

Transition and Coexistence IPv4-IPv6

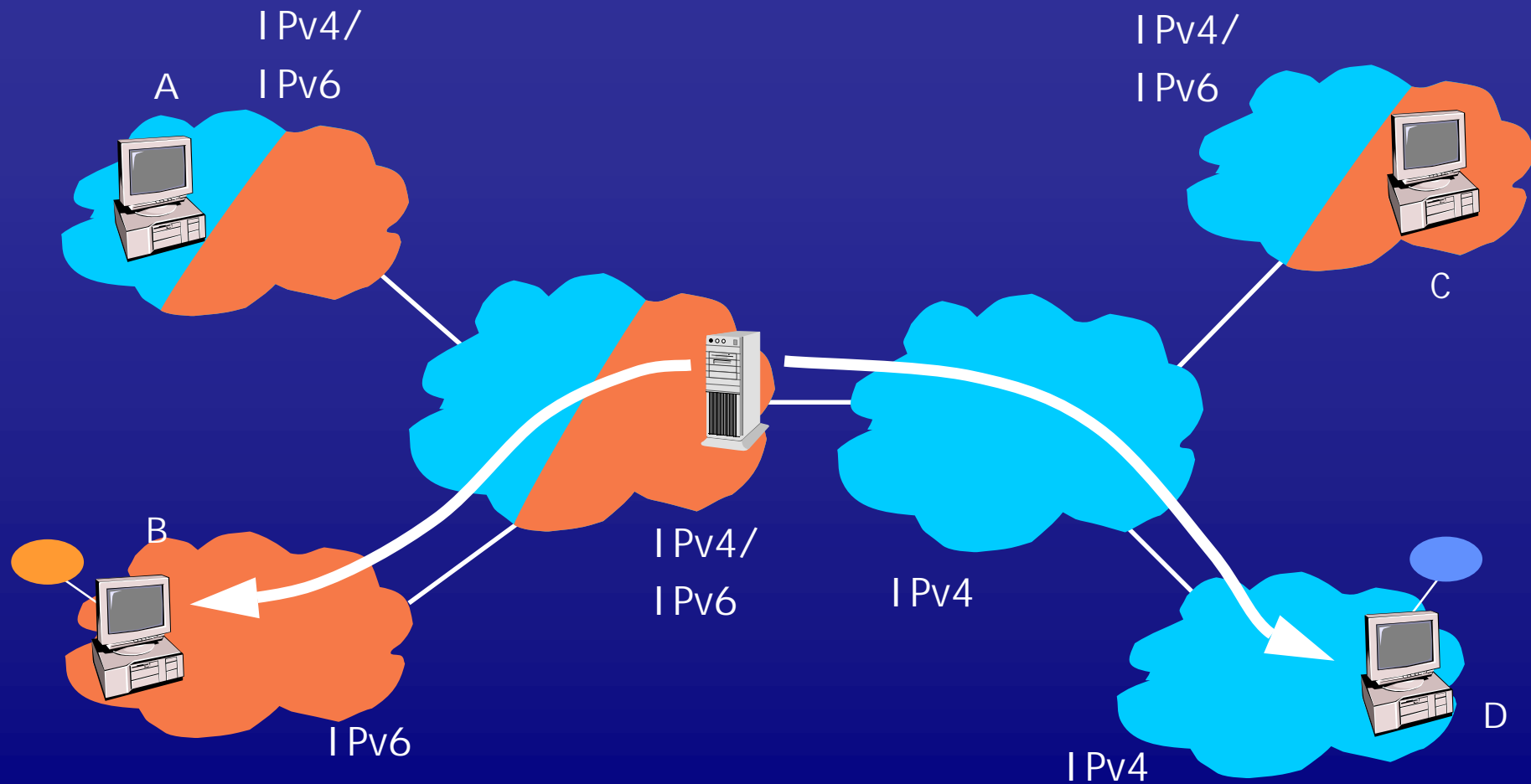
SIIT and NAT-PT

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Problem Presentation



Translators

□ Network level translators

- SIIT (Stateless IP/ICMP Translator)
- NAT-PT (Network Address Translation – Protocol Translation)
- BIS (Bump In the Stack) / MBIS (Multicast extensions to BIS)

□ Transport level translator

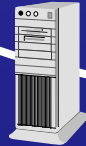
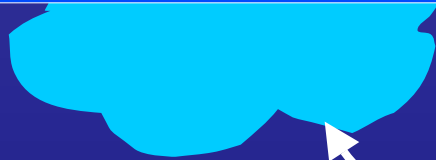
- Transport Relay Translator (TRT)

□ Application level translators

- SOCKS 64
- BIA (Bump in the API)

SIIT

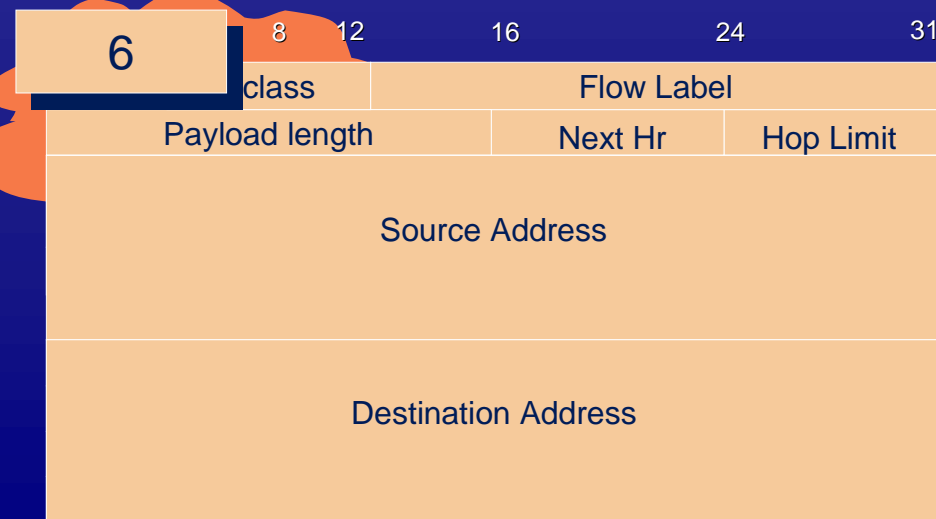
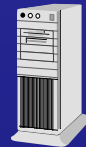
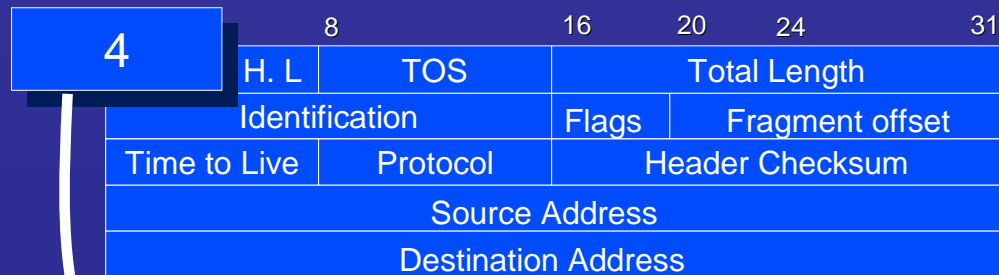
0	3	8	16	20	24	31
Vers	H. L	TOS	Total Length			
Identification			Flags	Fragment offset		
Time to Live		Protocol	Header Checksum			
Source Address						
Destination Address						



0	3	8	12	16	24	31
Vers	Tclass	Flow Label				
Payload length				Next Hr	Hop Limit	
Source Address						
Destination Address						

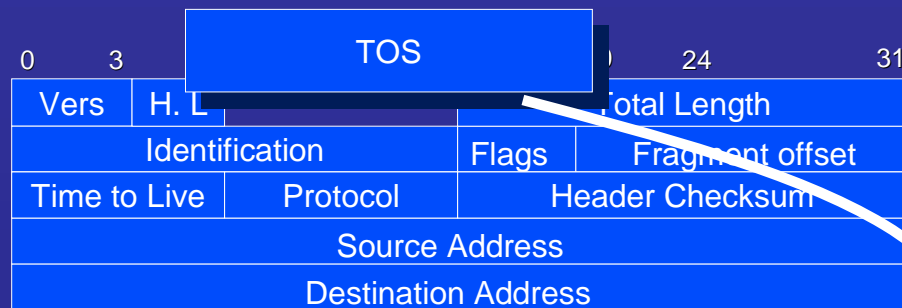
RFC 2765.- Stateless IP/ICMP Translation Algorithm (SIIT)

SIIT

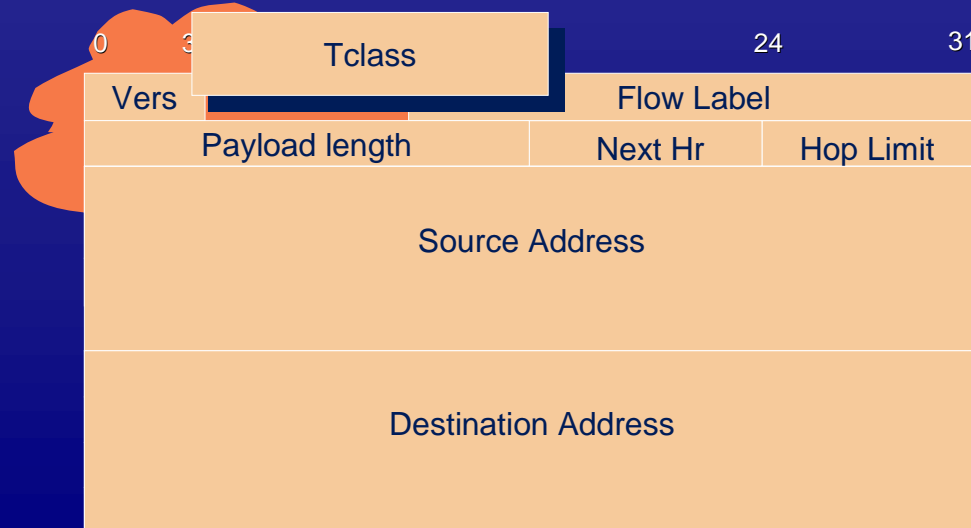
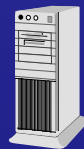


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SIIT



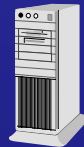
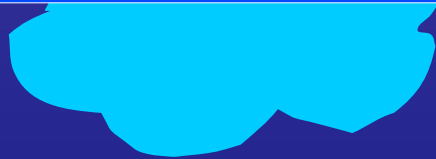
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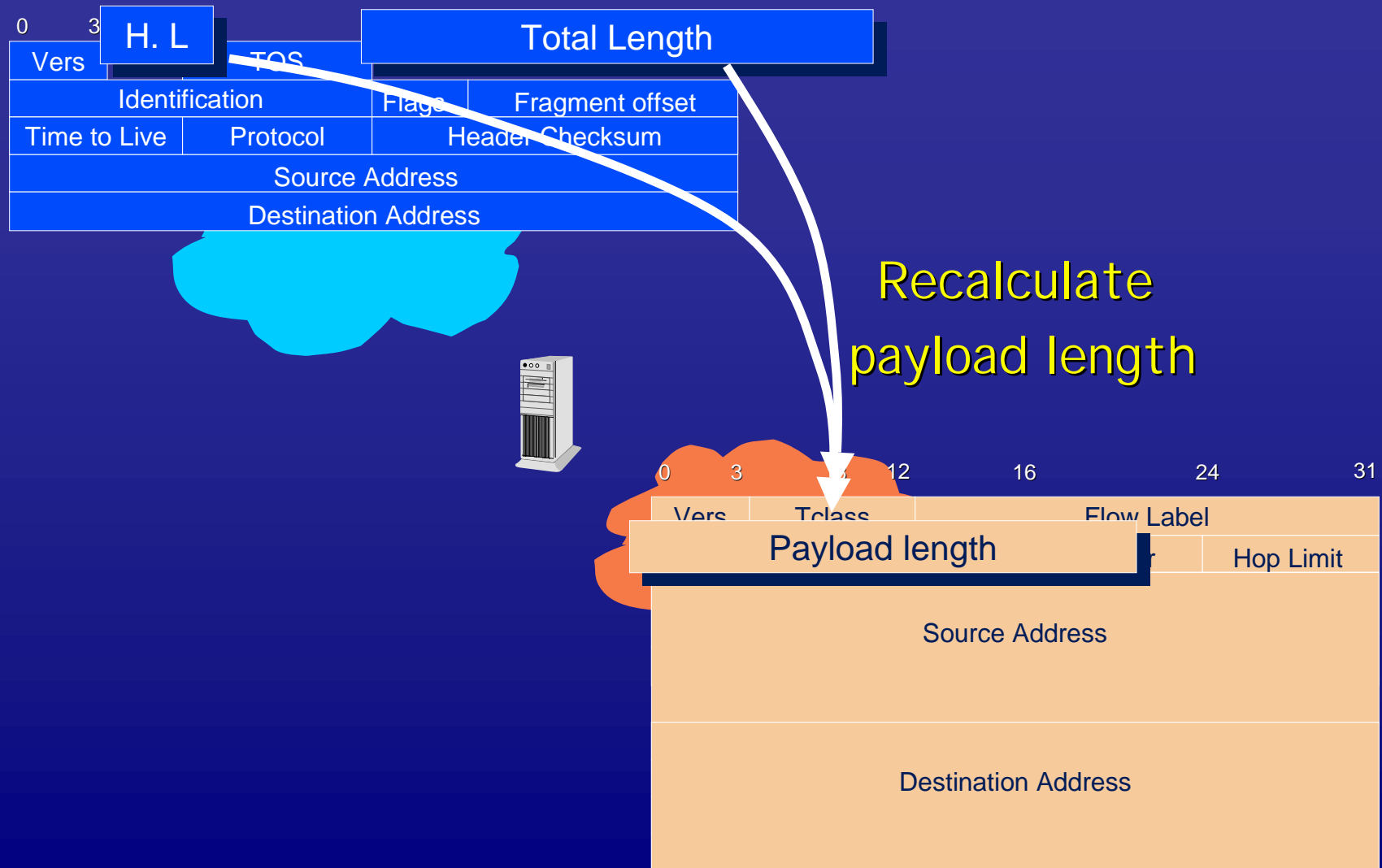
SIIT

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Vers	H. L	TOS	Total Length			
Identification			Flags	Fragment offset		
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Source Address						
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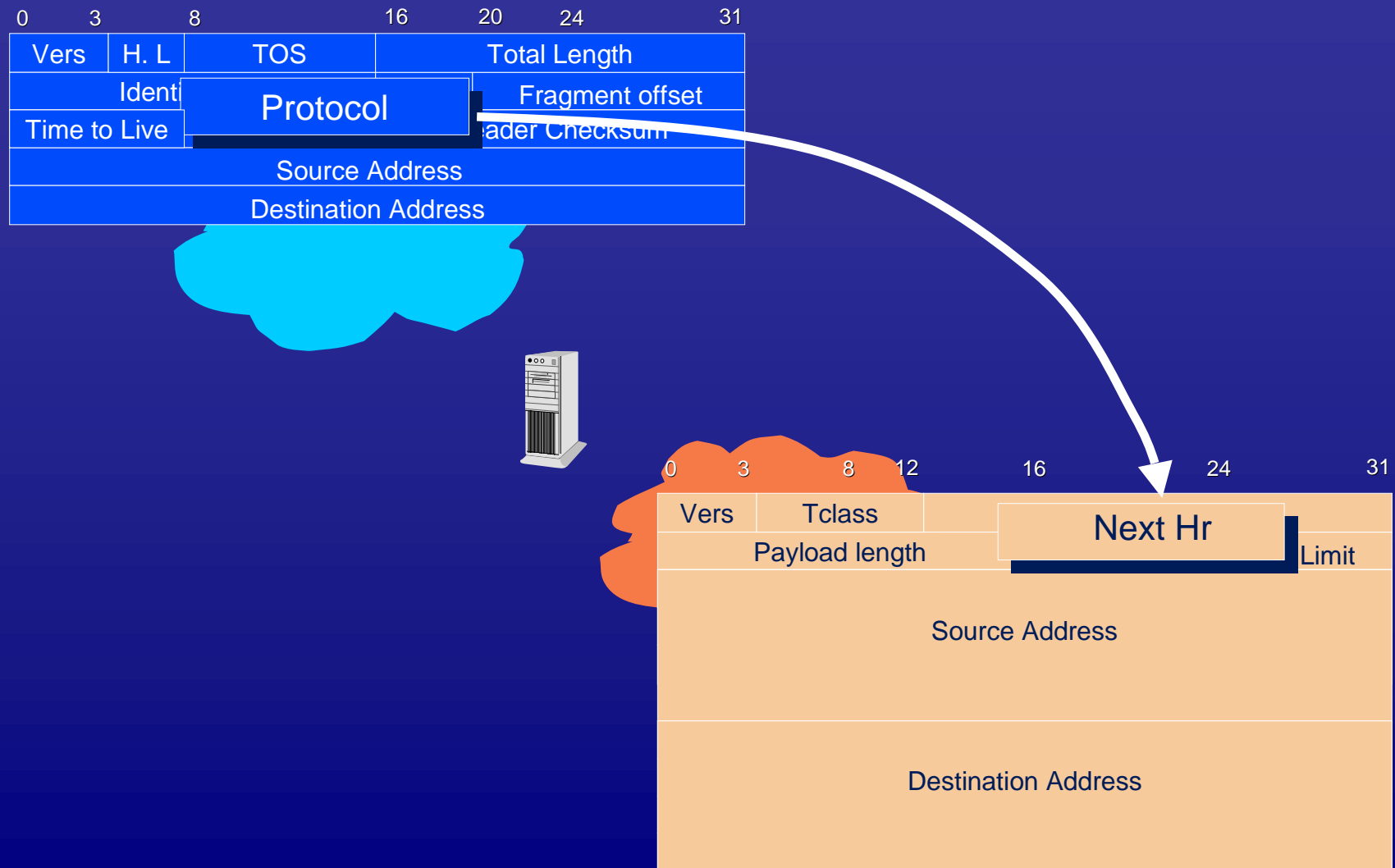
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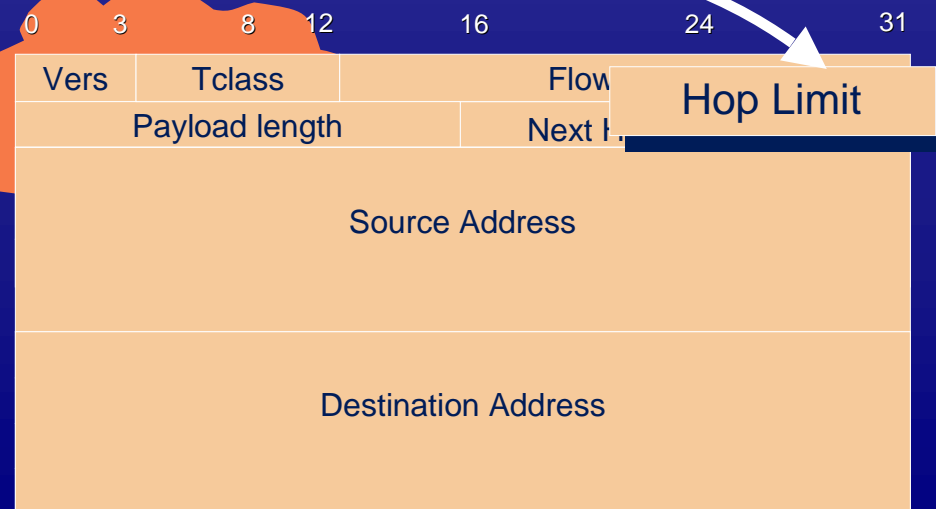
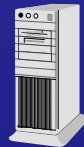
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SIIT



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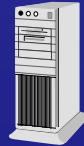
SIIT



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SIIT

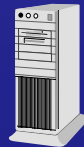
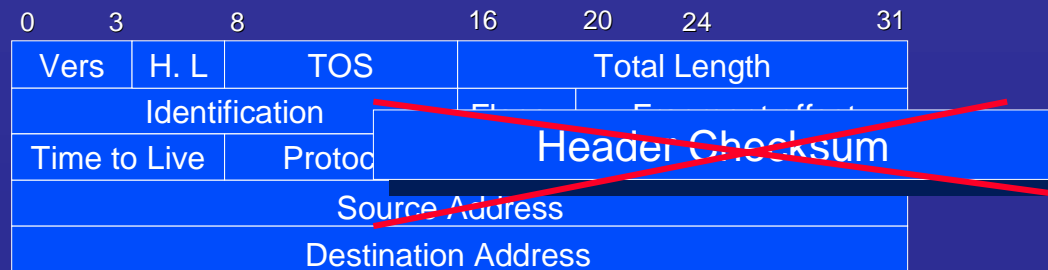
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Vers	H. L	TOS	Total Length			
Identification			Flags	Fragment offset		
Time to Live		Protocol	Header Checksum			
		Source Address				
		Destination Address				



Fragmented packets
generate IPv6
fragmentation options

0	3	8	12	16	24	31
Vers	Tclass		Flow Label			
Payload length				Next Hr		Hop Limit
Source Address						
Destination Address						

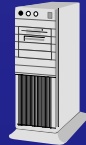
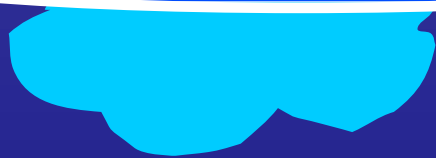
SIIT



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SIIT

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Vers	H. L	TOS	Total Length			
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0	3	8	12	16	24	31
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Destination Address						

RFC 2765.- Stateless IP/ICMP Translation Algorithm (SIIT)

SIIT

□ Similar rules for translating IPv6 to IPv4 and ICMP between IPv4 and IPv6

- Note that it is stateless

□ ICMP is also translated

- Headers and type values are translated
 - Some discarded, if no equivalent counterpart is defined
- ICMP error packets have inside an IP header, so translation is required
 - The rules for translating the inside IP packet are the same than for regular IP packets
 - The outermost IP header may change its length

SIIT

- ❑ In some cases IPv4 to IPv6 translation may result in IPv6 fragmentation
- ❑ ESP encryption transport mode is supported
- ❑ SIIT does not translate
 - Routing headers
 - Hop-by-hop options
 - Destination options
 - End-to-end AH header

NAT-PT

□ NAT-PT: (Network Address Translation – Protocol Translation). Address Translation

- It uses SIIT for Protocol Translation

□ Stateful operation

- Session traffic must traverse the same NAT-PT translator
- Once an association between addresses is established, it is kept for a given time

□ Address translation is sometimes required at application level

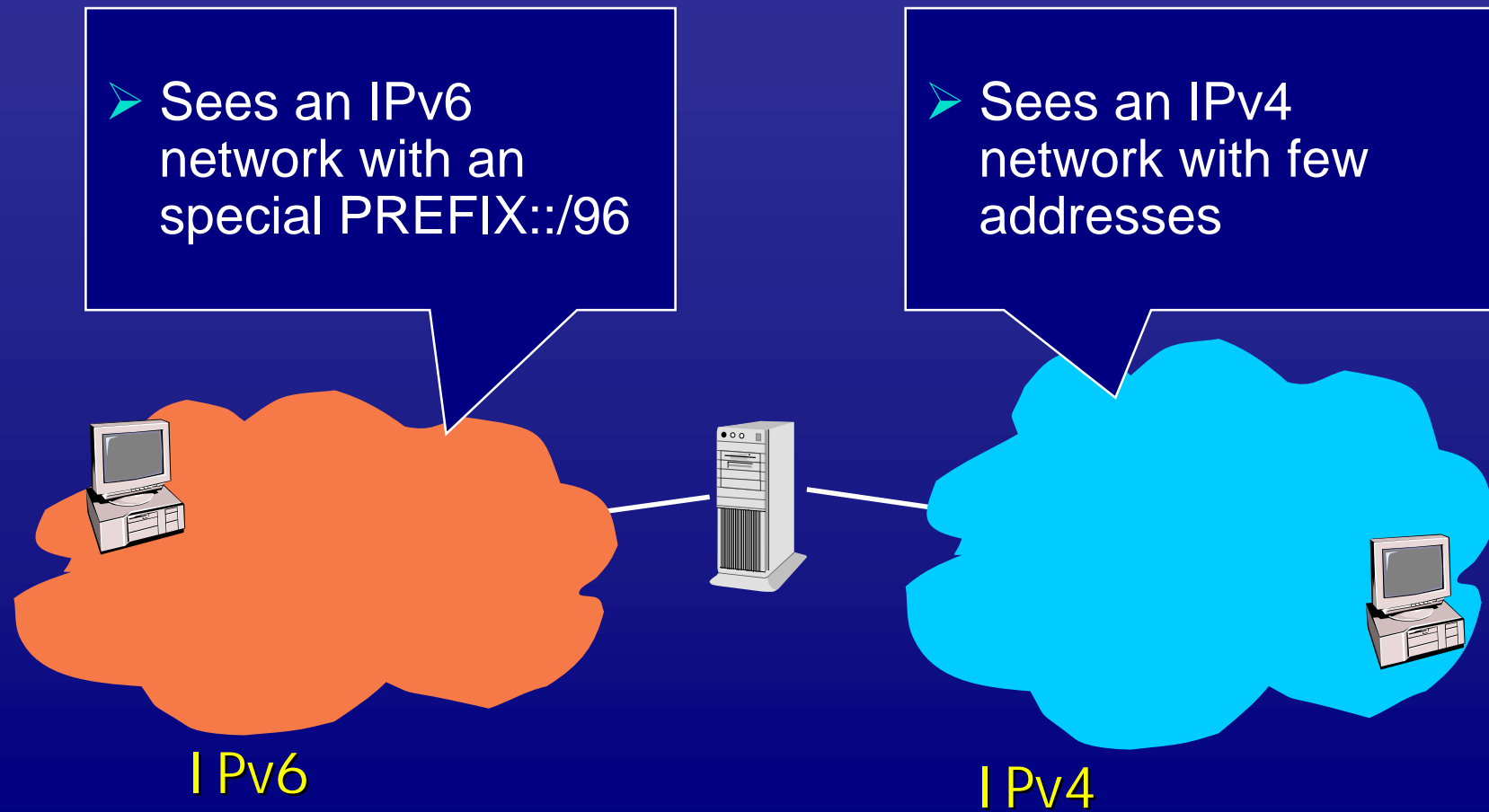
- For applications that transport addresses: DNS, FTP
 - Required DNS-ALG, FTP-ALG, ...-ALG

NAT-PT

Several flavours

- ❑ Traditional NAT-PT: communication initiated by IPv6 host
 - Basic NAT-PT
 - NAT-PT: Port translation
- ❑ Bidirectional NAT-PT: allows IPv4-initiated communication

NAT-PT



RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

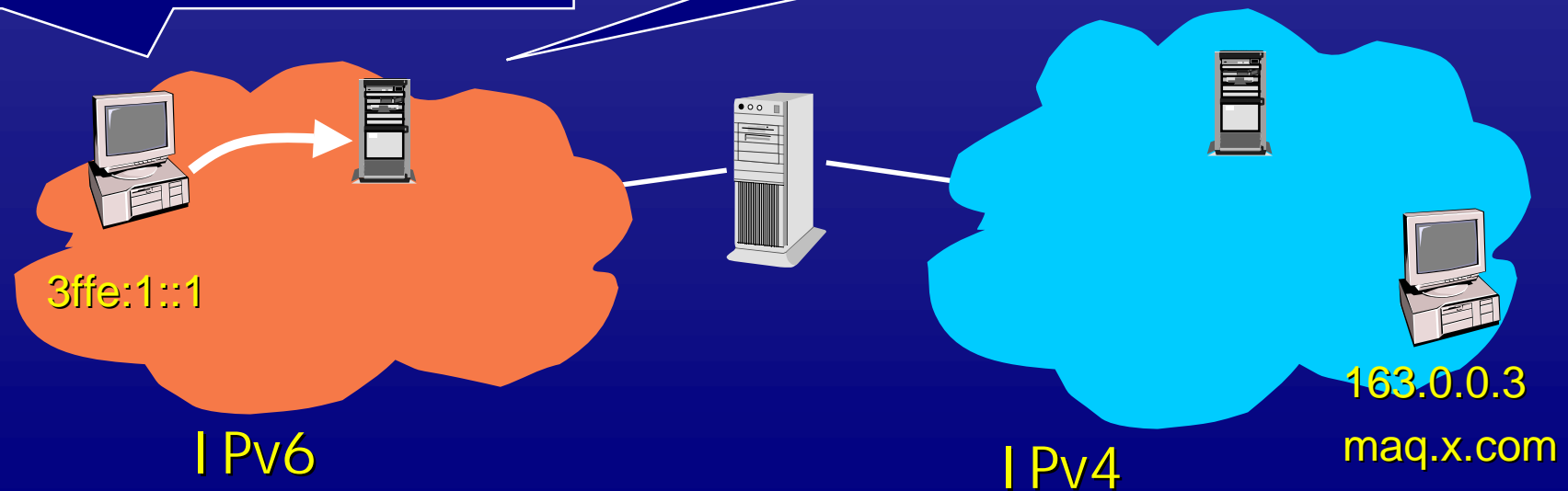
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NAT-PT

□ IPv6-initiated communication

- An application uses a name to start communication
 - The DNS resolver sends a lookup request

- Local DNS server
 - Name is not in cache. A DNS request is sent

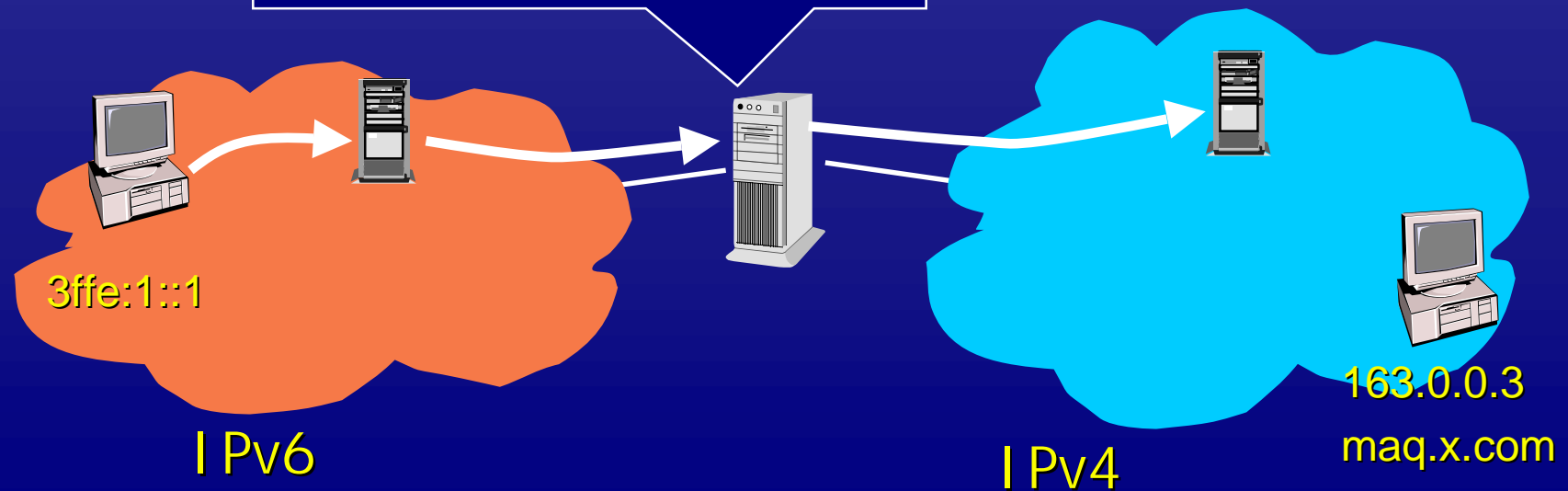


RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

NAT-PT

□ IPv6-initiated communication

- DNS-ALG translates query
- NAT-PT translates addresses



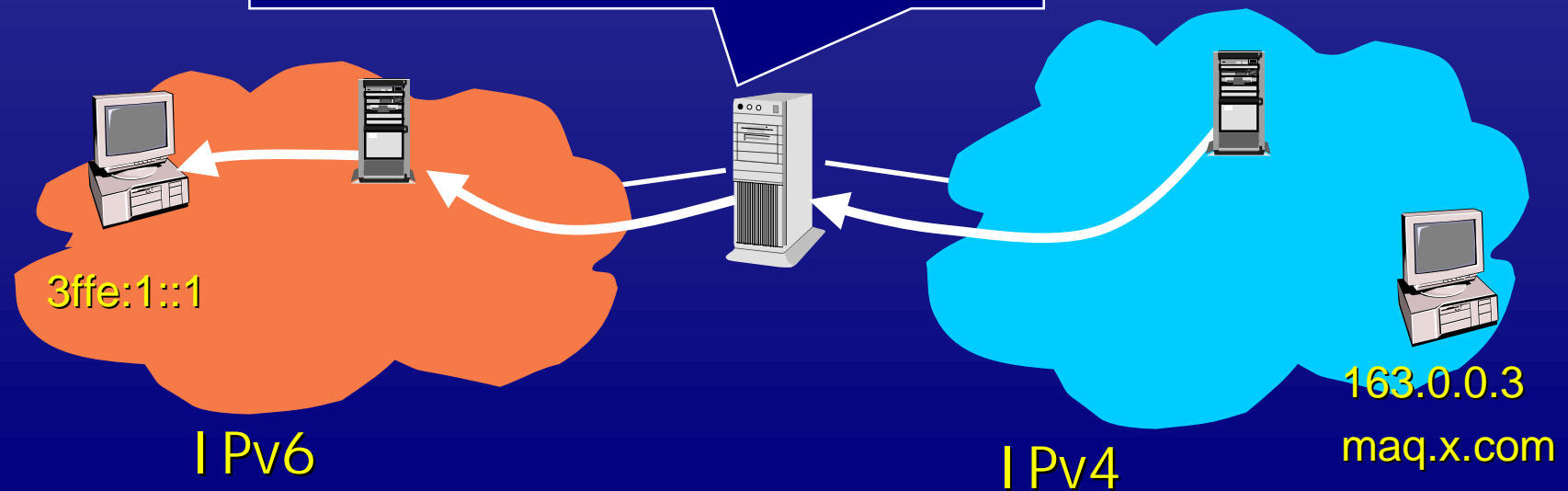
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NAT-PT

□ IPv6-initiated communication

- NAT-PT processes DNS response
 - DNS-ALG changes type, and IPv4 address for PREFIX::IPv4



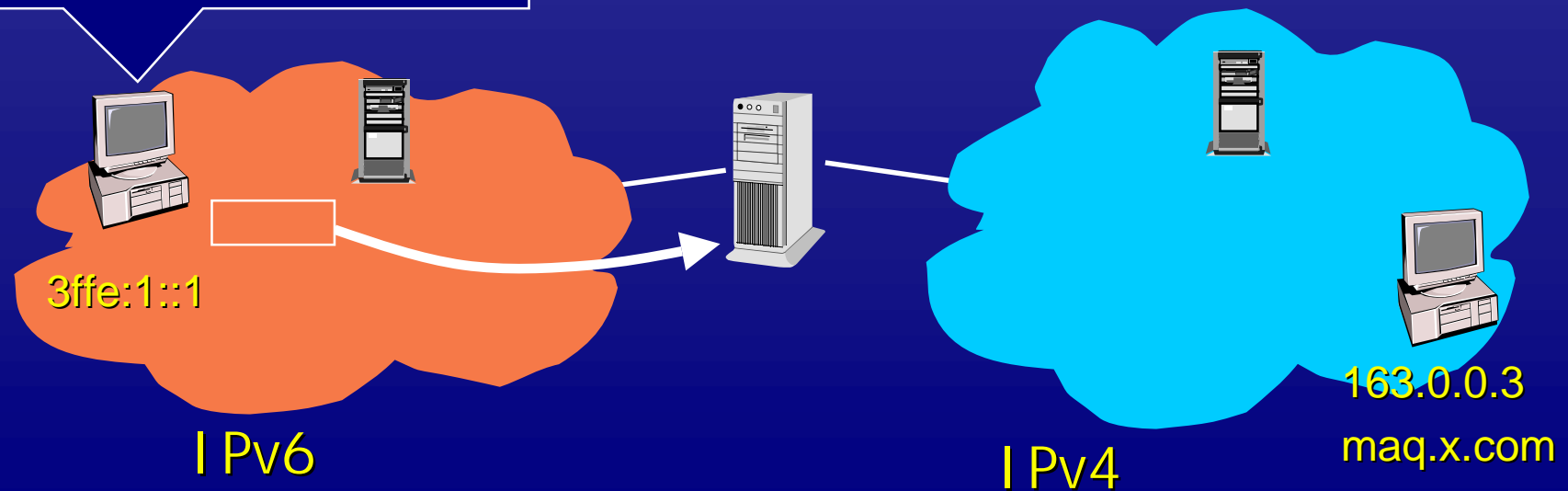
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NAT-PT

□ IPv6-initiated communication

- Source: 3ffe:1::1
- Destination: PREFIX::163.0.0.3

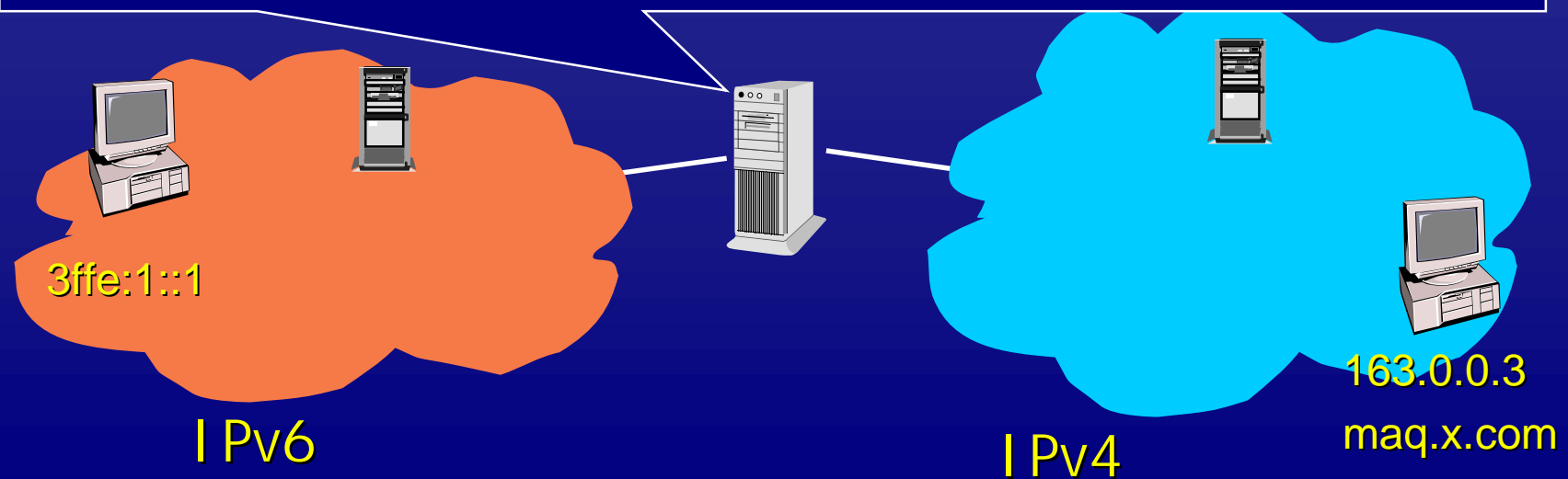


RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

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NAT-PT

- ☆ Looks for PREFIX::163.0.0.3 in its table, but it does not find it
- 🕒 Looks for a free IPv4 address (ej: 99.0.0.9), and associates it to 3fff::163.0.0.3
- 🕒 Generates packet
 - New destination address 163.0.0.3 (obtained from PREFIX::163.0.0.3)
 - New source address 99.0.0.9

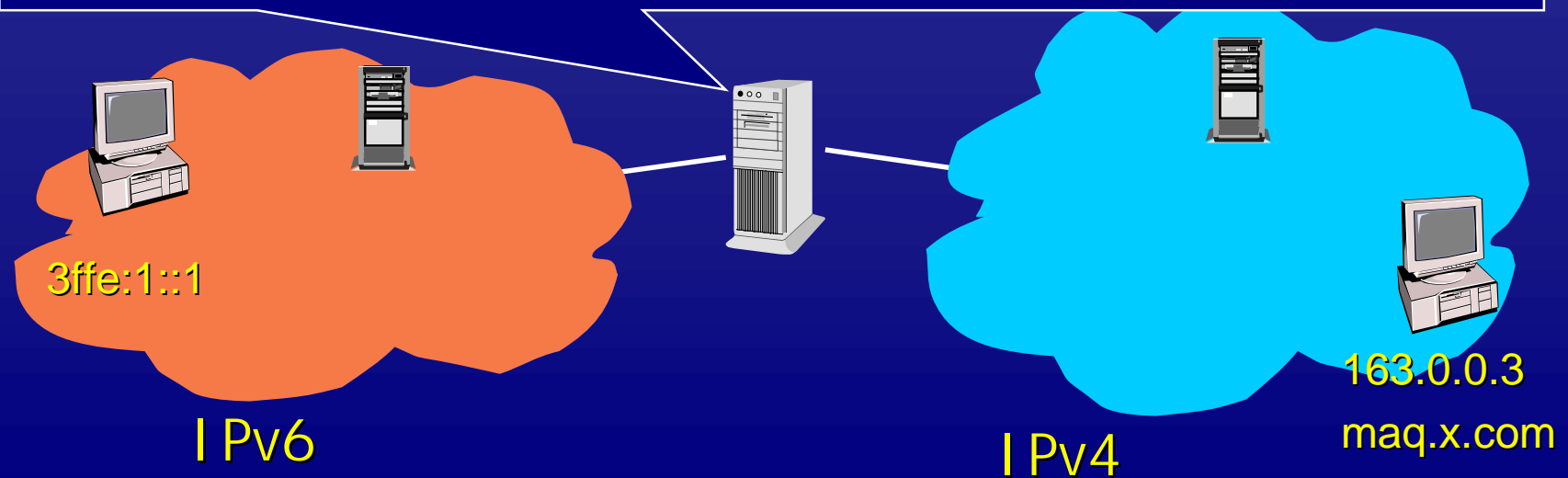


RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

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NAT-PT

- ⌚ If a protocol requiring ALG translation is detected, ALG translation is performed
- ⌚ SIIT translation is performed



RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

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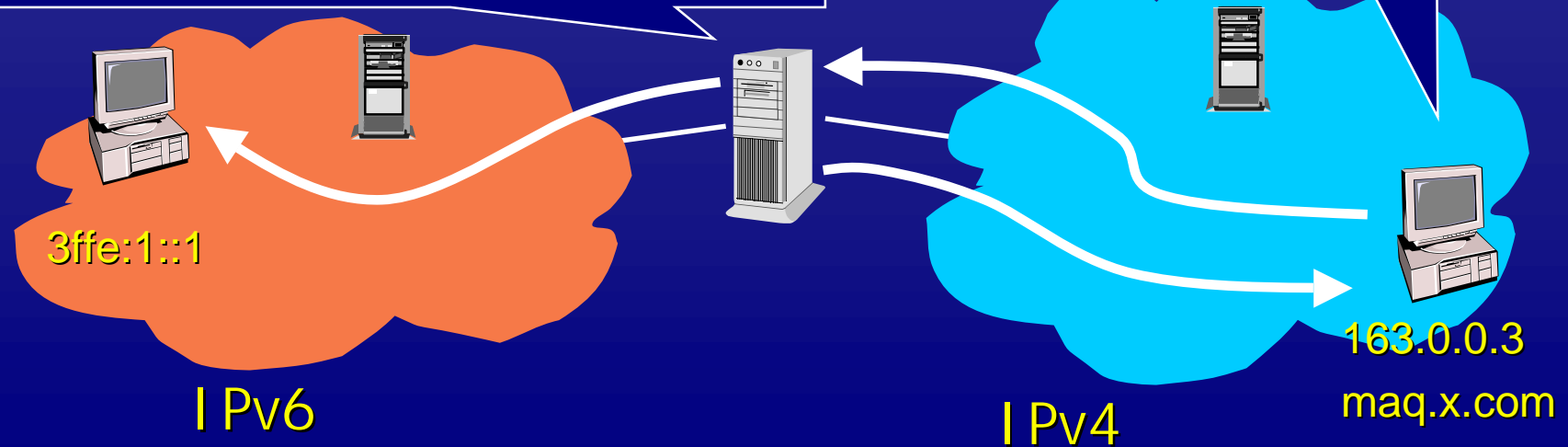
NAT-PT

IPv6-initiated communication

- ☆ Identifies destination address in table, and translates it
 - Also translates source address
- 🕒 Performs ALG if necessary
- 🕒 Executes SIIT translation

Response

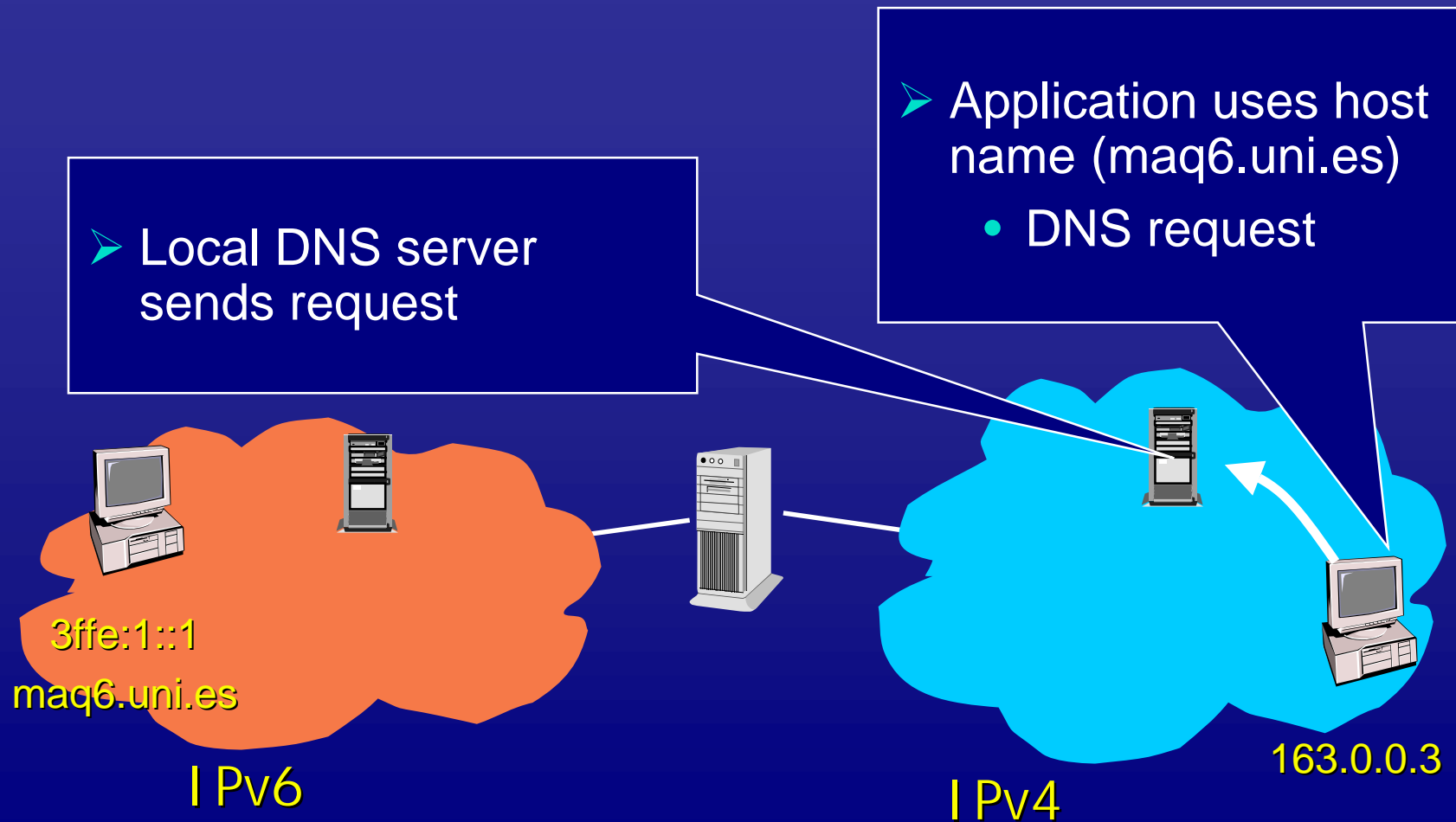
- Source: 163.0.0.3
- Destination: 99.0.0.9



RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

NAT-PT

□ IPv4-initiated communication



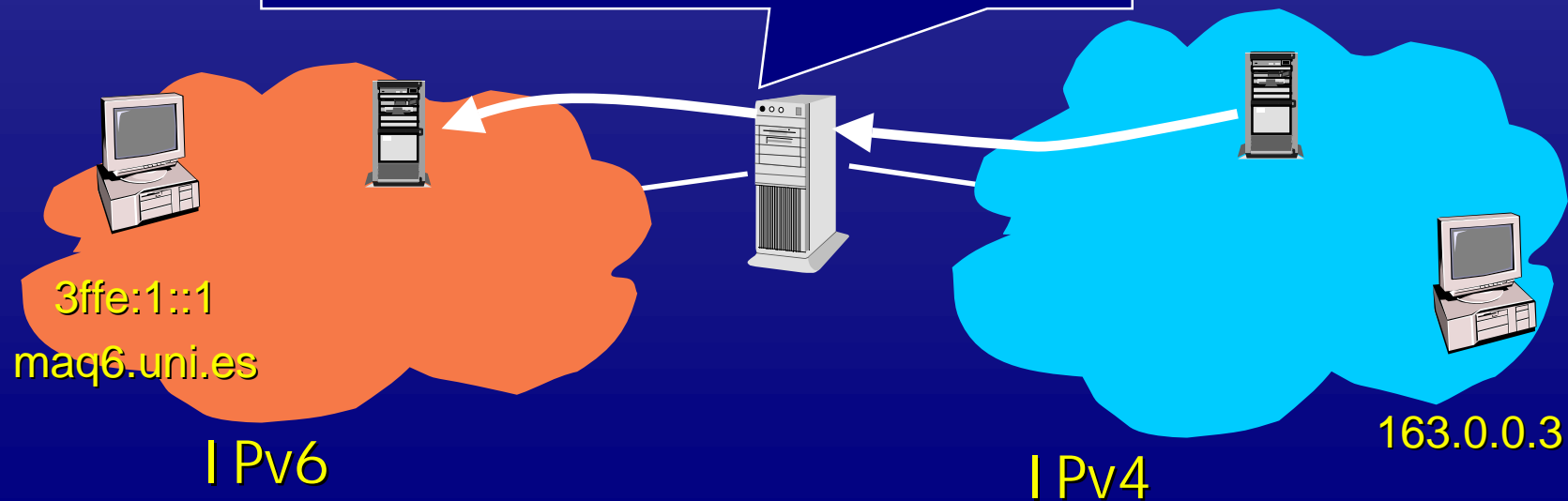
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NAT-PT

□ IPv4-initiated communication

- NAT-PT translates address and DNS request type



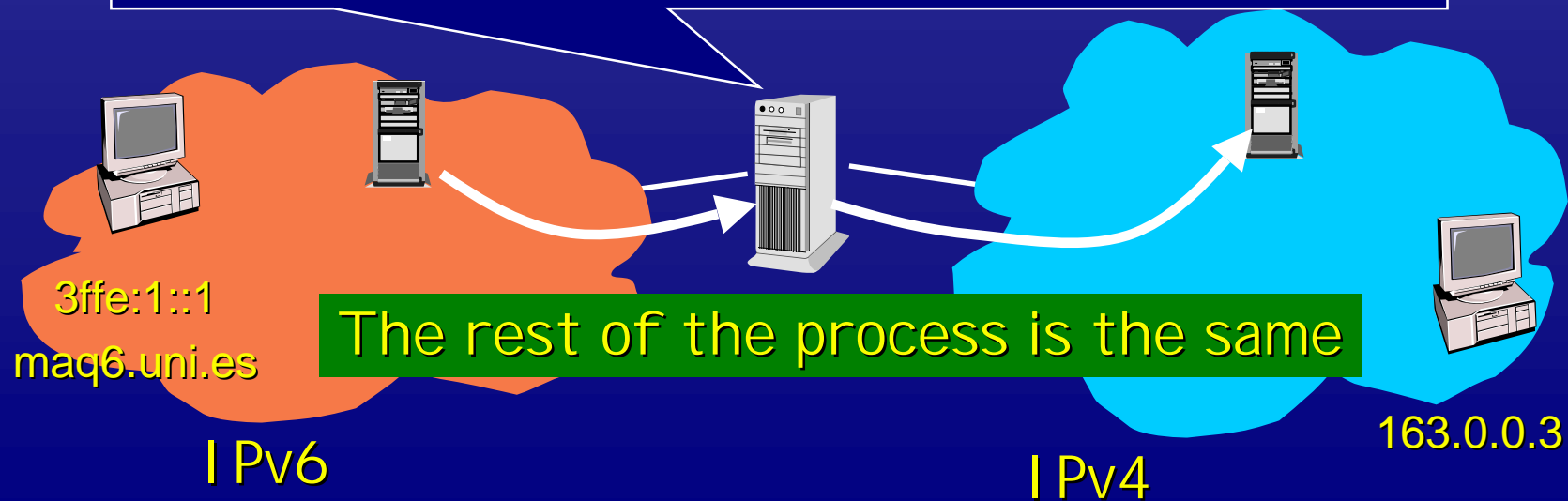
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NAT-PT

□ IPv4-initiated communication

- DNS-ALG detects address in DNS message (3ffe:1::1)
 - Looks for free IPv4 address, and associates it to IPv6 address
 - DNS response marked as not cacheable



RFC 2766.- Network Address Translation - Protocol Translation (NAT-PT)

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Final comments: NAT-PT

- ❑ Allows communication among IPv4/IPv6 domains by translating addresses and IP protocol
 - If communication starts at the IPv6 domain, state is established when the first data packet traverses the NAT-PT box
 - If communication starts at the IPv4 domain, state must be established when the first DNS response traverses the NAT-PT box
- ❑ Heavy mechanism: address state, protocol translation for each packet
- ❑ Single failure point
- ❑ Problems when the application transfers IP addresses
- ❑ SIIT protocol translation may result in information lost

References

- ❑ RFC 2765. "Stateless IP/ICMP Translation Algorithm (SIIT)". E. Nodmark. Febrero 2000.
- ❑ RFC 2766. "Network Address Translation - Protocol Translation (NAT-PT)". G. Tsirtsis, P. Srisuresh. Febrero 2000.
- ❑ "An overview of the introduction of IPv6 in the Internet". W. Biemolt et al. Trabajo en curso (<draft-ietf-ngtrans-introduction-to-ipv6-transition-07.txt>). Julio 2001.

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