IPv4 Addressing and IPv6

Antonio Carzaniga

Faculty of Informatics
University of Lugano

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Outline

- IPv4 Addressing
  - network addresses
  - classless interdomain routing
  - address allocation and routing
  - longest-prefix matching

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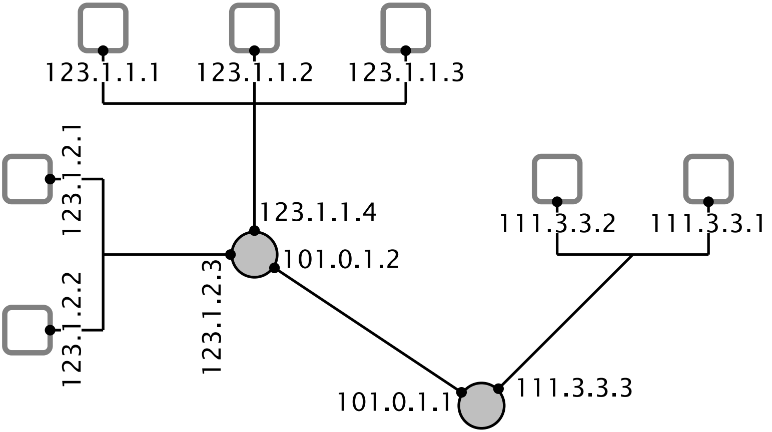
  - network addresses
  - classless interdomain routing
  - address allocation and routing
  - longest-prefix matching
- IPv6
  - motivations and design goals
  - datagram format
  - comparison with IPv4
  - extensions

*Inter*connection of *Net*works



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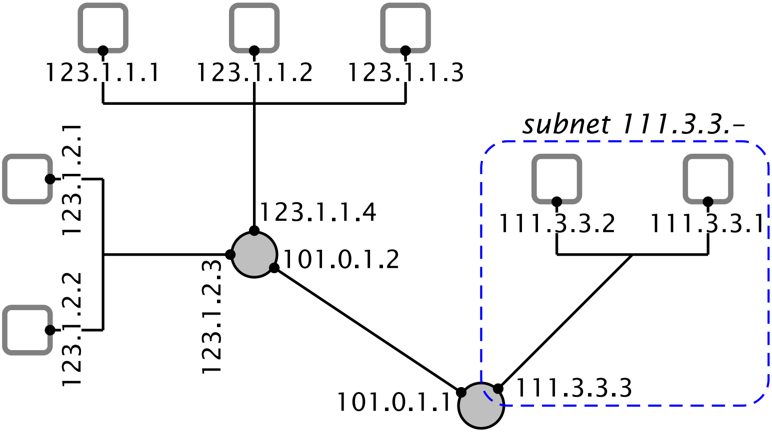

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- The assignment of addresses over an Internet topology is crucial to limit the complexity of routing and forwarding
- The key idea is to assign addresses with the *same prefix* to interfaces that are on the *same subnet*

Classless Interdomain Routing

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- All interfaces in the same subnet share the same *address prefix*
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  - 123.1.1.0/24 means that all the addresses share the same leftmost 24 bits with address 123.1.1.0
- This addressing scheme is not limited to entire bytes. For example, a network address might be 128.138.207.160/27

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128.138.207.160–128.138.207.191

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- In Java:

```
int match(int address, int network, int mask) {
   return (address & mask) == (network & mask);
}
```

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address class	*prefix length*
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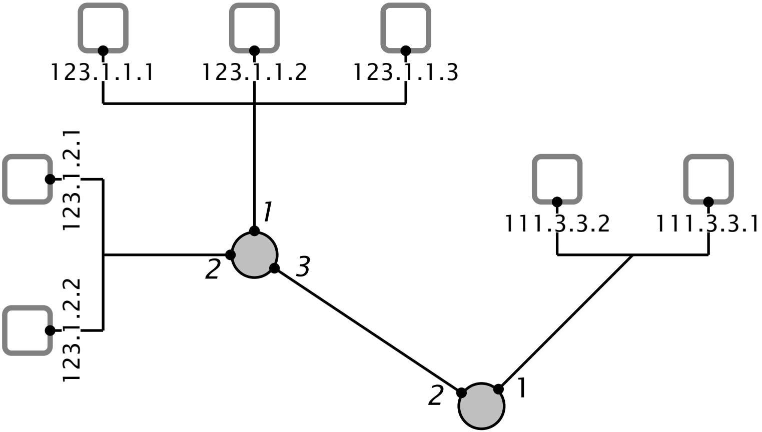
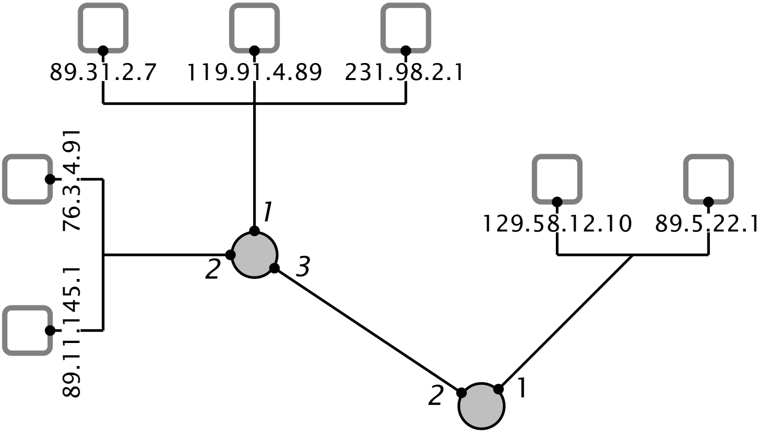
- Why is the idea of the common prefix so important?

- Routers outside a (sub)network can ignore the specifics of each address within the network
  - there might be some 64 thousands hosts in 128.138.0.0/16, but they all appear as one address from the outside

Example: Good Address Allocation



Example: Bad Address Allocation



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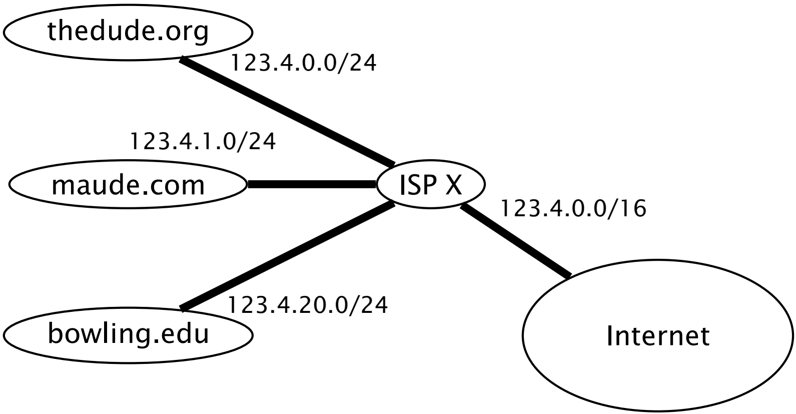

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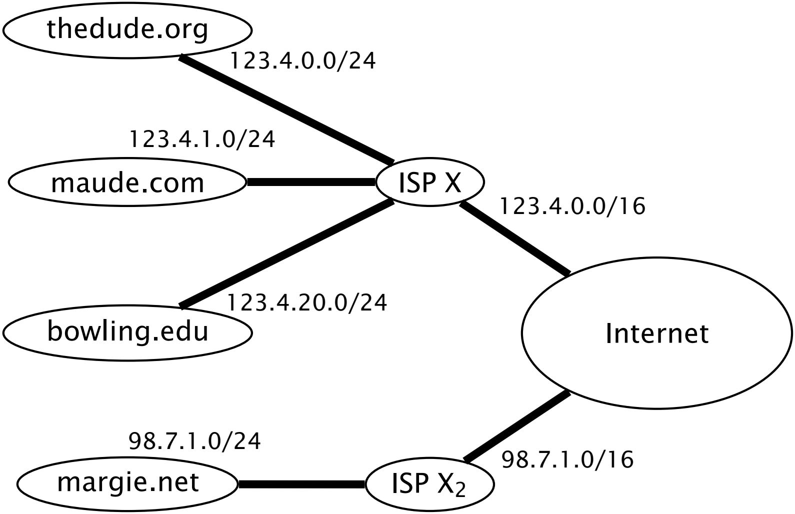

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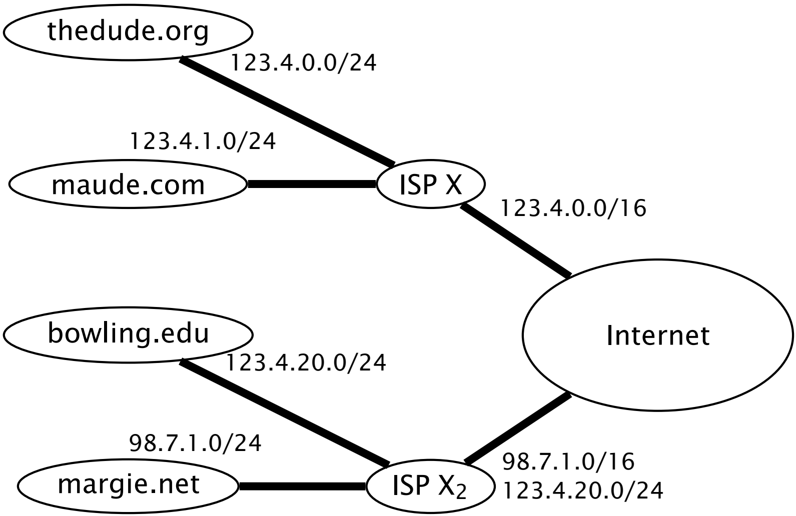

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forwarding table	
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98.7.1.0/16	2
123.4.20.0/24	2
128.0.0.0/1	3
66.249.0.0/16	3
0.0.0.0/1	4
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Special Addresses

IPv4 defines a number of special addresses or address blocks

- "Private," non-routable address blocks
  10.0.0.0/8, 172.16.0.0/12, and 192.168.0.0/16

- Default route
  0.0.0.0/0

- Loopback (a.k.a., localhost)
  127.0.0.0/8

- IP Multicast
  224.0.0.0/4

- Broadcast
  255.255.255.255/32

IPv6

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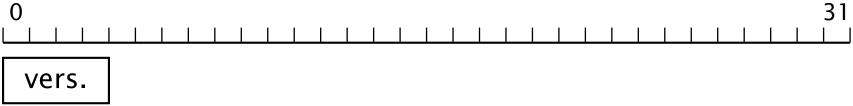
- Also, IPv6 improves various design aspects of IPv4

IPv6 Datagram Format

0 31

IPv6 Datagram Format



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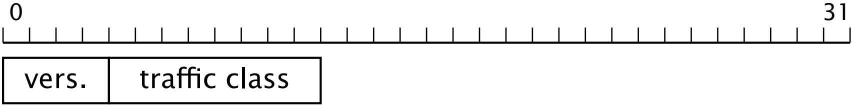

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0		31
vers.	traffic class	flow label

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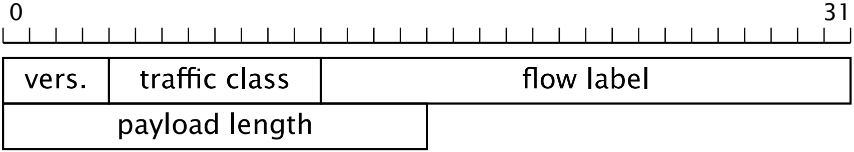

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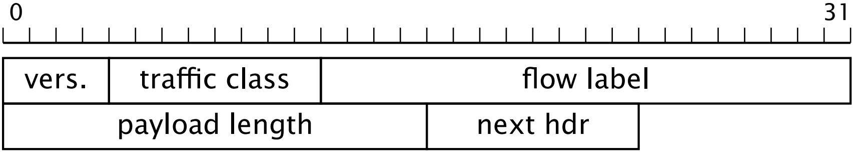
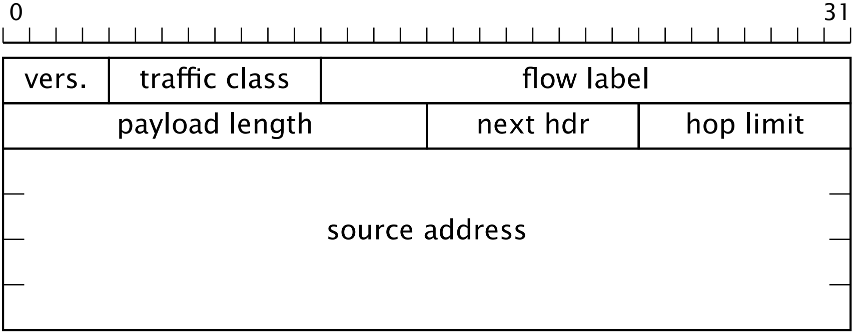


IPv6 Datagram Format

0			31
vers.	traffic class	flow label	
payload length		next hdr	hop limit

IPv6 Datagram Format



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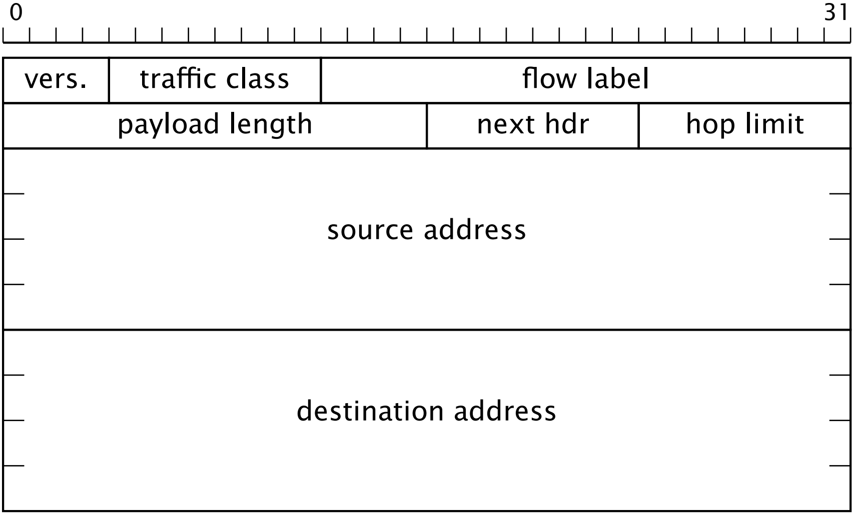

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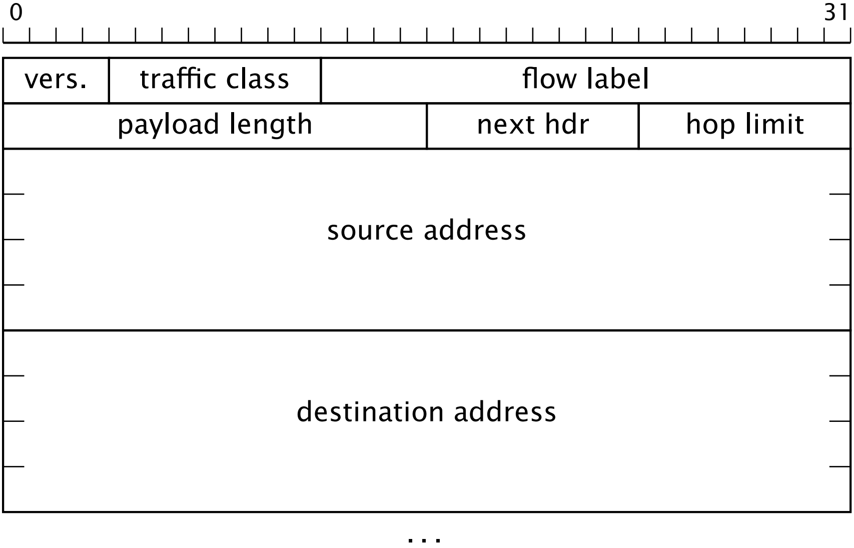

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  - e.g., video, voice, real-time traffic, etc.

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Higher-Level Protocol and Extensions

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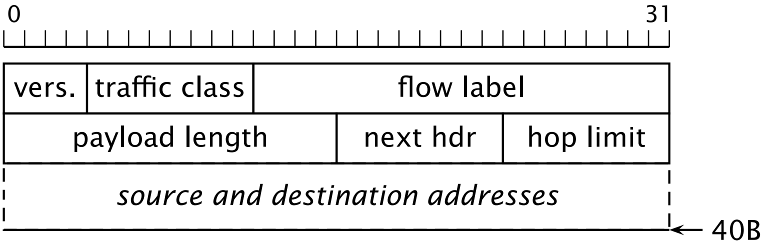

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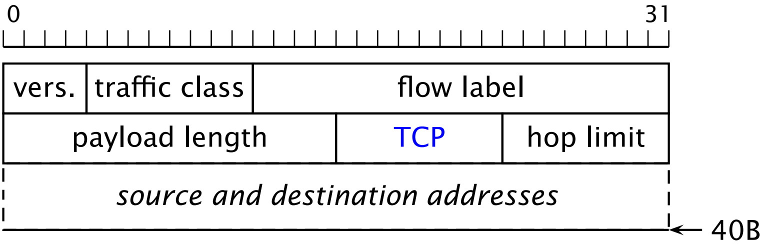

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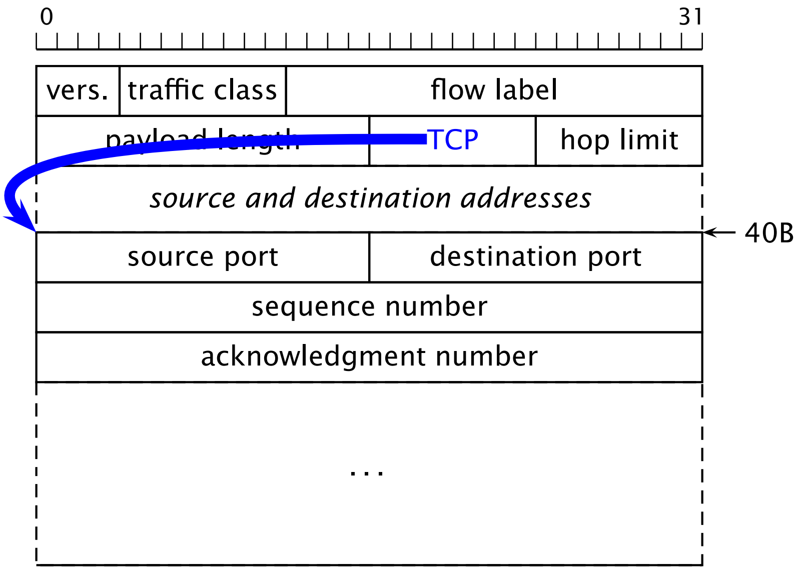

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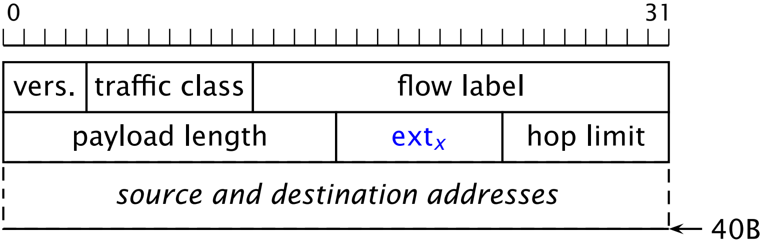

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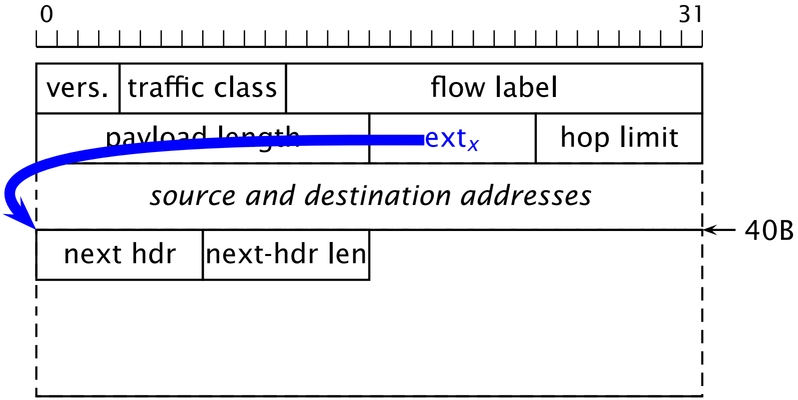

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