

Welcome to

IPv6 og netneutralitet

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Slides are available as PDF



Introduce IPv6 - facts and features

IPv6 addressing

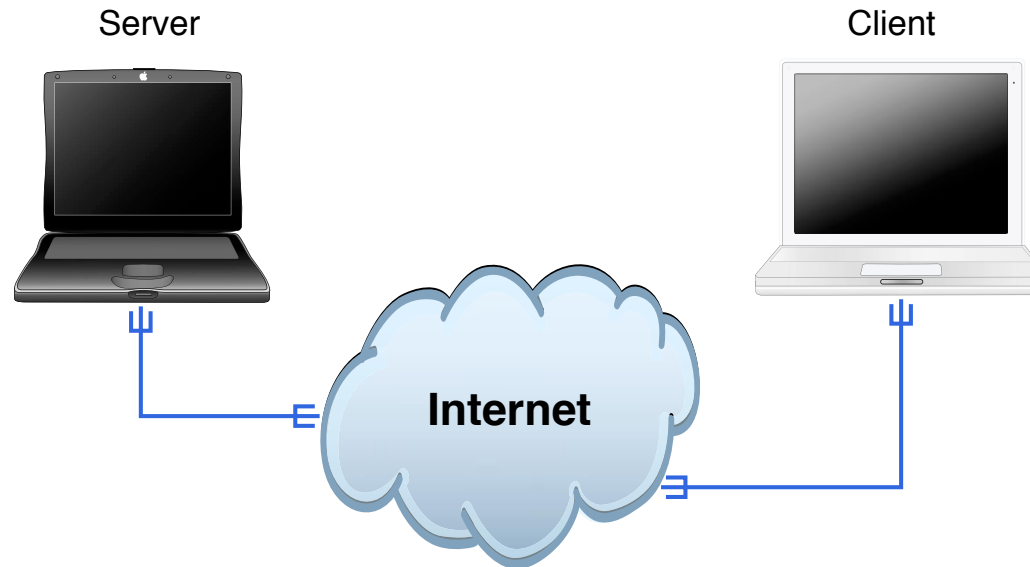
IPv4 vs IPv6 - Differences and similarities

Neighbor Discovery Protocol

Practical information about implementing IPv6 networks

Join a test network with your laptop

Network neutrality



Clients and servers

Rooted in academic networks

Protocols which are more than 20 years old, moved to TCP/IP in 1981

- 1961 L. Kleinrock, MIT packet-switching theory
- 1962 J. C. R. Licklider, MIT - notes
- 1964 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 IANA reserved blocks 7% (Maj 2010) - <http://www.potaroo.net/tools/ipv4/>

The Mobile Network in 2010 and 2011

Global mobile data traffic grew 2.6-fold in 2010, nearly tripling for the third year in a row. The 2010 mobile data traffic growth rate was higher than anticipated. Last year's forecast projected that the growth rate would be 149 percent. This year's estimate is that global mobile data traffic grew 159 percent in 2010.

...

Last year's mobile data traffic was three times the size of the entire global Internet in 2000. Global mobile data traffic in 2010 (237 petabytes per month) was over three times greater than the total global Internet traffic in 2000 (75 petabytes per month).

...

There will be 788 million mobile-only Internet users by 2015. The mobile-only Internet population will grow 56-fold from 14 million at the end of 2010 to 788 million by the end of 2015.

Kilde: *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010 - 2015*

OSI Reference
Model

Application
Presentation
Session
Transport
Network
Link
Physical

Internet protocol suite

Applications HTTP, SMTP, FTP, SNMP,	NFS
	XDR
	RPC
TCP UDP	
IPv4	IPv6 ICMPv6 ICMP
ARP RARP	
MAC	
Ethernet token-ring ATM ...	

IPv6: Internet redesigned? - no!

Preserve the good stuff

back to basics, internet as it used to be!

route 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!

Because all hosts can not be converted to TCP simultaneously, and some will implement only IP/TCP, it will be necessary to provide temporarily for communication between NCP-only hosts and TCP-only hosts. To do this certain hosts which implement both NCP and IP/TCP will be designated as relay hosts. These relay hosts will support Telnet, FTP, and Mail services on both NCP and TCP. These relay services will be provided beginning in November 1981, and will be fully in place in January 1982.

Initially there will be many NCP-only hosts and a few TCP-only hosts, and the load on the relay hosts will be relatively light. As time goes by, and the conversion progresses, there will be more TCP capable hosts, and fewer NCP-only hosts, plus new TCP-only hosts. But, presumably most hosts that are now NCP-only will implement IP/TCP in addition to their NCP and become "dual protocol" hosts. So, while the load on the relay hosts will rise, it will not be a substantial portion of the total traffic.

NCP/TCP Transition Plan November 1981 RFC-801

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Really how to use IPv6?

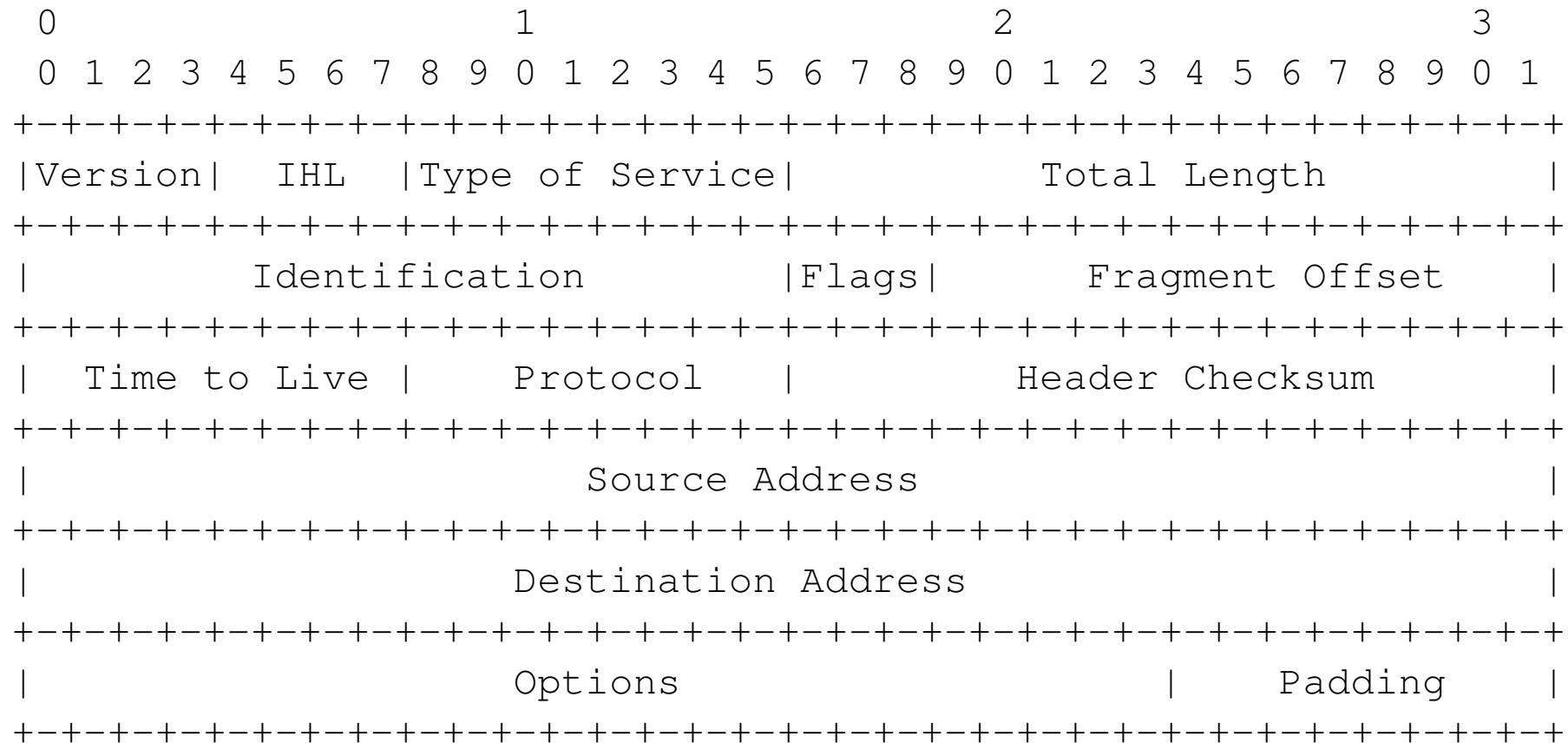
Get IPv6 address and routing

Add AAAA (quad A) records to your DNS

Done

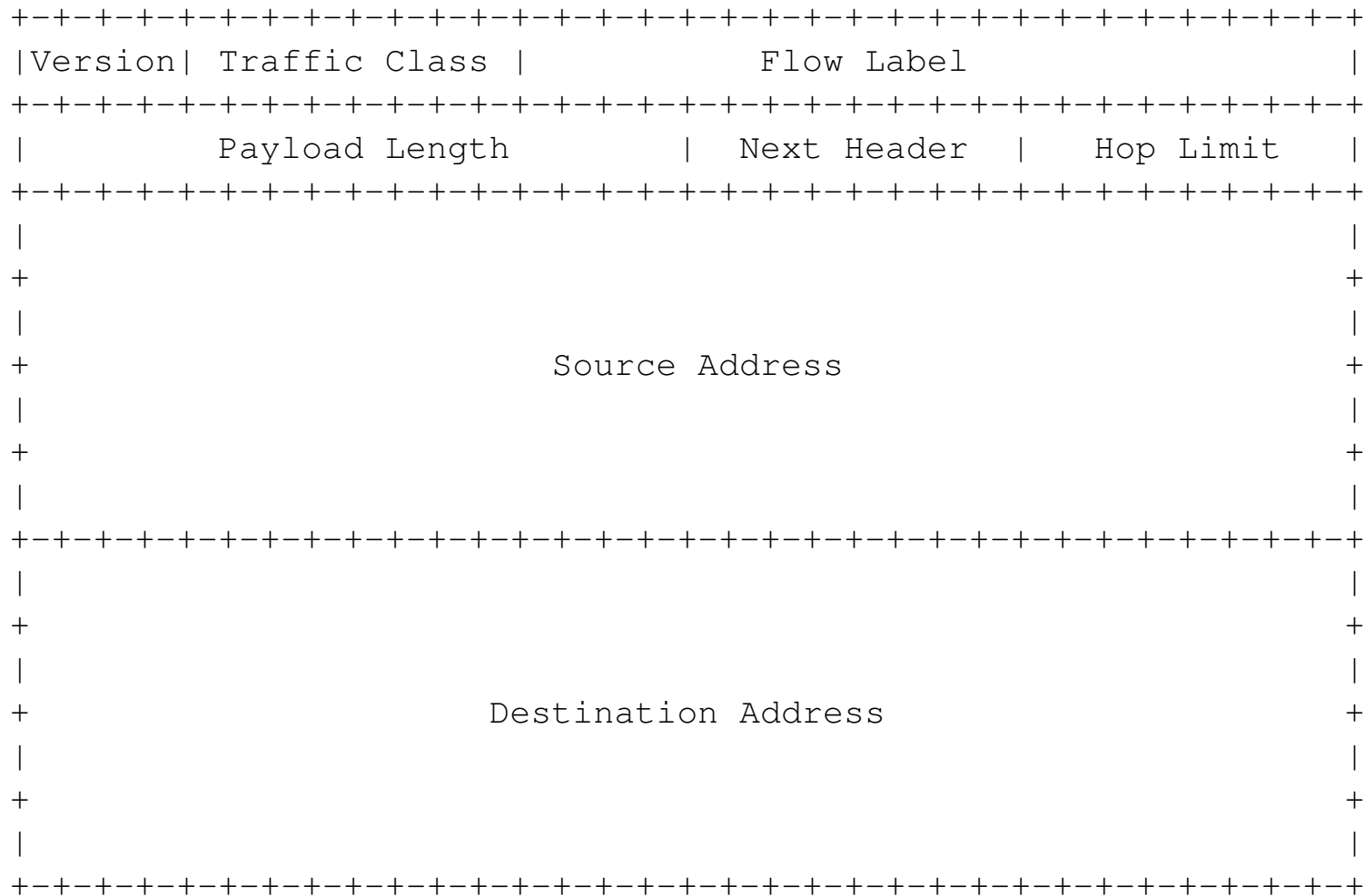
www.solidonetworks.com

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



Example Internet Datagram Header

IPv6 header - RFC-2460



IPv6 - extension headers RFC-2460

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

Note: IPsec (AH and ESP) are mandatory for IPv6 hosts

Path MTU, PMTU implemented larger default MTU, at least 1280 bytes

Fragmentation only at the source host, no router fragmentation

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 ::

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



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

- link-local unicast addresses
fe80::/10 generated from the interface MAC address EUI-64
- FEC0::/10 site-local - deprecated in RFC-3879
- 2001:0DB8::/32 NON-ROUTABLE range to be used for documentation purpose RFC-3849.
- FC00::/7 Unique Local IPv6 Unicast Addresses RFC-4193
<http://www.simplifiedns.com/private-ipv6.aspx>
If you do not like to put public addresses on internal network - use this instead

```
Command Prompt
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Henrik Kramshøj>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : kramse.dk
    IPv6 Address. . . . . : 2001:16d8:dd0f:cf0f:f049:94d0:75d8:683e
    Temporary IPv6 Address. . . . . : 2001:16d8:dd0f:cf0f:84bd:adea:fb61:8960
    Link-local IPv6 Address . . . . . : fe80::f049:94d0:75d8:683e%11
    IPv4 Address. . . . . : 10.0.42.107
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : fe80::200:24ff:fec8:b24c%11
                              10.0.42.1

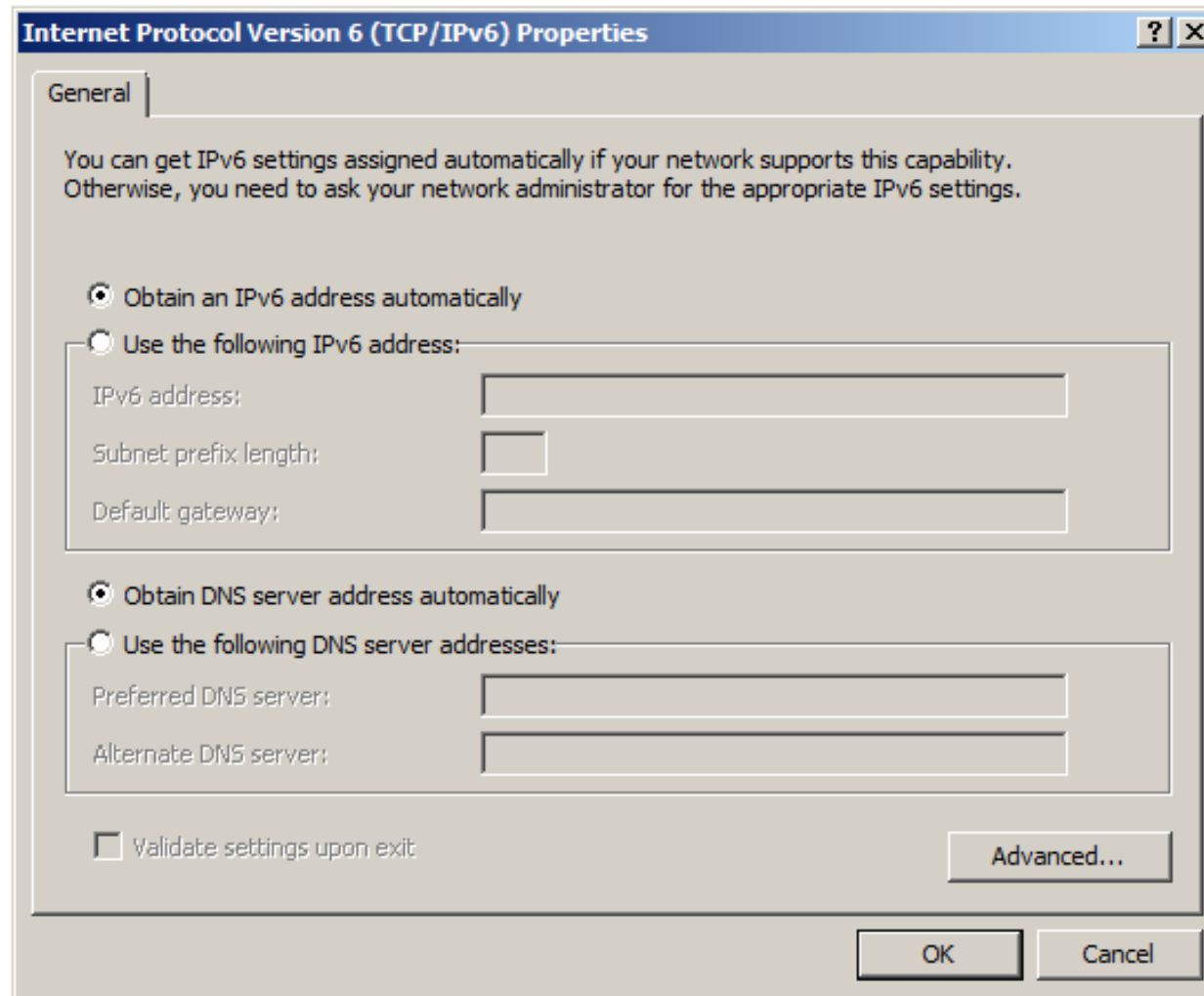
Tunnel adapter isatap.kramse.dk:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : kramse.dk

Tunnel adapter Local Area Connection* 11:

    Connection-specific DNS Suffix  . : 
    IPv6 Address. . . . . : 2001:0:5ef5:73b8:1000:322b:f5ff:d594
    Link-local IPv6 Address . . . . . : fe80::1000:322b:f5ff:d594%13
    Default Gateway . . . . . : 

C:\Users\Henrik Kramshøj>
```



```
$ 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
```

```
$ ping6 2001:1448:81:beef:20a:95ff:fef5:34df
```

```
PING6(56=40+8+8 bytes) 2001:1448:81:beef::1 --> 2001:1448:81:beef:20a:95ff:fef5:34df
16 bytes from 2001:1448:81:beef:20a:95ff:fef5:34df, icmp_seq=0 hlim=64 time=10.639 ms
16 bytes from 2001:1448:81:beef:20a:95ff:fef5:34df, icmp_seq=1 hlim=64 time=1.615 ms
16 bytes from 2001:1448:81:beef:20a:95ff:fef5:34df, icmp_seq=2 hlim=64 time=2.074 ms
^C
```

```
--- 2001:1448:81:beef:20a:95ff:fef5:34df ping6 statistics ---
```

```
3 packets transmitted, 3 packets received, 0% packet loss
```

```
round-trip min/avg/max = 1.615/4.776/10.639 ms
```

```
$ ping6 www.kame.net
```

```
PING6(56=40+8+8 bytes) 2001:16d8:dd00:75::2 --> 2001:200:dff:fff1:216:3eff:feb1:44d7
16 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7, icmp_seq=0 hlim=50 time=340.213 ms
16 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7, icmp_seq=1 hlim=50 time=371.965 ms
16 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7, icmp_seq=2 hlim=50 time=393.242 ms
16 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7, icmp_seq=3 hlim=50 time=418.496 ms
^C
```

```
--- orange.kame.net ping6 statistics ---
```

```
4 packets transmitted, 4 packets received, 0.0% packet loss
```

```
round-trip min/avg/max/std-dev = 340.213/380.979/418.496/28.727 ms
```

Nping testing IPv6 TCP connections

```
$ nping -6 www.solidonetworks.com
```

```
Starting Nping 0.5.35DC1 ( http://nmap.org/nping ) at 2011-04-06 06:25 CEST
SENT (0.0000s) Starting TCP Handshake > 2a02:9d0:10::9:80
RECV (0.7110s) Handshake with 2a02:9d0:10::9:80 completed
SENT (1.0010s) Starting TCP Handshake > 2a02:9d0:10::9:80
RECV (1.0960s) Handshake with 2a02:9d0:10::9:80 completed
SENT (2.0030s) Starting TCP Handshake > 2a02:9d0:10::9:80
RECV (2.0860s) Handshake with 2a02:9d0:10::9:80 completed
SENT (3.0050s) Starting TCP Handshake > 2a02:9d0:10::9:80
RECV (3.0940s) Handshake with 2a02:9d0:10::9:80 completed
SENT (4.0060s) Starting TCP Handshake > 2a02:9d0:10::9:80
RECV (4.1240s) Handshake with 2a02:9d0:10::9:80 completed
```

```
Max rtt: 711.307ms | Min rtt: 82.840ms | Avg rtt: 219.132ms
TCP connection attempts: 5 | Successful connections: 5 | Failed: 0 (0.00%)
Tx time: 4.00702s | Tx bytes/s: 99.82 | Tx pkts/s: 1.25
Rx time: 4.12474s | Rx bytes/s: 48.49 | Rx pkts/s: 1.21
Nping done: 1 IP address pinged in 4.12 seconds
```

```
$ ping6 -w -l en1 ff02::1
```

```
PING6 (72=40+8+24 bytes) fe80::223:6cff:fe9a:f52c%en1 --> ff02::1
30 bytes from fe80::223:6cff:fe9a:f52c%en1: bigfoot
36 bytes from fe80::216:cbff:feac:1d9f%en1: mike.kramse.dk.
38 bytes from fe80::200:aaff:feab:9f06%en1: xrx0000aaab9f06
34 bytes from fe80::20d:93ff:fe4d:55fe%en1: harry.local
36 bytes from fe80::200:24ff:fec8:b24c%en1: kris.kramse.dk.
31 bytes from fe80::21b:63ff:fef5:38df%en1: airport5
32 bytes from fe80::216:cbff:fec4:403a%en1: main-base
44 bytes from fe80::217:f2ff:fee4:2156%en1: Base Station Koekken
35 bytes from fe80::21e:c2ff:feac:cd17%en1: arnold.local
```

Only Two places need updating the file `/etc/sysconfig/network`:

```
NETWORKING=yes  
NETWORKING_IPV6=yes  
HOSTNAME=host1.armadahosting.com  
GATEWAY=10.234.123.254
```

From the file: `/etc/sysconfig/network-scripts/ifcfg-eth0`:

```
DEVICE=eth0  
BOOTPROTO=none  
ONBOOT=yes  
BROADCAST=10.234.123.255  
NETWORK=10.234.123.0  
NETMASK=255.255.255.0  
IPADDR=10.234.123.90  
USERCTL=no  
IPV6INIT=yes  
IPV6ADDR=2a02:9d0:10::10:234:123:90  
IPV6_DEFAULTGW=2a02:9d0:10::1
```

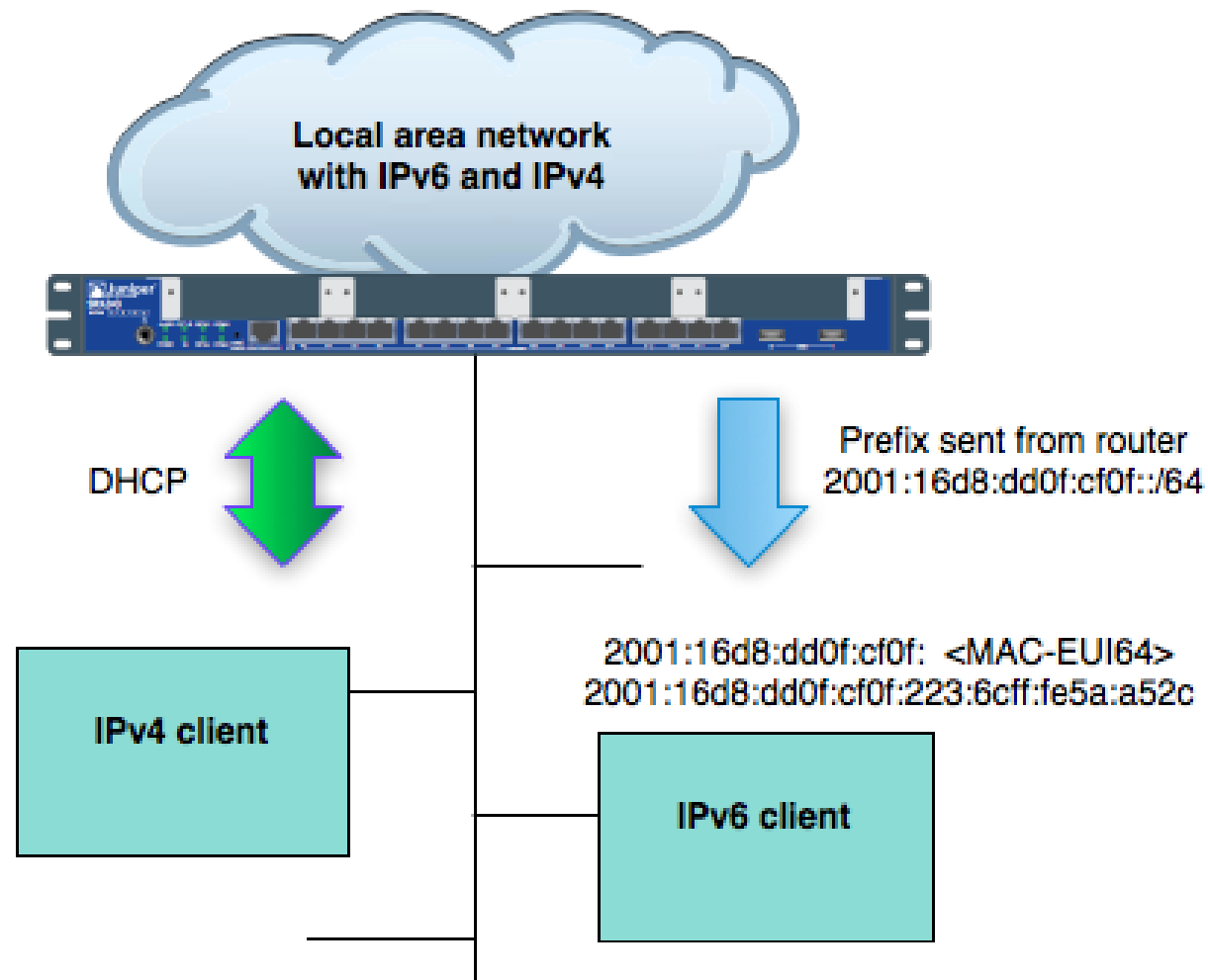

Modified EUI-64 format-based interface identifiers

```
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



IPv6 is default for a lot of services

```
root# telnet localhost 80
```

```
Trying ::1...
```

```
Connected to localhost.
```

```
Escape character is '^]'.
```

```
GET / HTTP/1.0
```

```
HTTP/1.1 200 OK
```

```
Date: Thu, 19 Feb 2004 09:22:34 GMT
```

```
Server: Apache/2.0.43 (Unix)
```

```
Content-Location: index.html.en
```

```
Vary: negotiate,accept-language,accept-charset
```

```
...
```

It is recommended that applications try IPv6 first, if AAAA address available

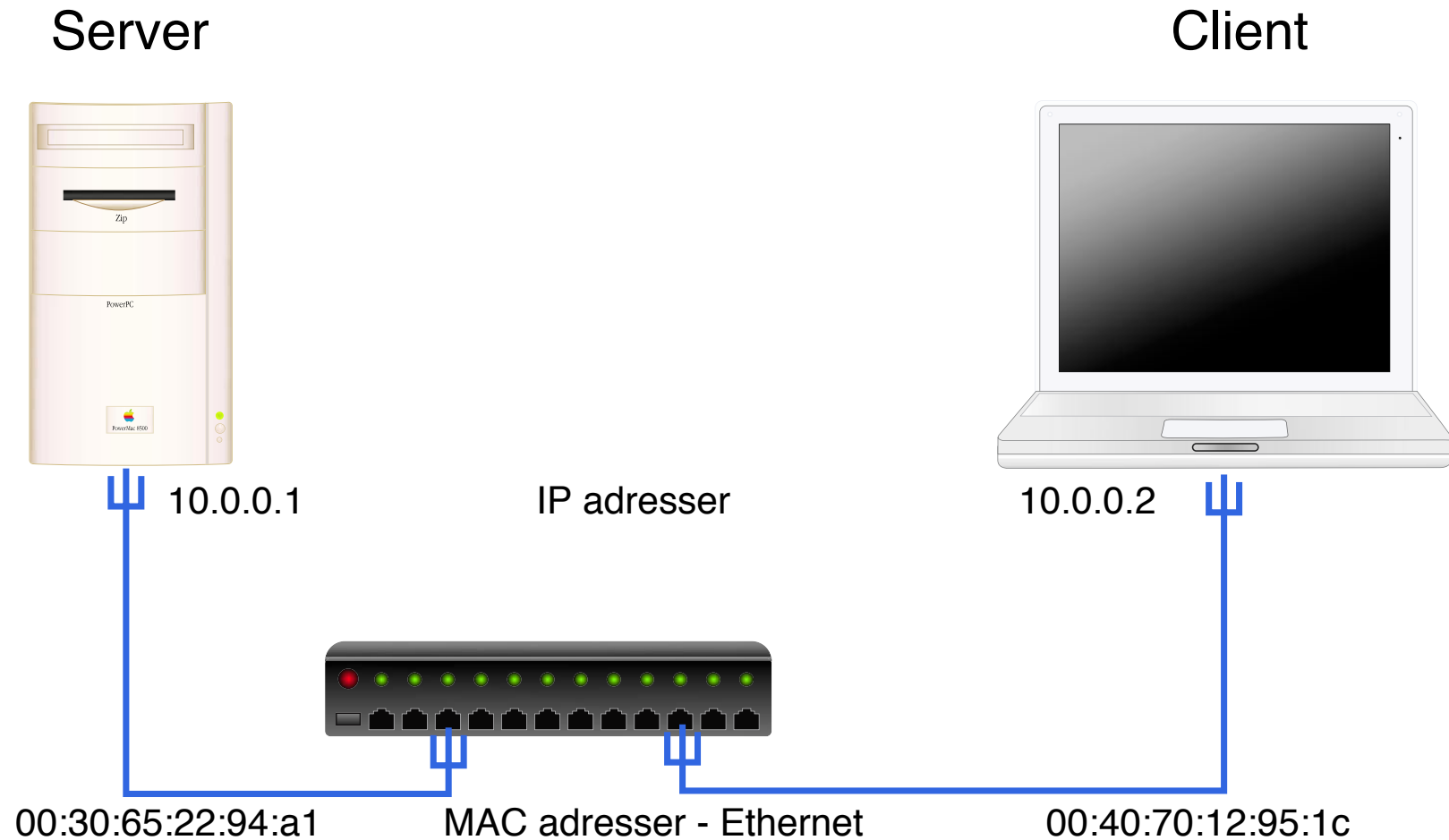
```
Listen 0.0.0.0:80
Listen [::]:80
...
Allow from 127.0.0.1
Allow from 2001:1448:81:0f:2d:9ff:f86:3f
Allow from 217.157.20.133
```

IPv6 goes into the same places as IPv4

IPv4 and port numbers are fine

IPv6 and port numbers - use [address]:port

Example from Apache HTTPD web server <http://httpd.apache.org>



ping 10.0.0.2 from server

ARP Address Resolution Protocol request/reply:

- ARP request broadcasted on layer 2 - Who has 10.0.0.2 Tell 10.0.0.1
- ARP reply (from 10.0.0.2) 10.0.0.2 is at 00:40:70:12:95:1c

IP ICMP request/reply:

- Echo (ping) request from 10.0.0.1 to 10.0.0.2
- Echo (ping) reply from 10.0.0.2 to 10.0.0.1
- ...

ARP is performed on Ethernet before IP can be transmitted

IPv6 neighbor discovery protocol (NDP)

OSI	IPv4	IPv6
Network	IP / ICMP	IPv6 / ICMPv6
Link	ARP	
Physical	Physical	Physical

ARP er væk

NDP erstatter og udvider ARP, Sammenlign `arp -an` med `ndp -an`

Til dels erstatter ICMPv6 således DHCP i IPv6, DHCPv6 findes dog

NB: bemærk at dette har stor betydning for firewallregler!

RFC4861 Neighbor Discovery for IP version 6 (IPv6)

```
$ arp -an
```

```
? (10.0.42.1) at 0:0:24:c8:b2:4c on en1 [ethernet]  
? (10.0.42.2) at 0:c0:b7:6c:19:b on en1 [ethernet]
```

```
$ ndp -an
```

Neighbor	Linklayer Address	Netif	Expire	St	Flgs	Prbs
::1	(incomplete)	lo0	permanent	R		
2001:16d8:ffd2:cf0f:21c:b3ff:fec4:e1b6	0:1c:b3:c4:e1:b6	en1	permanent	R		
fe80::1%lo0	(incomplete)	lo0	permanent	R		
fe80::200:24ff:fec8:b24c%en1	0:0:24:c8:b2:4c	en1	8h54m51s	S	R	
fe80::21c:b3ff:fec4:e1b6%en1	0:1c:b3:c4:e1:b6	en1	permanent	R		

Autoconfiguration - what is the network prefix

Duplicate Address Detection - can I use this address

Neighbor Discovery - which neighbors exist

Link layer addresses - "ARP" for IPv6

Neighbor Unreachability Detection, or NUD) - neighbors still alive

IPv6 is already in your network - see next slide

Take control of IPv6, do not just block it ☺

Strategy and actions points

- Collect information about IPv6
- Collect information about your network
- Collect information about your hosts and services
- Ask your providers for IPv6 plans
- Experiment with IPv6 - today
- Implement small proof of concept, in production!
- Expand coverage



An important consideration is that IPv6 is quite likely to be already running on the enterprise network, whether that implementation was planned or not. Some important characteristics of IPv6 include:

- IPv6 has a mechanism to automatically assign addresses so that end systems can easily establish communications.
- IPv6 has several mechanisms available to ease the integration of the protocol into the network.
- Automatic tunneling mechanisms can take advantage of the underlying IPv4 network and connect it to the IPv6 Internet.

Kilde:

http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6553/white_paper_c11-629391.html



For an IPv4 enterprise network, the existence of an IPv6 overlay network has several of implications:

- The IPv4 firewalls can be bypassed by the IPv6 traffic, and leave the security door wide open.
- Intrusion detection mechanisms not expecting IPv6 traffic may be confused and allow intrusion
- In some cases (for example, with the IPv6 transition technology known as 6to4), an internal PC can communicate directly with another internal PC and evade all intrusion protection and detection systems (IPS/IDS). Botnet command and control channels are known to use these kind of tunnels.

Kilde:

http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6553/white_paper_c11-629391.html

Guidelines for the Secure Deployment of IPv6, SP800-119, NIST

<http://csrc.nist.gov/publications/nistpubs/800-119/sp800-119.pdf>

The Second Internet: Reinventing Computer Networks with IPv6, Lawrence E. Hughes,
October 2010,

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

IPv6 Network Administration af David Malone og Niall Richard Murphy

<http://www.ripe.net>

This presentation ☺

devices - what is a network device?

switches - Layer 2 does not matter much, management by RFC-1918 IPv4 is OK

routers - most important, connectivity MUST support IPv6. Check vendor home page - do NOT assume support is ready

Security devices: firewalls, IDS/IPS, VPN - critical and support in general poor. Some vendors such as Cisco ASA and Juniper SRX has good support

Remember to add IPv6 to list of requirements for new devices

servers and services, today everything is IPv4 - in Europe

clients - do you only support PCs running Windows? think again.
Smart phones and tablets are the future

Desktop and laptop operating systems:

clients Windows, Linux and Mac OS X HAS great IPv6 support
(Dont ask about Windows Xp and Vista, kill them on sight)

Mobile operating systems: support is rapidly increasing, iPhone/iPad - OK, Android 2.x
yes, we think so but double check ☺

Ask your providers for IPv6 plans

Hvad er dit spørgsmål

Hvornår forventer I at få IPv6? Pt. er hastigheden jo 0Kb/s med IPv6 hos jer ;-)

Dit telefonnummer hos 3 20266000

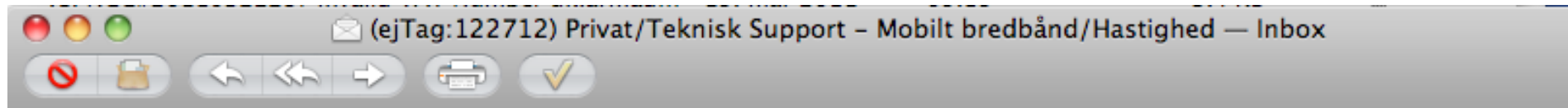
Dit navn Henrik Kramshøj

Kontaktnummer 20266000

E-mailadresse hlk@solido.net

Har du kontaktet 3s kundeservice om denne henvendelse tidligere?
Nej

Question sent to Danish Mobile operator 3.dk - a 3G company



From: kundeservice@3.dk
Subject: (ejTag:122712) Privat/Teknisk Support - Mobilt bredbånd/Hastighed
Date: 29. mar 2011 10.48.36 CEST
To: Henrik Kramshøj

Hej Henrik!

Tak for din mail!

Det er korrekt at IPv6 ikke er understøttet af vores netværk på nuværende tidspunkt - om gør det muligt at benytte IPv6 i fremtiden vides ikke.

Med venlig hilsen

Frederik

Teknisk Frontline
Consumer Management, 3

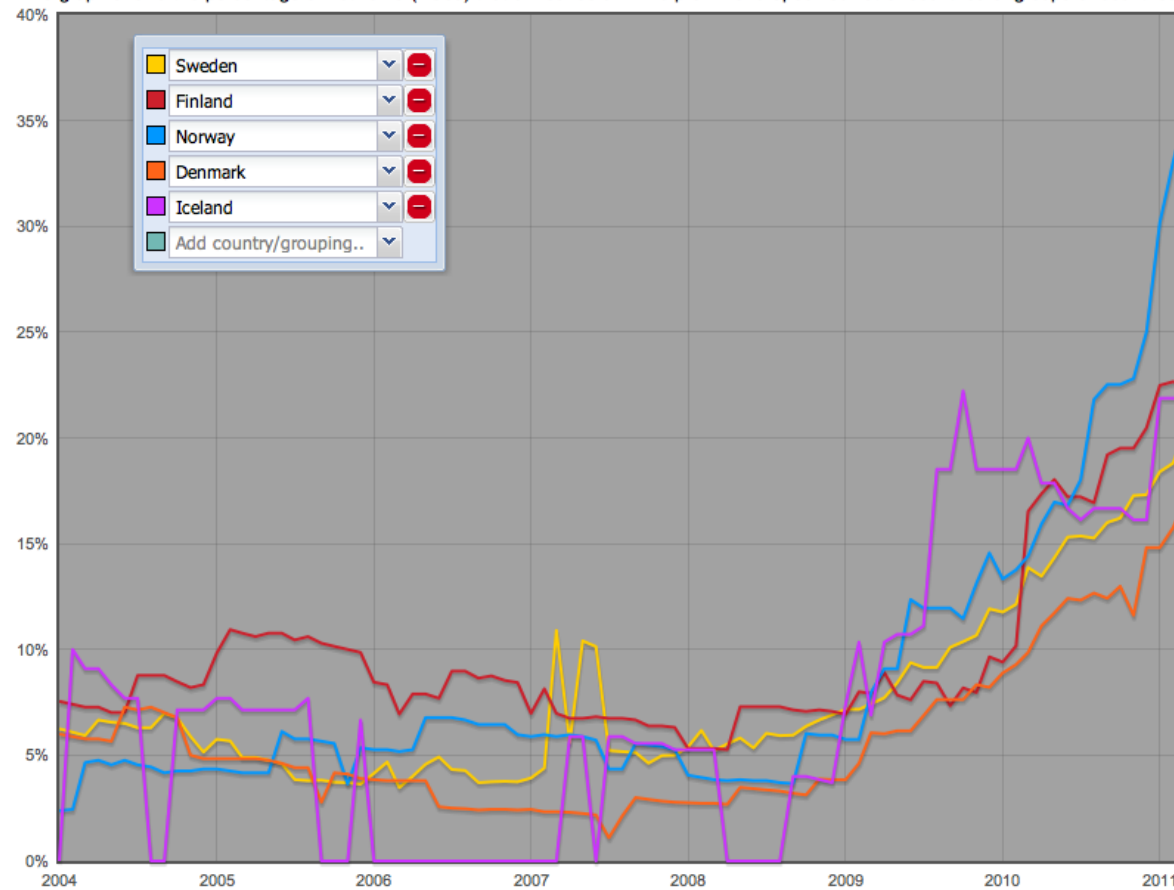
IPv6 in the Nordic region, and Iceland



IPv6 Enabled Networks

permalink: <http://v6asns.ripe.net/v/6?s=SE;s=FI;s=NO;s=DK;s=IS>

This graph shows the percentage of networks (ASes) that announce an IPv6 prefix for a specified list of countries or groups of countries



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 NEEED



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

Native IPv6 - available at some hosting providers in DK

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

Implement small proof of concept, in production!

You have plenty!

Providers and LIRs will typically get /32

Providers will typically give organisations /48 or /56

Your /48 can be used for:

- 65536 subnets - all host subnets are /64
- Each subnet has 2^{64} addresses

Preparing an IPv6 Addressing Plan Manual

December 2010: Original text

March 2011: Translation provided by RIPE NCC

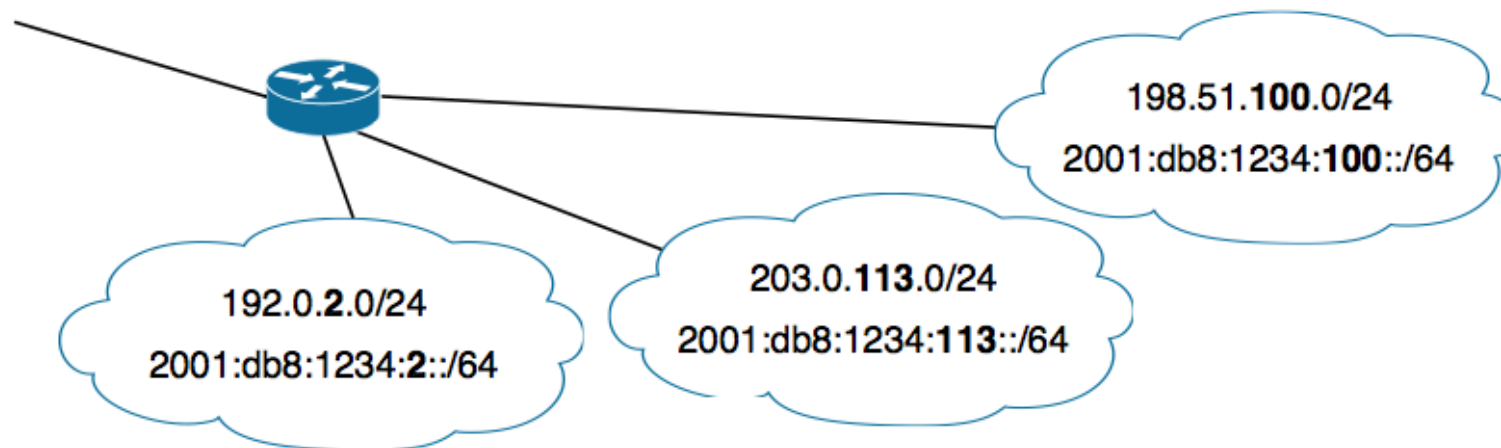


http://www.ripe.net/training/material/IPv6-for-LIRs-Training-Course/IPv6_addr_plan4.pdf

3.2 Direct Link Between IPv4 and IPv6 Addresses

If the existing IPv4 networks use only /24 subnets (for example, from 203.0.113.0 to 203.0.113.255), a direct link can be established between IPv4 addresses and the new IPv6 addresses. In this case, you can include the penultimate number of the IPv4 address (113 in 203.0.113.0/24, for example) in the IPv6 subnet. The IPv6 address will then be 2001:db8:1234:113::/64.

Such an IPv4-to-IPv6 transition could appear as follows:



Easy and coupled with VLAN IDs it will work 😊

Make sure you establish IPv6 in **production**

Enabling service on IPv6 without production - bad experience for users

Start by enabling your DNS servers for IPv6 - and DNSSEC - and DNS over TCP
Remember that your firewall might have problems with large DNS packets

Add a production IPv6 router - hardware device or generic server

Tunnels are OK, and SixXS consider their service production

About World IPv6 Day

On 8 June, 2011, Google, Facebook, Yahoo!, Akamai and Limelight Networks will be amongst some of the major organisations that will offer their content over IPv6 for a 24-hour "test flight". The goal of the Test Flight Day is to motivate organizations across the industry - Internet service providers, hardware makers, operating system vendors and web companies - to prepare their services for IPv6 to ensure a successful transition as IPv4 addresses run out.

Please join us for this test drive and help accelerate the momentum of IPv6 deployment.

<http://isoc.org/wp/worldipv6day/> **and** <http://test-ipv6.com/>

- 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 is here already - use it

`http://www.ipv6actnow.org/`

`http://digitaliser.dk/group/374895`

`http://www.ipv6tf.dk`

Join the fun - join the wireless network

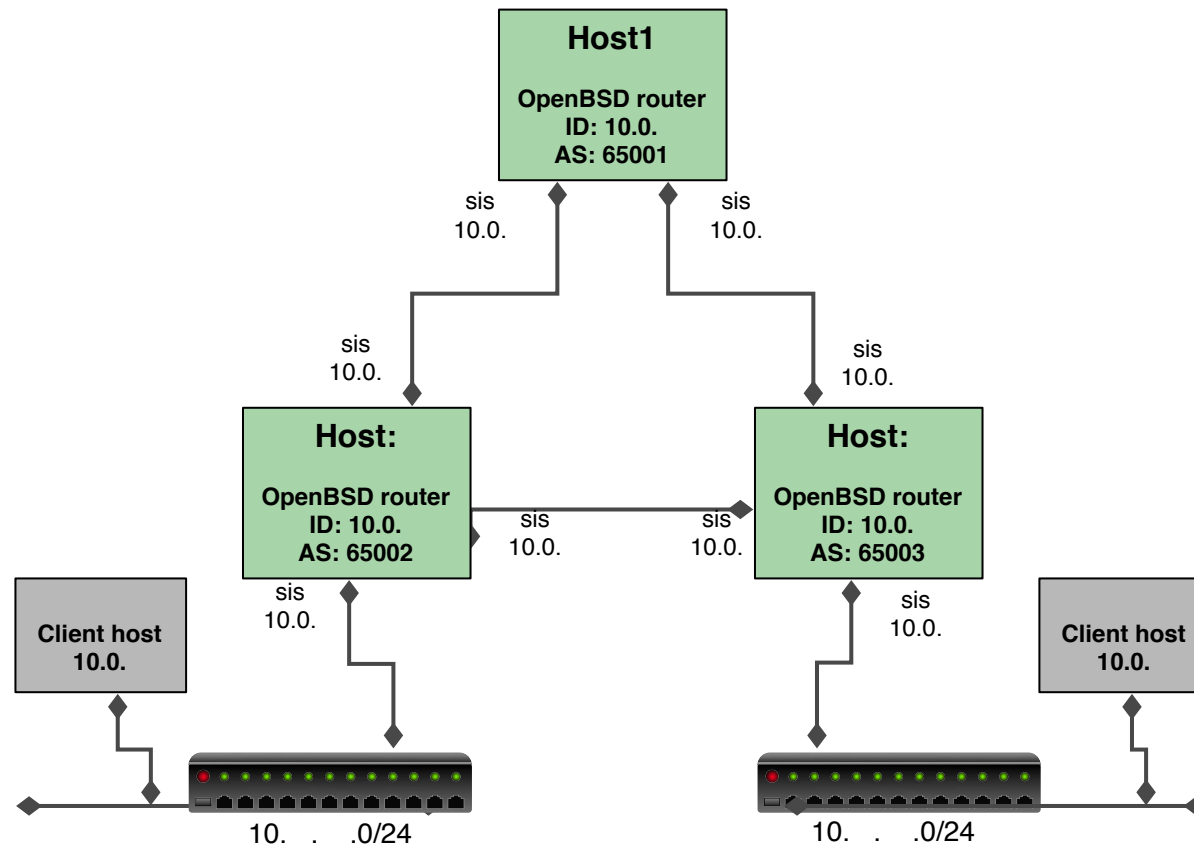
Use ping/ping6 and traceroute to test connectivity

Try in your browser:

- <http://www.kame.net> Dancing turtle
- <http://www.ripe.net> RIPE, look for address up right corner
- <http://loopsofzen.co.uk/> Play a game
- <https://www.sixxs.net/> Apply for IPv6 tunnel

Done 😊

OpenBGPD netværk



What is Border Gateway Protocol (BGP)

Online lookups in BGP

Hurricane Electric

<http://bgp.he.net>

RIPE Routing Information Service

<http://www.ripe.net>

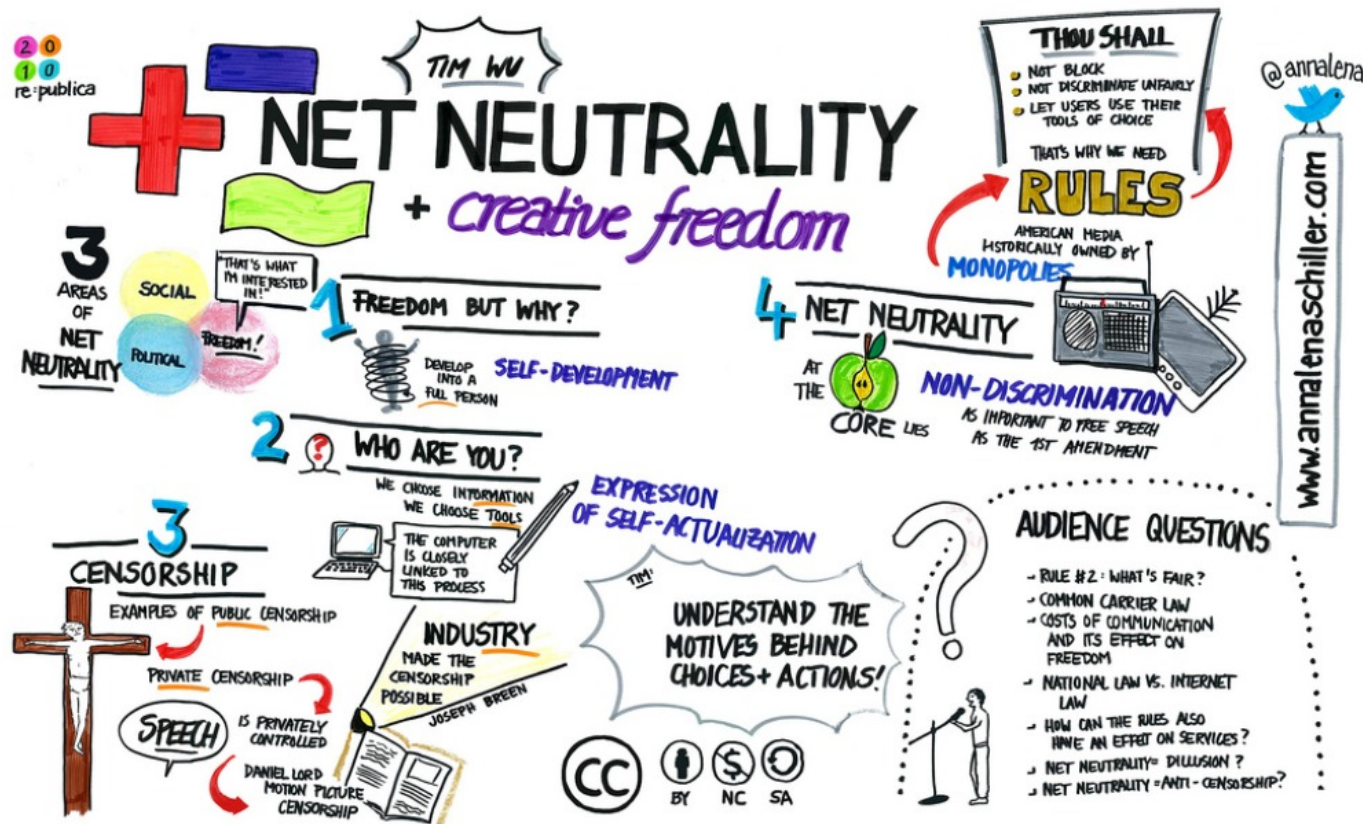
Wikipedia BGP and links

http://en.wikipedia.org/wiki/Border_Gateway_Protocol

<file:///userdata/projects/security-courses/presentations/network/ipv6-intro-neutrality/files/nanog49-cowie-hepner-final-14Jun.pdf>

See more Renesys presentations from

<http://www.renesys.com/tech/presentations/index.shtml>



Sources: http://en.wikipedia.org/wiki/Network_neutrality

http://en.wikipedia.org/wiki/Network_neutrality_in_the_United_States

Andre eksempler:

Cogent vs HE

Cogent vs Global Crossing, Hint: Cogent er pris presser!

Comcast vs Level3

Routing over andre lande med specielt lav moms/skat

Økonomi og politik mere end teknik

Det danske DNS filter

kontrol og anonymitet, IPv6 autoconfig, privacy issues

HTTPS vs HTTP, POP3 vs POP3S, IMAP vs IMAPS

DNSSEC vs DNS spoofing

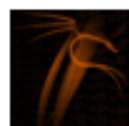
VPN forbindelser

```
file:///userdata/projects/security-courses/presentations/network/  
ipv6-intro-neutrality/files/nanog49-lightning-Iroot.pdf
```

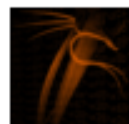
Henrik Lund Kramshøj
hlk@solidonetworks.com

`http://www.solidonetworks.com`

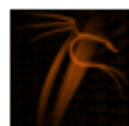
You are always welcome to send me questions later via email



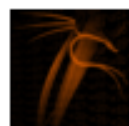
exploitdb [webapps] – BPAffiliate Affiliate Tracking
Authentication Bypass Vulnerability: <http://bit.ly/9LOC3K>
about 5 hours ago via twitterfeed



exploitdb [webapps] – BPDIRECTORY Business Directory
Authentication Bypass Vulnerability: <http://bit.ly/c4TeLz>
about 5 hours ago via twitterfeed



exploitdb [webapps] – BPCONFERENCEReporting Web Reporting
Authentication Bypass Vulnerability: <http://bit.ly/cM61AK>
about 5 hours ago via twitterfeed



exploitdb [webapps] – BPREALESTATE Real Estate
Authentication Bypass Vulnerability: <http://bit.ly/bYx2aY>
about 5 hours ago via twitterfeed



sans_isc [Diary] Mac OS X Server v10.6.5 (10H575) Security
Update: <http://support.apple.com/kb/HT4452>, (Tue, Nov
16th): <http://bit.ly/azBrso>
about 7 hours ago via twitterfeed

Twitter has become an important new resource for lots of stuff

Twitter has replaced RSS for me

Guidelines for the Secure Deployment of IPv6, SP800-119, NIST

<http://csrc.nist.gov/publications/nistpubs/800-119/sp800-119.pdf>

The Second Internet: Reinventing Computer Networks with IPv6, Lawrence E. Hughes, October 2010,

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

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

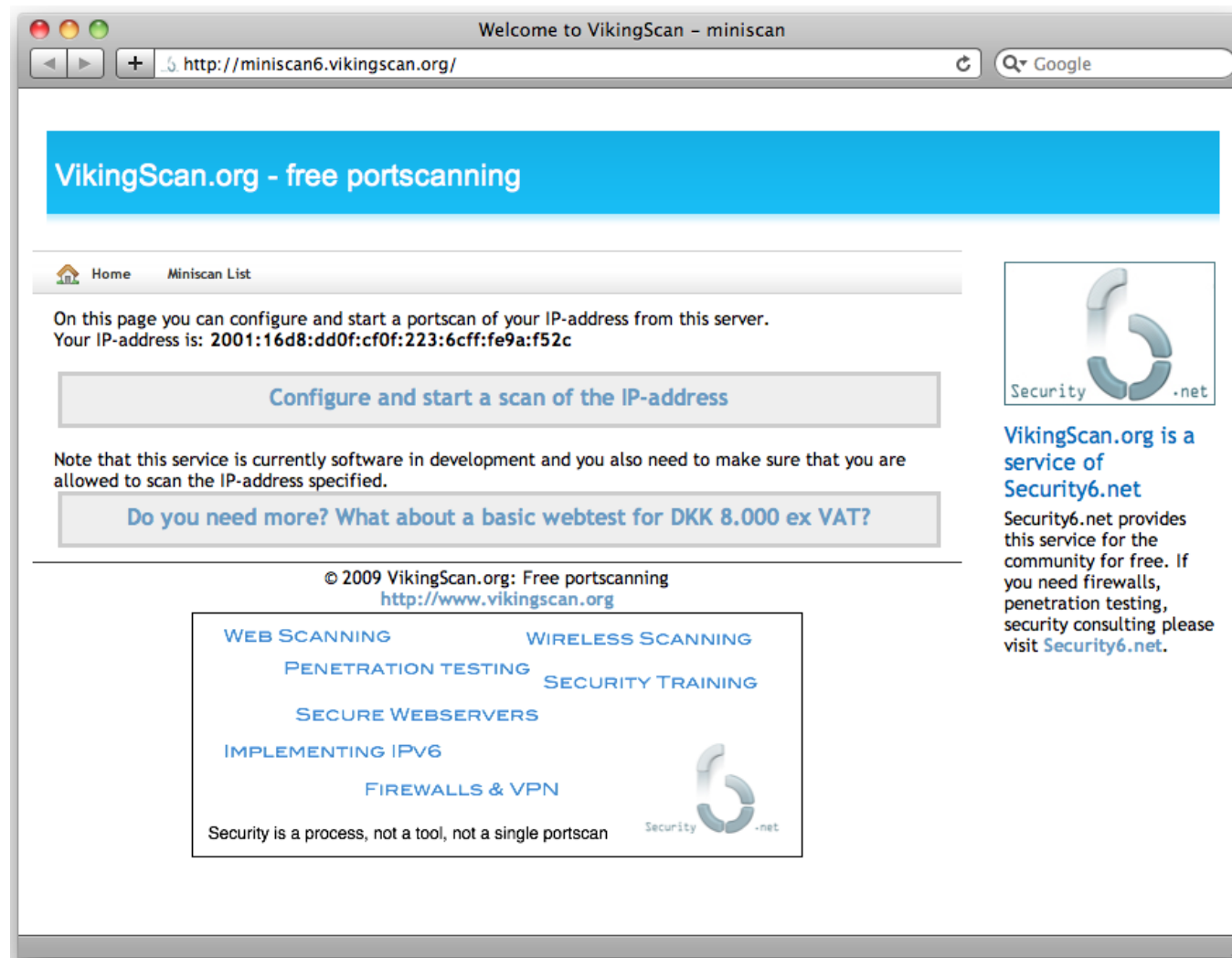
IPv6 Advanced Protocols Implementation af Qing Li, Jinmei Tatuya og Keiichi Shima

- flere andre



Danish IPv6 Task Force

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





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