

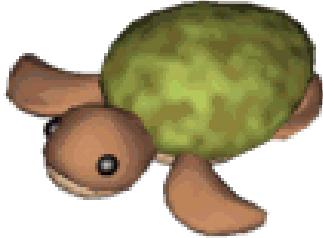
Welcome to

# IPv6 is here your fridge is on the network

Henrik Lund Kramshøj  
[hlk@solidonetworks.com](mailto:hlk@solidonetworks.com)

<http://www.solidonetworks.com>

Slides are available as PDF



Introduce IPv6

IPv6 addressing

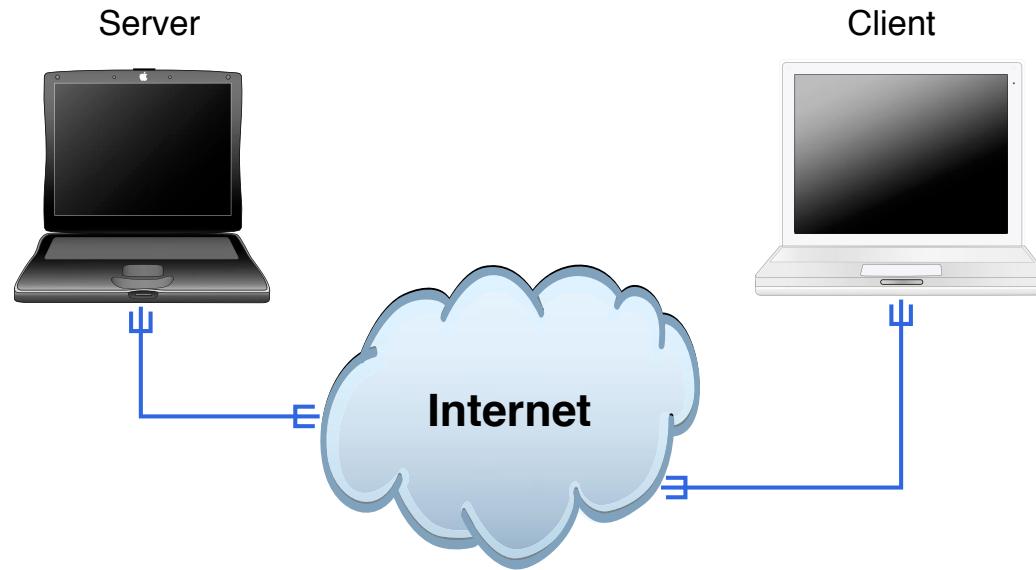
IPv4 vs IPv6 - Differences and similarities

The future is here

Denmark is falling behind on IPv6

Ressources

Expect you to be administrators of IP networks



Clients and servers

Rooted in academic networks

Protocols which are more than 20 years old

Very little encryption and security built into the network

1960s L. Kleinrock, MIT packet-switching theory, J. C. R. Licklider, MIT - notes ,  
Paul Baran: On Distributed Communications

1969 ARPANET 4 nodes

1971 14 nodes

1973 Design of Internet Protocols started

1973 Email is about 75% of all ARPANET traffic

1974 TCP/IP: Cerf/Kahn: A protocol for Packet Network Interconnection

1983 EUUG → DKUUG/DIKU forbindelse

1988 About 60.000 systems on the internet - The Morris Worm hits about 10%

2002 Ialt ca. 130 millioner på Internet

2010 1,966,514,816 users <http://www.internetworldstats.com/stats.htm>

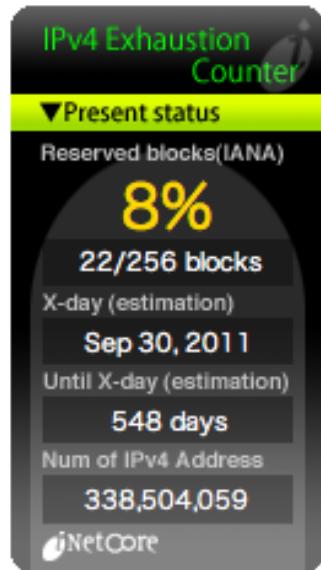
2010 **IANA reserved blocks 8% (March 2010) - <http://www.potaroo.net/tools/ipv4/>**

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**Projected IANA Unallocated Address Pool Exhaustion: 30-Sep-2011**

**Projected RIR Unallocated Address Pool Exhaustion: 27-Jul-2012**

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March 2010

<http://www.potaroo.net/tools/ipv4/>

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**Projected IANA Unallocated Address Pool Exhaustion: 26-May-2011**

**Projected RIR Unallocated Address Pool Exhaustion: 20-Jan-2012**

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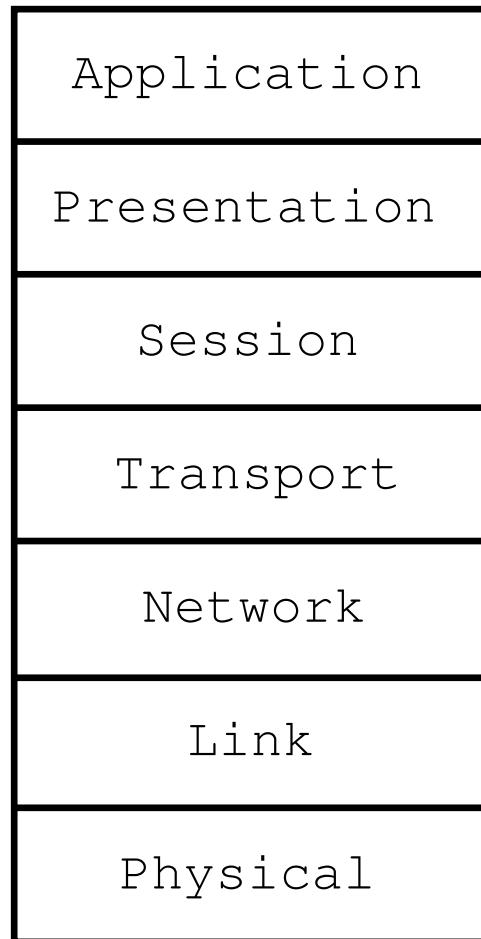


Updated September 2010

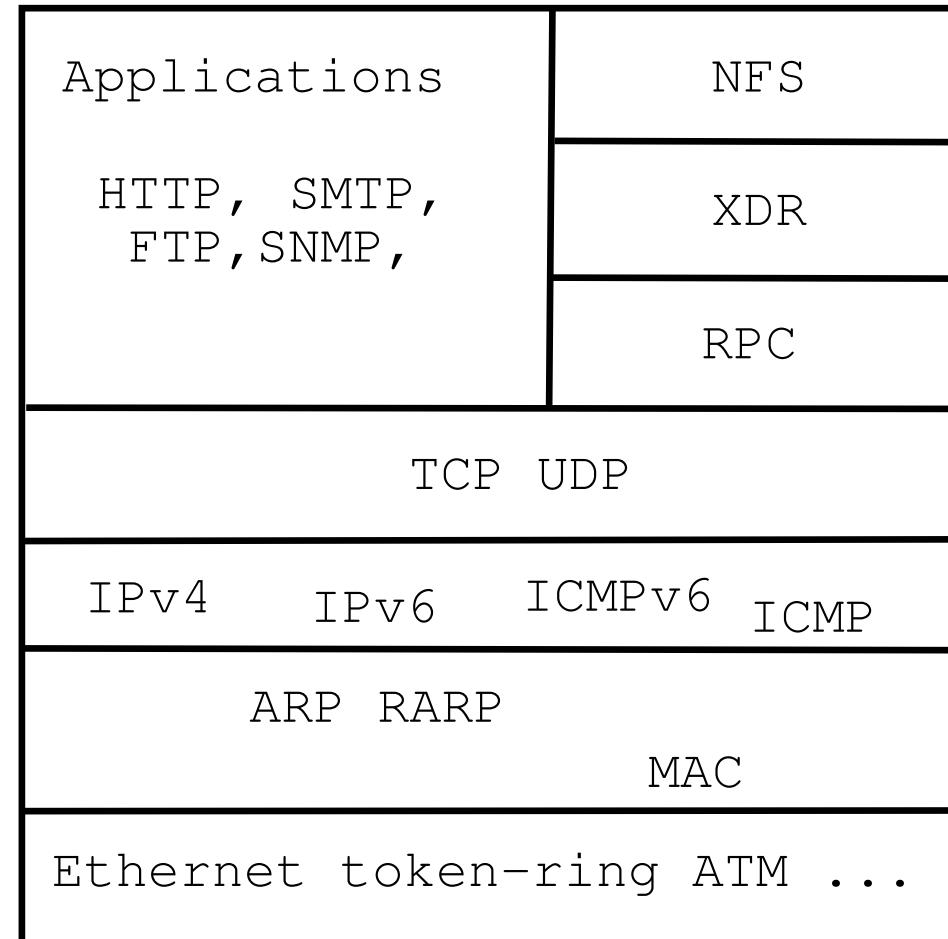
<http://www.potaroo.net/tools/ipv4/>

No more talk, we need IPv6, get to work - end of discussion

OSI Reference Model



Internet protocol suite



Preserve the good stuff

back to basics, internet as it used to be!

fate sharing - connection rely on end points, not intermediary NAT boxes

end-to-end transparency - you have an address and I have an address

Wants: bandwidth +10G, low latency/predictable latency, Quality of Service, Security

## IPv6 is evolution, not revolution

Note: IPv6 was not designed to solve all problems, so don't expect it to!

# How to use IPv6



[www.solidonetworks.com](http://www.solidonetworks.com)

[hlk@solidonetworks.com](mailto:hlk@solidonetworks.com)

# Really how to use IPv6?

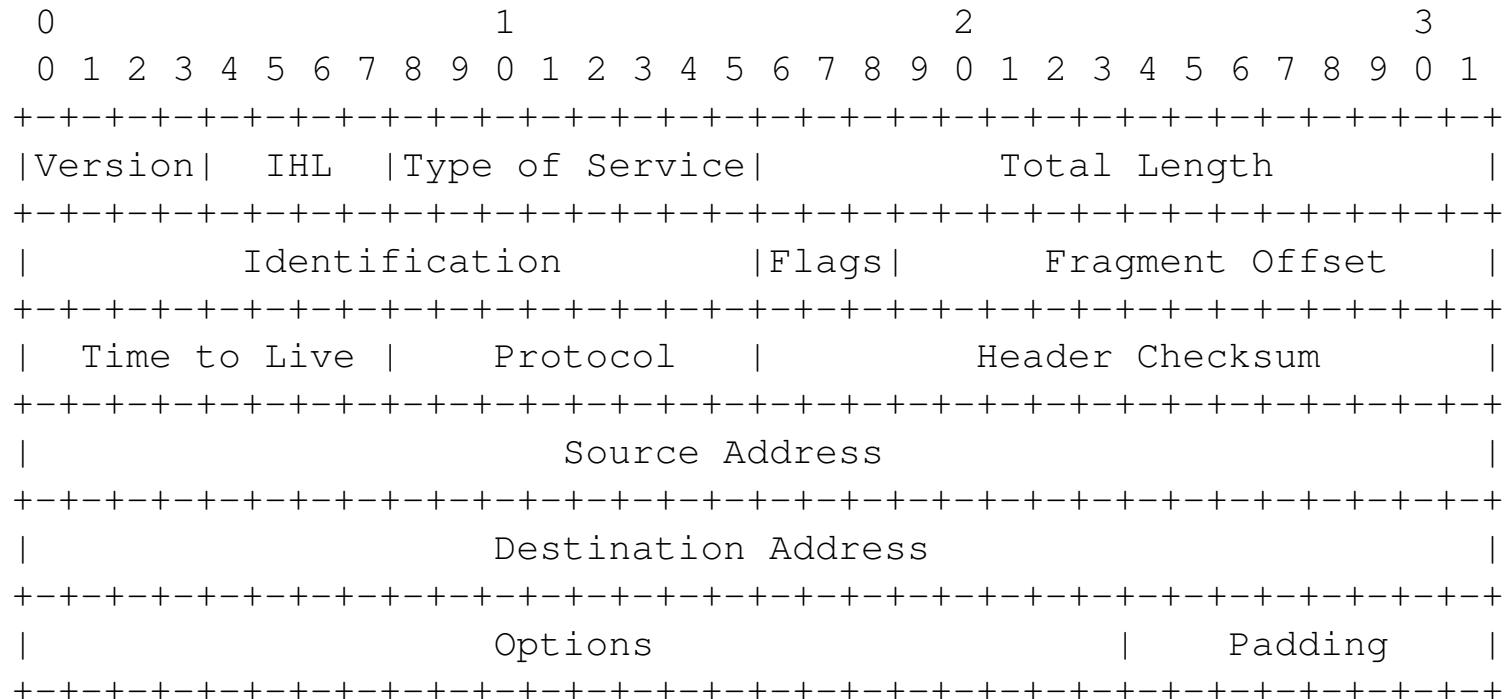
Get IPv6 address and routing

Add AAAA (quad A) records to your DNS

Done

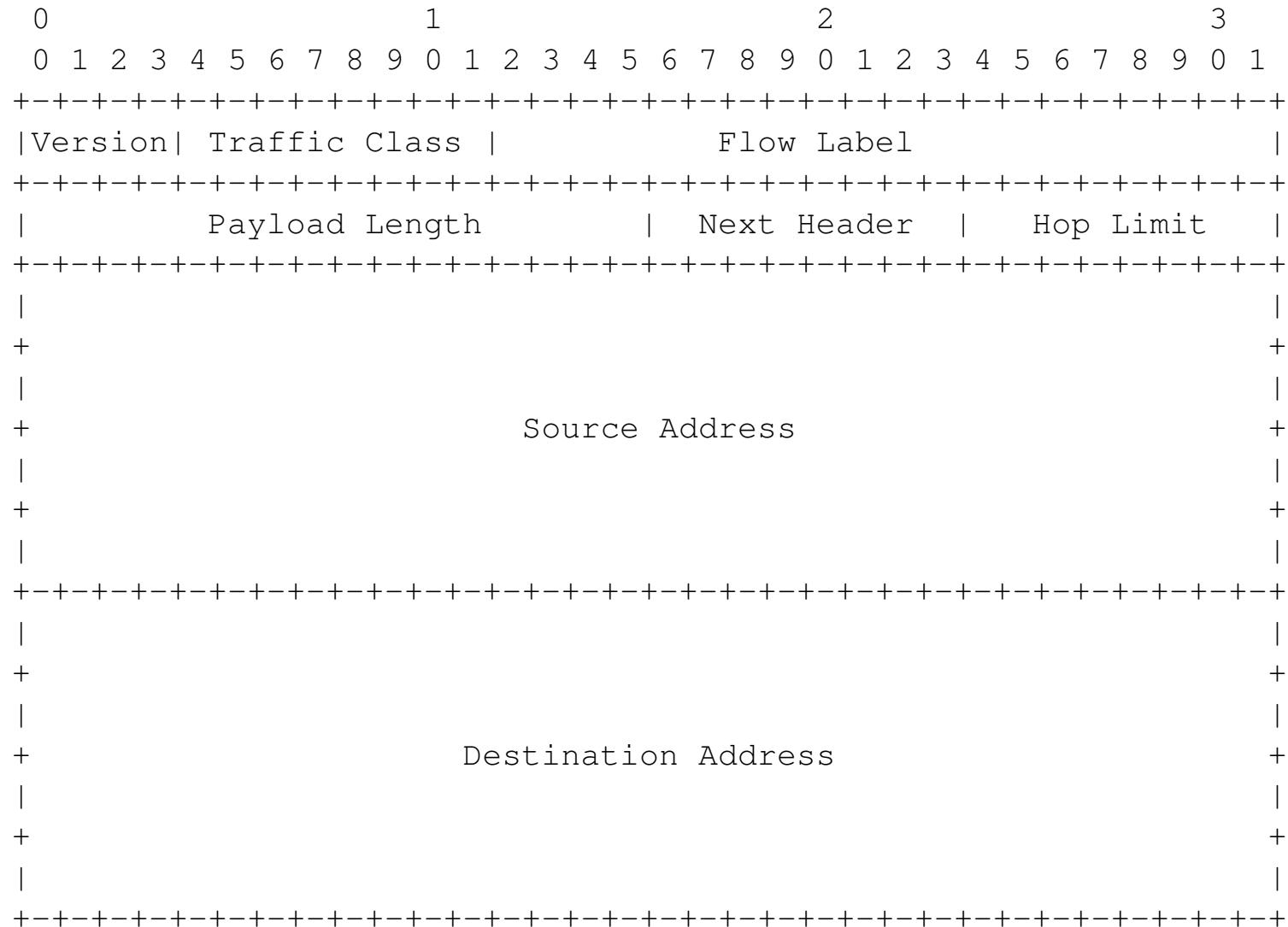
www	IN A	91.102.95.20
	IN AAAA	2a02:9d0:10::9

# IPv4 header - RFC-791 September 1981



Example Internet Datagram Header

# IPv6 header - RFC-2460 December 1998



- Hop-by-Hop Options
- Routing (Type 0)
- Fragment - fragmentation only at end-points!
- Destination Options
- Authentication
- Encapsulating Security Payload

Addresses are always 128-bit identifiers for interfaces and sets of interfaces

Unicast: An identifier for a **single interface**.

A packet sent to a unicast address is delivered to the interface identified by that address.

Anycast: An identifier for a **set of interfaces** (typically belonging to different nodes).

A packet sent to an anycast address is **delivered to one** of the interfaces identified by that address (the "nearest" one, according to the routing protocols' measure of distance).

Multicast: An identifier for a **set of interfaces** (typically belonging to different nodes).

A packet sent to a multicast address is **delivered to all interfaces identified by that address**.

subnet prefix	interface identifier
---------------	----------------------

2001:16d8:ff00:012f:0000:0000:0000:0002

2001:16d8:ff00:12f::2

8 times 4 hex-digits separated by colon x:x:x:x:x:x:x:x

Written as ipv6-address/prefix-length CIDR notation

Leading zeros can be removed

One or more groups of 16 bits of zeros can be replaced by ::

Note: [http://en.wikipedia.org/wiki/Classless\\_Inter-Domain\\_Routing](http://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing)

## Examples:

- ABCD:EF01:2345:6789:ABCD:EF01:2345:6789
- Address 2001:DB8:0:0:8:800:200C:417A
- Address of loopback ::1
- IPv6 prefix 2a02:09d0:95::1/64, subnet 2a02:09d0:0095:0000::/64
- Address 2a02:09d0:95::1 or 2a02:09d0:0095:0000:0000:0000:0000:0001
- Hint: use programming libraries to parse them :-)

Name servers for .dk

p.nic.dk has IPv6 address 2001:500:14:6036:ad::1

s.nic.dk has IPv6 address 2a01:3f0:0:303::53

b.nic.dk has IPv6 address 2a01:630:0:80::53

ns1.gratisdns.dk has IPv6 address 2a02:9d0:3002:1::2

ns1.censurfridns.dk has IPv6 address 2002:d596:2a92:1:71:53::

www.solidonetworks.com has IPv6 address 2a02:9d0:10::9

# IPv6 in practice ipconfig/ifconfig and ping

```
$ ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
inet6 fe80::216:cbff:feac:1d9f%en0 prefixlen 64 scopeid 0x4
inet 10.0.42.15 netmask 0xffffffff broadcast 10.0.42.255
inet6 2001:16d8:dd0f:cf0f:216:cbff:feac:1d9f prefixlen 64 autoconf
ether 00:16:cb:ac:1d:9f
media: autoselect (1000baseT <full-duplex>) status: active

$ ping6 ::1
PING6(56=40+8+8 bytes) ::1 --> ::1
16 bytes from ::1, icmp_seq=0 hlim=64 time=0.089 ms
16 bytes from ::1, icmp_seq=1 hlim=64 time=0.155 ms

$ traceroute6 2001:16d8:dd0f:cf0f::1
traceroute6 to 2001:16d8:dd0f:cf0f::1 (2001:16d8:dd0f:cf0f::1)
from 2001:16d8:dd0f:cf0f:216:cbff:feac:1d9f, 64 hops max, 12 byte packets
1  2001:16d8:dd0f:cf0f::1  0.399 ms  0.371 ms  0.294 ms
```

## Modified EUI-64 format-based interface identifiers

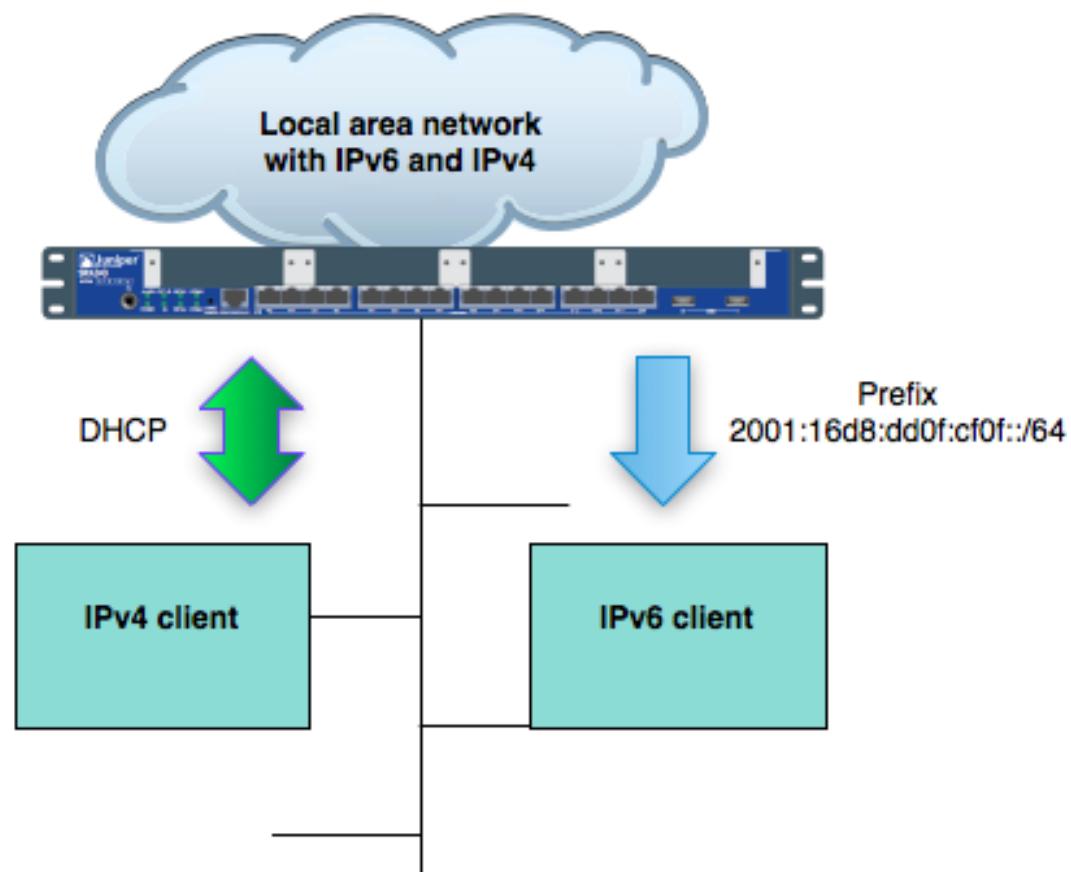
```
ifconfig en1
en1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
      ether 00:23:6c:9a:f5:2c
                  00-23-6c-ff-fe-9a-f5-2c 48-bit MAC stretched to become EUI-64
                  02-23-6c-ff-fe-9a-f5-2c inverting the "u" bit (universal/local bit)
                  fe80:: + 0223:6cff:fe9a:f52c add link-local prefix
      inet6 fe80::223:6cff:fe9a:f52c%en1 prefixlen 64 scopeid 0x6
```

DHCPv6 is available, but **stateless autoconfiguration** is king

Routers announce subnet prefix via **router advertisements**

Individual nodes then combine this with their EUI64 identifier

## Router advertisements



Native IPv6 - available at some places in DK  
Ask your provider - prepare to switch provider if no plan

Automatic tunnels 6to4, Teredo etc.

- 6to4 benytter IPv4 infrastrukturen
- Teredo sender IPv6 gennem IPv4/UDP pakker

Configured tunnels and tunnelbrokers

- <http://sixxs.net> IPv6 Deployment & Tunnel Broker
- <http://he.net> hurricane electric internet services

Notice: you probably already have IPv6 traffic in your network!

# Allocating IPv6 addresses

You have plenty!

Providers will typically get /32

Providers will typically give you /48 or /56

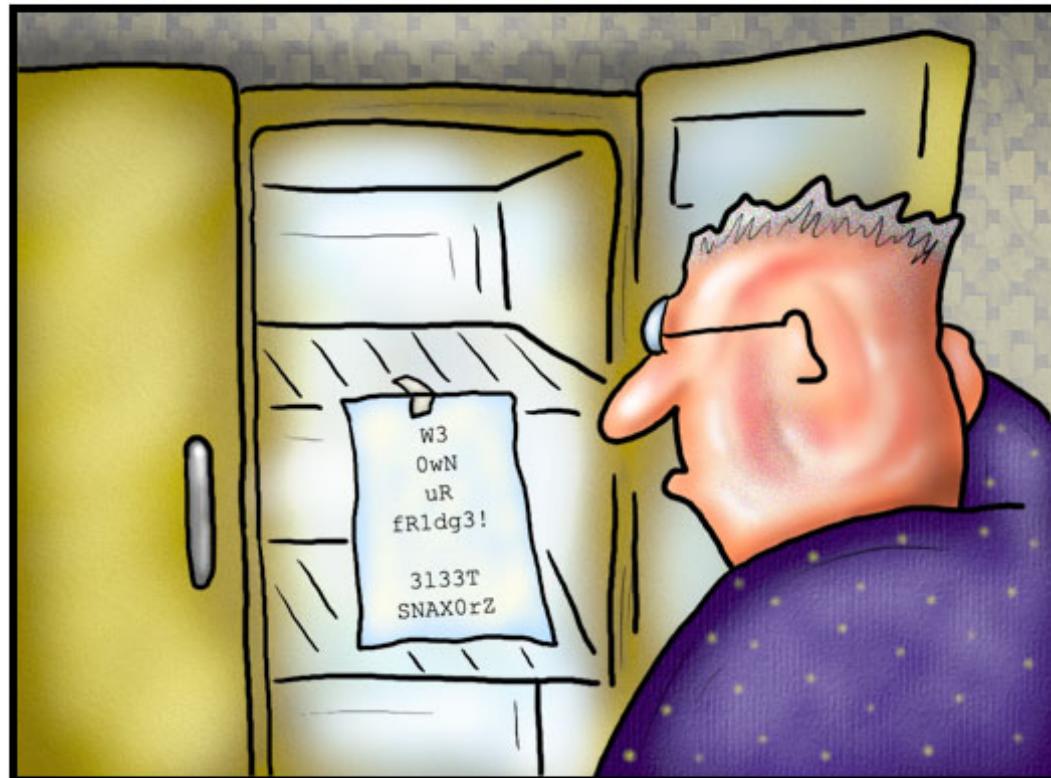
Your /48 can be used for:

- 65536 subnets
- Each subnet has  $2^{64}$  addresses

What can we use IPv6 for?

## DOCTOR FUN

4 June 2003



Copyright © 2003 David Farley, d-farley@ibiblio.org  
<http://ibiblio.org/Dave/drfun.html>  
This cartoon is made available on the Internet for personal viewing only. Opinions expressed herein are solely those of the author.

The brave new world of IPv6

Source: Dr Fun 2003/06/04 The brave new world of IPv6

You have a gazillion IPs what now?

Be creative. No limits!

|  
About 4 billion mobiles and 1 billion PCs

source Vincent Cert <http://www.youtube.com/watch?v=t9M0RPNr9qg>

Putting your fridge on the internet, need more milk!

Report back to manufacturer, each different part has address, easier

Ping light2324.kitchen - still working?

## Internet sharing and always on



Internet tethering to your friends, at home, at the bus, train  
Each will get their own address - enables direct two-way communication  
Mobile IPv6 - better than IPv4 and will be useful

## Sensors

Does your lawn need water and where?

Throw a bucket of sensor and let them figure it out

## Pressure sensors

Measure the load on ships, containers, people, real life traffic

## Tracking devices

Busses, taxis, deliveries

## Snow on a mountain

Spread sensors across a mountain and mesh network them, no problem

## Ad-Hoc networks

6LoWPAN IPv6 over Low power Wireless Personal Area Networks

## Intelligent Clothing - Wearable Electronics, Smart Clothes

# Sample idea, Biodevices Vital Jacket



Biodevices brings us the Vital Jacket. This garment is used to monitor ECG waves and Heart rate levels. This can be used for sports, fitness, and medical purposes.

<http://www.crunchwear.com/biodevices-vital-jacket/>

## Building automation

- To reduce energy consumption by at least 25%.
- To ease the deployment and integration of building automation systems.
- To manage access control and to improve security.
- To provide innovative tools for meeting and conference rooms.
- To develop innovative interfaces within the building (virtual assistant, etc.).
- To enable individual environment customization by the users (temperature, light, music, etc.).
- and more

<http://www.smartipv6building.org/>

Who would have guessed the applications?

World Wide Web

World Wide chatting - MSN, IRC, Jabber etc.

Distribution of software - peer to peer

Facebook

Twittter

Foursquare

Whats next?

Smart internet devices + GPS + video + users = fun and business!

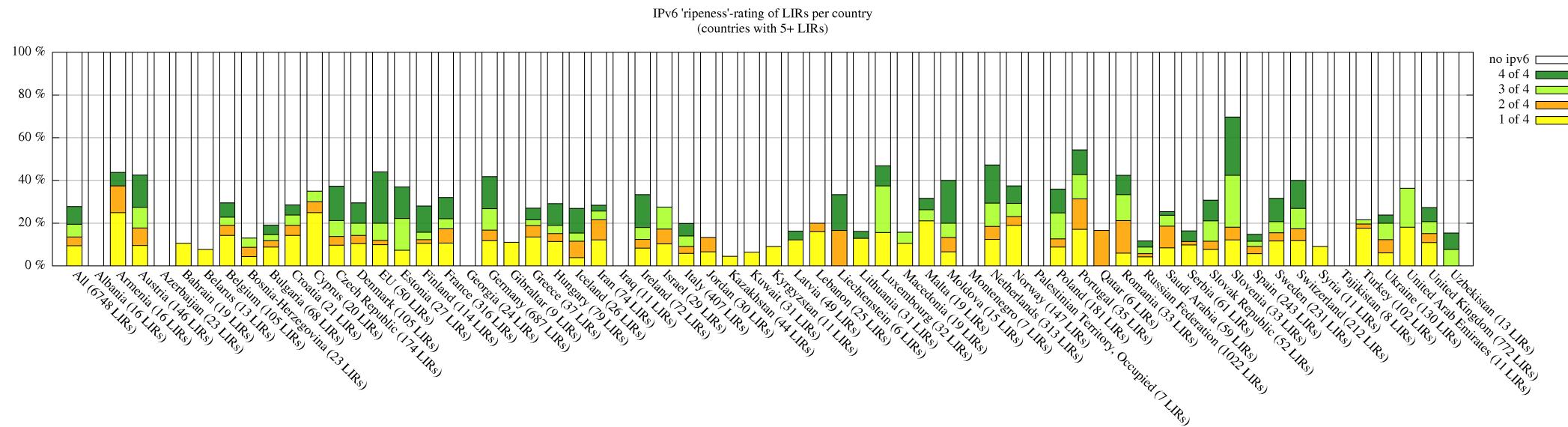
Sometimes named the Internet of Things

- An almost unlimited scalability with a very large IPv6 address space ( $2^{128}$  addresses), enabling IP addresses to each and every device.
- Address self-configuration mechanisms, easing the deployment.
- Improved security and authentication features, such as mandatory IPSec capacities and the possibility to use of the address space to include encryption keys.
- Peer-to-peer connectivity, solving the NAT barrier with specific and permanent IP addresses for any device and/or user of the Internet.
- Mobility features, enabling a seamless connexion when moving from one access point to another access point on the Internet.
- Multi cast and any cast functionalities.
- IPv6 will provide an easier remote interaction with each and every device with a **direct integration to the Internet**. In other words, IPv6 will make possible to move from a network of servers, to a network of things.

## Business case for IPv6 is **continuity**

Partial quote from <http://www.smartipv6building.org/index.php/en/ipv6-potential>

# IPv6 ripeness



IPv6 ripeness from <http://labs.ripe.net/>

Too little interest - less than 100 people thinking about IPv6?

Some providers have some IPv6 connectivity

NO ISPs have IPv6 to consumers

NO ISPs market IPv6 as a product, except me perhaps :-)

Perceived NO NEED

|

Free, a major French ISP rolled-out IPv6 at end of year 2007

XS4All As of August 2010 native IPv6 DSL connections became available to almost all their customers.

Source: [http://en.wikipedia.org/wiki/IPv6\\_deployment](http://en.wikipedia.org/wiki/IPv6_deployment)



## Danish IPv6 Task Force

Danish IPv6 task force - unofficial  
<http://www.ipv6tf.dk>

## IPv6 is here already - use it

<http://www.ipv6actnow.org/>

<http://digitaliser.dk/group/374895>

<http://www.ipv6tf.dk>

# Questions?



Henrik Lund Kramshøj  
hlk@solidonetworks.com

<http://www.solidonetworks.com>

You are always welcome to send me questions later via email

Welcome to VikingScan – miniscan

http://miniscan6.vikingscan.org/ Google

## VikingScan.org - free portscanning

Home Miniscan List

On this page you can configure and start a portscan of your IP-address from this server.  
Your IP-address is: 2001:16d8:dd0f:cf0f:223:6cff:fe9a:f52c

Configure and start a scan of the IP-address

Note that this service is currently software in development and you also need to make sure that you are allowed to scan the IP-address specified.

Do you need more? What about a basic webtest for DKK 8.000 ex VAT?

© 2009 VikingScan.org: Free portscanning  
<http://www.vikingscan.org>

WEB SCANNING WIRELESS SCANNING  
PENETRATION TESTING SECURITY TRAINING  
SECURE WEBSERVERS  
IMPLEMENTING IPV6  
FIREWALLS & VPN

Security is a process, not a tool, not a single portscan

  
Security .net

VikingScan.org is a service of Security6.net  
Security6.net provides this service for the community for free. If you need firewalls, penetration testing, security consulting please visit [Security6.net](http://www.security6.net).

- Stevens, Comer,
- Network Warrior
- TCP/IP bogen på dansk
- KAME bøgerne
- O'Reilly generelt IPv6 Essentials og IPv6 Network Administration
- O'Reilly cookbooks: Cisco, BIND og Apache HTTPD
- Cisco Press og website
- Firewall bøger, Radia Perlman: IPsec,

*IPv6 Network Administration* af David Malone og Niall Richard Murphy - god til real-life admins, typisk O'Reilly bog

*IPv6 Essentials* af Silvia Hagen, O'Reilly 2nd edition (May 17, 2006) god reference om emnet

*IPv6 Core Protocols Implementation* af Qing Li, Tatuya Jinmei og Keiichi Shima

*IPv6 Advanced Protocols Implementation* af Qing Li, Jinmei Tatuya og Keiichi Shima

- flere andre

# Contact information



- Henrik Lund Kramshøj, freelance IT-security consultant
- Email: [hlk@solidonetworks.com](mailto:hlk@solidonetworks.com)      Mobile: +45 2026 6000
- Educated from the Computer Science Department at the University of Copenhagen, DIKU
- CISSP and CEH certified
- 2003 - 2010 Independent security consultant
- 2010 - owner and partner in Solido Networks Aps