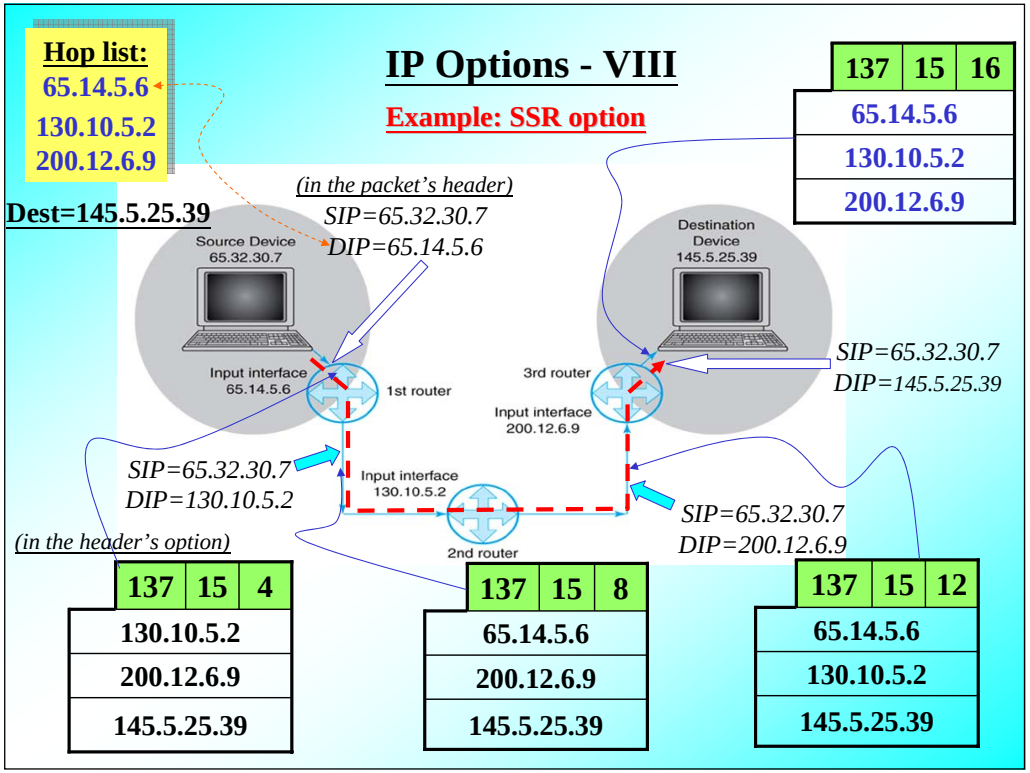
RA

Code (1B)	length (1B)	Data field (2B)

- Protocol uses RS option: ReSerVation Protocol (path establishment, teardown, reservation comfirmation), IGMP

IP Options - VIII

Example: SSR option



IP Options - IX

- **Security** ~ provides a way for hosts to send security, compartmentation, handling restriction, and TCC (closed user group) parameters

  (cf., RFC 1108, 1038, DOD Defense Intelligent Agency Manual (DIAM) 65-19)

type (1B)	length (1B)	Security(2B) classification	Compartments (2B)	Handling (2B) Restriction	Transmission control codes (3B)

Type = 130; Length = 11

An all zero value is used when the information transmitted is not compartmented. Other values for the compartments field may be obtained from the Defense Intelligence Agency.

The values for the control and release markings are alphanumeric digraphs and are defined in the Defense Intelligence Agency Manual DIAM 65-19, "Standard Security Markings".

IP Options - X

Hex Code	Security classification
0000	Unclassified
F135	Confidential
785A	EFTO
BC4D	MMMM
AF26	PROG
AF13	Restricted
D788	Secret
6BC5	Top secret

• Specifies one of 16 levels of security (eight of which are reserved for future use).

A **trigraph** (from the Greek words tria = three and grapho = write) is a group of three symbols but represent one thing or pronounce one sound.

• **Transmission Control Code** (TCC field):

~ Provides a means to segregate traffic and define controlled communities of interest among subscribers. The TCC values are *trigraphs*, and are available from HQ DCA Code 530.

- Must be copied on fragmentation.