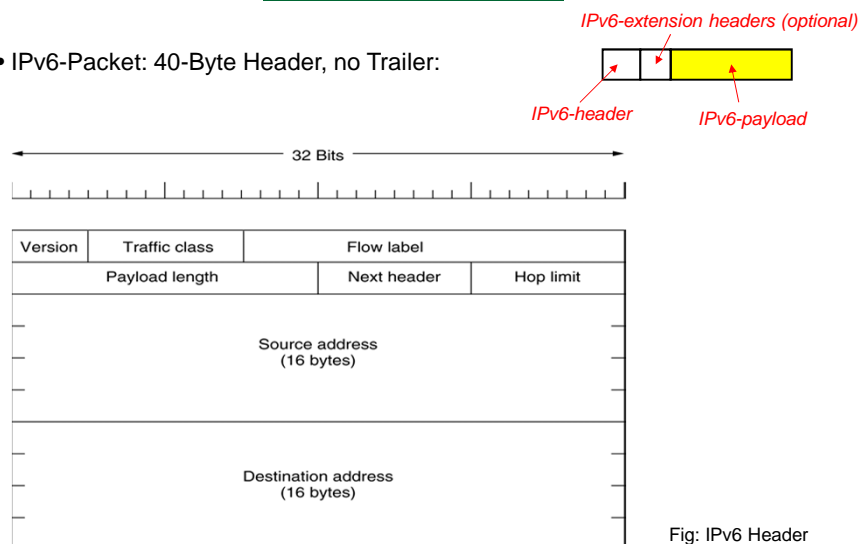


## IP Version 6 (IPv6)

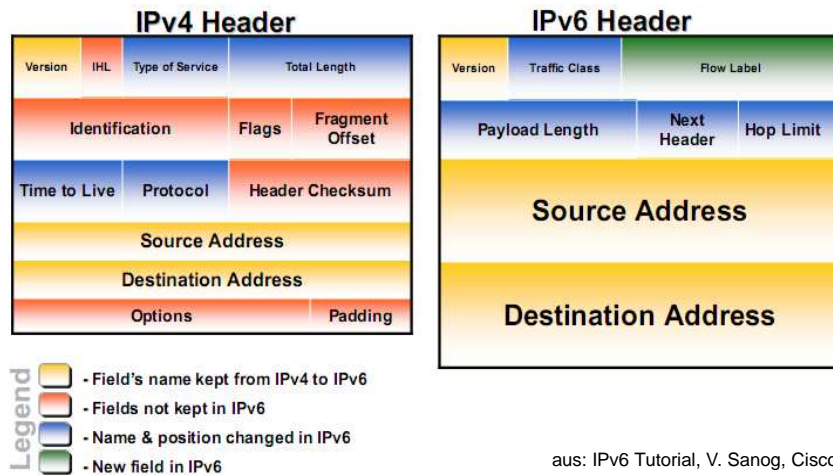
- IPv4 Address Pool Exhaustion
  - estimated by IANA: 01-Oct-2011
- Neue IP Version: **IPv6**
  - Anforderungen
    - Vereinfachung des Protokolls
    - Höhere Sicherheit
    - Stärke Betonung von QoS
    - Bessere Unterstützung von *Multicasting*
    - Möglichkeit für Hosts ohne Adressänderung auf Reisen zu gehen
    - Koexistenz von IP Version 4 & Version 6

## IPv6 Header

- IPv6-Packet: 40-Byte Header, no Trailer:



## IPv4 / IPv6 Header Comparison



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3

## IPv6 Header

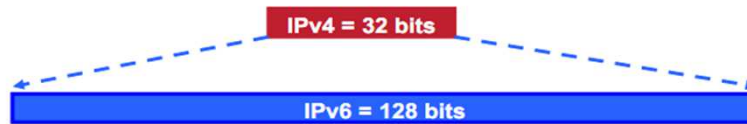
- **Traffic Class**
  - similar to Type-of-Service
- **Flow Label**
  - *“for engineering different traffic patterns”*
- **Payload Length**
- **Next Header**
  - any other (optional) header next
- **Hop Limit**
  - similar to TTL

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4

## IPv6 Address



## IPv4

32 bits

**= 4,294,967,296 possible addressable devices**

## IPv6


**128 bits: 4 times the size in bits**

**=  $3.4 \times 10^{38}$  possible addressable devices**

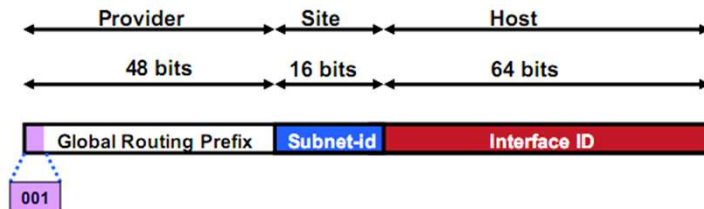
**= 340,282,366,920,938,463,463,374,607,431,768,211,456**

~  $5 \times 10^{28}$  addresses per person on the planet

## IPv6 Address Notation

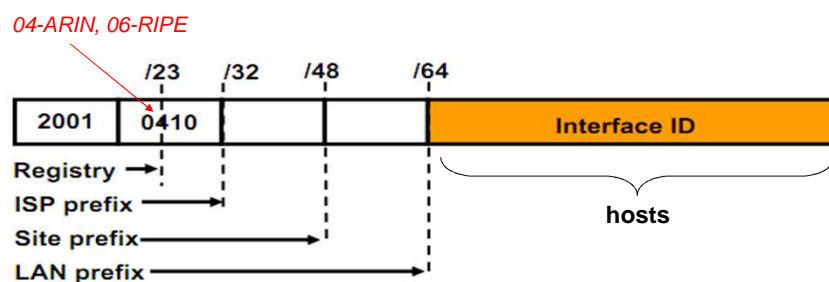
- 16 bit fields in case insensitive colon hexadecimal representation  
2031:0000:130F:0000:0000:09C0:876A:130B
  - Leading zeros in a field are optional:  
2031:0:130F:0:0:9C0:876A:130B
  - Successive fields of 0 represented as ::, but only once in an address:  
2031:0:130F::9C0:876A:130B is ok  
2031::130F::9C0:876A:130B is **NOT** ok
- 
- 0:0:0:0:0:0:1 → ::1 (loopback address)  
 0:0:0:0:0:0:0 → :: (unspecified address)

## IPv6 Global Unicast Address



- IPv6 Global Unicast addresses are:  
Addresses for generic use of IPv6  
Structured as a hierarchy to keep the aggregation
- First 3 bits 001 (2000::/3) is first allocation to IANA for use for IPv6 Unicast

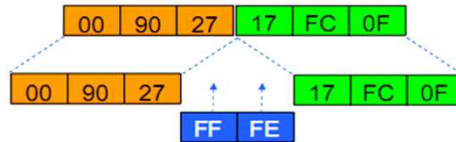
## IPv6 Address Allocation



- The allocation process is:  
The IANA has allocated 2001::/16 for initial IPv6 unicast use  
Each registry gets /23 prefixes from the IANA  
Registry allocates a /32 prefix to an IPv6 ISP  
Policy is that an ISP allocates a /48 prefix to each end customer

## IPv6 EUI-64 Address

Ethernet MAC address  
(48 bits)



64 bits version



Uniqueness of the MAC

000000X0 where X =  $\begin{cases} 1 = \text{unique} \\ 0 = \text{not unique} \end{cases}$   
X = 1

Eui-64 address



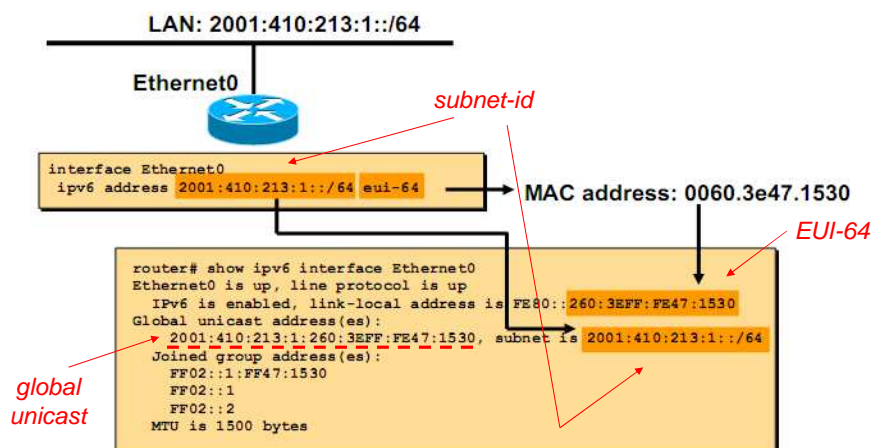
- EUI-64 address is formed by inserting FFFE and OR'ing a bit identifying the uniqueness of the MAC address

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9

## IPv6 EUI-64 Address



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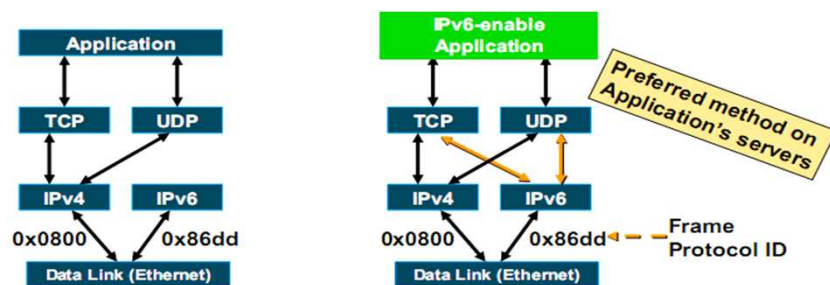
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10

## IPv6 Benefits

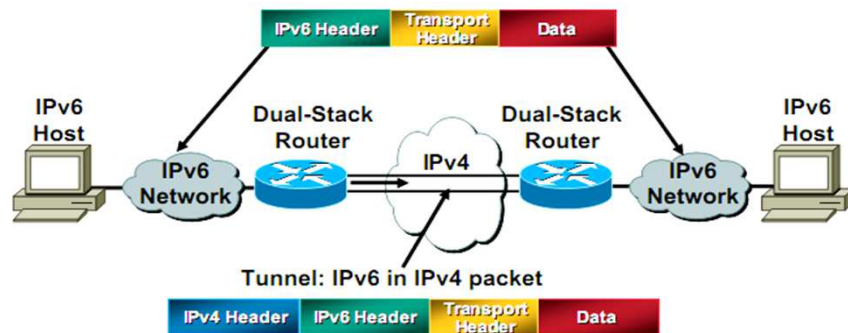
- What's really changed?
  - expanded address space
  - header format simplification
    - fixed length
    - optional headers are daisy-chained
  - no checksum at the IP network layer
  - no hop-by-hop fragmentation
    - path MTU discovery
  - no broadcast

## Dual Stack Approach



- Dual stack node means:
  - Both IPv4 and IPv6 stacks enabled
  - Applications can talk to both
  - Choice of the IP version is based on name lookup and application preference

## IPv6-over-IPv4 Tunnel



- Tunneling is encapsulating the IPv6 packet in the IPv4 packet
- Tunneling can be used by routers and hosts

## NAT-PT

Network Address Translation – Port Translation (NAT-PT)

