

# Internetdagarna 2008: DNSSEC and IPv6 deployment workshop

20 October 2008

Norra Latin, Stockholm

## IPv6 - real life operations and experience with customers



Jeroen Massar, SixXS

[jeroen@unfix.org](mailto:jeroen@unfix.org) / [jeroen@sixxs.net](mailto:jeroen@sixxs.net)

**SixXS**



# SixXS

- **Service for providing ISPs with a quick way of enabling their user base with IPv6.**
- **Tunnel Broker PoPs in Belgium, Estonia, Finland, Germany, Ireland, Italy, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, Sweden, Switzerland, United Kingdom and the United States.**

**Thanks to all the ISPs who are providing these PoPs, as without them it would not be possible to do this!**

- **FAQ, Wiki and Forum.**
- **11.000++ *active* users and tunnels.**
- **4700++ *active* subnets (/48's).**

# Protocol 41

- **Protocol 41 = IPv6**
- **It specifies how to put an IPv6 packet inside IPv4.**
- **Protocol 41 is static only.**
- **Protocol 41 doesn't cross NATs.**

# Heartbeat

- **Dynamic/non-24/7 IPv4 endpoints.**
- **Proto-41 is static. The moment the user unplugs, another user can get that IPv4 address. That user then gets proto-41 packets and the firewall tool beeps with warnings, which sometimes results in abuse reports because we are attacking them.**
- **Allows one to move around proto-41 tunnels automatically or enable/disable them on the fly.**

# AYIYA – Anything in Anything

- **Proto-41 tunnels can't cross NATs.**
- **Proto-41 tunnels are not authenticated.**  
(read: one can spoof them easily)
- **Heartbeat runs next-to the proto-41 tunnel.**  
**Heartbeat might work, proto-41 might not.**

**AYIYA solves these issues by tunneling IPv6 inside IPv4/UDP and signing these packets.**

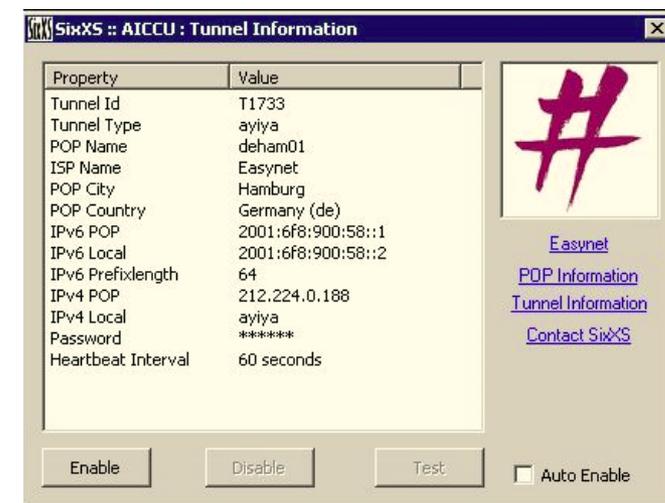
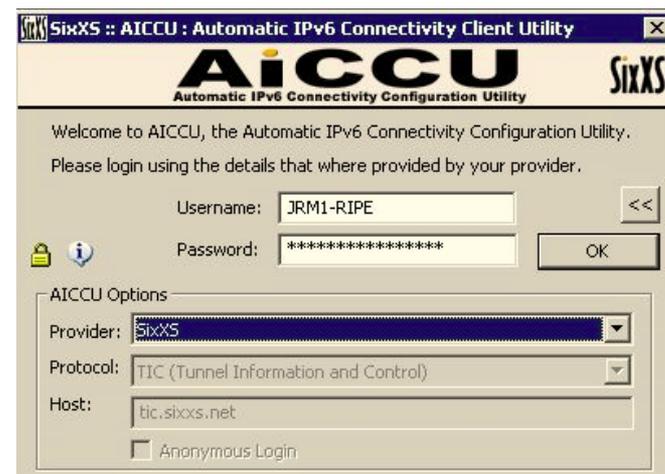
# AICCU

## Automatic IPv6 Connectivity Client Utility

- Proto-41, heartbeat and AYIYA tunnels.
- Windows GUI, Debian Debconf, CLI.
- Currently a small “Test” mode for diagnosing common issues, testing at least that the basics work.

## Soon:

- Public AYIYA/DNS support.
- Comprehensive “test” mode.
- GUI for all platforms.



# IPv6Gate

**Allows access to any IPv4 website over IPv6 from IPv6-only hosts.**

**<http://www.internetdagarna.se.sixxs.org>**

**Also allows the reverse: IPv6-only site from IPv4-only host:**

**<http://www.kame.net.ipv4.sixxs.org>**

# RFC4193 - ULA

## IPv6 ULA (Unique Local Address)

### RFC4193 Registration

- **fd00::/8 ULA Locally Assigned.**  
It is Unique, but maybe not Unique enough as it has a chance that it is not.
- **fc00::/8 ULA “Registered” – not specified and thus can’t be used.**
- **Nearly 200 registrations**
- **Of course not guaranteed, when people don’t check this list it can’t be.**

# GRH – Ghost Route Hunter

- **Peers actively with over 150 ISPs around the world.**
- **A tool for detecting and hunting down Ghost Routes in the IPv6 routing tables and displaying DFP availability.**
- **Distributed Looking Glass**
- **Missing Prefixes**
- **Prefix Comparison**

# GRH - Sweden

Sweden (.se) has:



- 52 IPv6 DFPs.
- 2 (3.85%) reclaimed (6BONE).
- 2 (3.85%) returned (6BONE).
- 26 (50.00%) unannounced.
- 22 (42.31%) announced.
- Contains I.root-server.net prefix
- First RIR prefixes allocated in 2000 to SWIPNET and SUNET.

<http://www.sixxs.net/tools/grh/dfp/all/?country=se>

LG Prefix	ld	NetName	Owner	AS	S	Allocated	First seen	Seen by	Last seen (*)
LG 2001:498::/32	SE-SWIPNET-20000828	TELE2-SWIPNET	TELE2 SWIPNET	A	2000-08-28			87%	2008-10-17 16:17:32
LG 2001:490::/32	SE-SUNET-20001218	SUNET	SUNET	A	2000-12-18			100%	2008-10-17 16:17:32
LG 2001:760::/32	SE-TELE2-20010321	TDC Song AB	TDC Song AB	A	2001-03-21			0%	never 2003-06-12 08:28:03
LG 2001:760::/32	SE-PERSPEKTIV-20060217	Perspektiv Broadband AB	Perspektiv Broadband AB	A	2006-02-17	2006-02-18 10:30:58		100%	2008-10-17 16:17:32
LG 2001:760::/48	SE-NETMODIX-20021108	Netnod Internet Exchange	Netnod Internet Exchange	A	2002-11-08			0%	never
LG 2001:760::/48	RIX-GH-20030314	Regional Internet Exchange	Regional Internet Exchange	A	2003-03-14			0%	never
LG 2001:760::/48	SOL-IX-IPv6-20030915	SOL-IX	SOL-IX	A	2003-09-15			0%	never
LG 2001:760::/48	RIX-UA-IPv6	RIX-UA	RIX-UA	A	2006-05-11			0%	never
LG 2001:760::/48	GIX-SE-20060523	Göteborgs Internet-excha	Göteborgs Internet-excha	A	2006-05-23			0%	never
LG 2001:760::/48	STHIX-IPv6-REERING-N	STHIX	STHIX	A	2007-07-25			0%	never
LG 2001:760::/48	JIXP-20080527	Jönköping IXP	Jönköping IXP	A	2008-05-27			0%	never
LG 2001:760::/32	I.root-server.net-200	Special net for DNS I.roo	Special net for DNS I.roo	A	2003-09-16	2003-09-17 02:51:14		100%	2008-10-17 16:17:32
LG 2001:948::/32	SE-NO-RDUNET-20021016	Nordultra	Nordultra	A	2002-10-16			100%	2008-10-17 16:17:32
LG 2001:900::/32	SE-BAHNSUP-20021031	Bahnhof	Bahnhof	A	2002-10-31			100%	2008-10-17 16:17:32
LG 2001:900::/32	SE-DCS-20021104	DCS	DCS	A	2002-11-04	2003-11-13 16:30:51		100%	2004-11-26 16:17:32
LG 2001:440::/32	SE-GAVLENET-20030225	GävleNet	GävleNet	A	2003-02-25	2007-10-26 10:02:31		100%	2008-10-17 16:17:32
LG 2001:680::/32	SE-BITNET-20030227	Bitnet	Bitnet	A	2003-02-27			0%	never
LG 2001:680::/32	SE-SANDNET-20030228	Sandnet	Sandnet	A	2003-02-28			0%	never
LG 2001:680::/32	SE-SEVENEELS-20030303	SevenEels	SevenEels	A	2003-03-03			0%	2007-08-02 09:32:23
LG 2001:680::/32	SE-LIDEN-20030506	Lidén Network AB	Lidén Network AB	A	2003-05-06	2003-04-21 22:02:17		100%	2008-10-17 16:17:32
LG 2001:1400::/32	SE-FMV-20030508	FMV	FMV	A	2003-05-08	2005-10-23 00:33:59		100%	2008-10-17 16:17:32
LG 2001:1980::/32	SE-DATAPHONE-20030511	Dataphone Sweden AB	Dataphone Sweden AB	A	2003-05-11			0%	never
LG 2001:1630::/32	SE-TEKNIKPARK-20031106	Teknikpark Söderhamn	Teknikpark Söderhamn	A	2003-11-06			0%	never
LG 2001:1660::/32	SE-LJUSNET-20031128	Ljusöla Enät AB	Ljusöla Enät AB	A	2003-11-28			0%	never
LG 2001:1608::/32	SE-PORT80-20040115	Port80 AB	Port80 AB	A	2004-01-15	2005-01-04 02:47:17		100%	2008-10-17 16:17:32
LG 2001:1670::/32	SE-ERICSSON-20040510	Ericsson	Ericsson	A	2004-05-10	2004-08-27 14:47:14		100%	2008-10-17 16:17:32
LG 2001:4040::/32	SE-STADSNAT-20040630	Värmdö Energy AB	Värmdö Energy AB	A	2004-06-30			0%	never
LG 2001:4008::/32	SE-NAO-20051108	Net at Once AB	Net at Once AB	A	2005-11-08	2005-12-19 02:17:22		100%	2008-10-17 16:17:32
LG 2000:800::/25	SE-SWIPNET-20080128	Tele2/SWIPnet	Tele2/SWIPnet	A	2008-01-28	2008-06-12 16:32:37		100%	2008-10-17 16:17:32
LG 2001:580::/32	SE-SUNET-20060301	Carelink AB	Carelink AB	A	2006-03-01			0%	never
LG 2001:680::/32	SE-SYSTEM-20060509	SYSTEM Net AB	SYSTEM Net AB	A	2006-05-09	2006-09-15 07:47:20		100%	2008-10-17 16:17:32
LG 2001:280::/32	SE-KTHNOC-20070103	Kungliga Tekniska Hogsko	Kungliga Tekniska Hogsko	A	2007-01-03	2007-02-09 15:32:23		0%	2008-05-08 12:47:29
LG 2001:2980::/32	SE-SPACECUMIP-20070113	Spacecum Networks	Spacecum Networks	A	2007-01-13	2007-08-24 16:02:47		100%	2008-10-17 16:17:32
LG 2001:200::/32	SE-IP-ONLY-20070216	IP-Only Tele Communicatio	IP-Only Tele Communicatio	A	2007-02-16			0%	never
LG 2001:3080::/32	SE-OWINIT-20070614	Owinit Broadband AB	Owinit Broadband AB	A	2007-06-14	2008-02-27 11:47:27		100%	2008-10-17 16:17:32
LG 2001:3000::/32	SE-NETMOD-20070709	NetMod	NetMod	A	2007-07-09	2008-02-15 13:32:31		100%	2008-10-17 16:17:32
LG 2001:6900::/32	SE-INTRON-20071129	BRS-Inttron AB	BRS-Inttron AB	A	2007-11-29	2007-12-11 22:17:31		100%	2008-10-17 16:17:32
LG 2001:600::/32	SE-ARSTB-20071212	Nocom Networks AB	Nocom Networks AB	A	2007-12-12			0%	never
LG 2002:300::/32	SE-NETT-20080213	Net IT Internet Solutions	Net IT Internet Solutions	A	2008-02-13			0%	never
LG 2002:800::/32	SE-TELSEK-20080222	Teleseks Broadband Svan	Teleseks Broadband Svan	A	2008-02-22	2008-06-20 00:02:34		89%	2008-10-17 16:17:32
LG 2002:160::/32	SE-TEKNIKMERLET-20080311	Teknikmerlet AB	Teknikmerlet AB	A	2008-03-11	2008-06-23 13:32:35		87%	2008-10-17 16:17:32
LG 2002:190::/32	SE-TERACOM-20080318	Teracom AB	Teracom AB	A	2008-03-18			0%	never
LG 2002:290::/32	SE-LOOPA-20080407	Loopa AB	Loopa AB	A	2008-04-07	2008-04-16 23:47:29		99%	2008-10-17 16:17:32
LG 2002:470::/32	SE-FD-20080604	Fiber Direkt i Sverige AB	Fiber Direkt i Sverige AB	A	2008-06-04			0%	never
LG 2002:5080::/32	SE-TYFON-20080623	Tyfon	Tyfon	A	2008-06-23			0%	never
LG 2002:490::/32	SE-Owiesaraboln-20080826	Owiesaraboln AB	Owiesaraboln AB	A	2008-08-26			0%	never
LG 2002:750::/32	SE-GLE-IFE-20080903	GleSYS Internet Services	GleSYS Internet Services	A	2008-09-03	2008-09-09 15:02:40		99%	2008-10-17 16:17:32
LG 2002:790::/32	SE-RIN-20080905	RIN Sweden AB	RIN Sweden AB	A	2008-09-05			0%	never
LG 2002:7080::/32	SE-ALLTELE-20080917	AllTele Allmanna Svenska	AllTele Allmanna Svenska	A	2008-09-17			0%	never
LG 396:200::/24	SIXS/SE	SixXS	SixXS	A	1997-08-14			0%	2006-06-06 16:17:21
LG 396:2700::/24	BRA/SE	Swedish Institute of Com	Swedish Institute of Com	A	1997-09-22	2003-06-13 10:55:25		0%	2003-06-13 10:55:25
LG 396:4008::/32	SEVL/SE	SEVL	SEVL	A	2002-05-03			0%	2005-06-20 21:03:58

The database currently holds 52 IPv6 DFPs:  
 Of which 2 (3.85%) are reclaimed, 2 (3.85%) are returned to the pool and 26 (50.00%) IPv6 DFPs didn't have a routing entry.  
 Thus 22 (42.31%) networks are currently correctly announced.  
 0 (0.00%) only announced, a /32 while they have been allocated, a /32.  
 0 (0.00%) announce both their /32 and their /32.



# Top 10 IPv6 Problems

**On special request....**

## **The top 10 IPv6 Problems**

**(actually just a grab out of a somewhat bottomless pit, and it really depends on what kind of problems one is looking at (user, administrator), thus a top 2000 would be more appropriate)**

# Top 10 IPv6 Problems ::0

## **ISP/upstream doesn't want/ do IPv6**

**Bug them a lot and hope you carry enough weight**

# Top 10 IPv6 Problems ::1

## No IPv6 hardware/software support

When you find a program which doesn't support IPv6, patch it, I do  
{check the about->license page of PuTTY and various others}

Read: "Porting applications to IPv6 by Eva M. Castro":

<http://gsync.escet.urjc.es/~eva/IPv6-web/ipv6.html>

# Top 10 IPv6 Problems ::2

## **Firewall blocks packets completely**

**Can happen on the local host**

**(some firewall product properly drop anything not IPv4 and not explicitly allowed)**

# Top 10 IPv6 Problems ::3

## IPv4 NAT

**Protocol-41 doesn't travel over NATs**

# Top 10 IPv6 Problems ::4

## 6to4

**Packets flow in two directions, but are also tunneled, thus issues can arise on the path from and to the hosts in IPv4 and IPv6, where both can be even made more difficult to diagnose due to routing issues On top of that the 6to4 IPv4 address is anycasted, which makes it even more fun to figure out where a problem might be.**

# Top 10 IPv6 Problems ::5

## **ICMP Packet Too Large Filtered by a Firewall**

**Causes your TCP connection to hang when the packet is too large, and thus gets dropped. Easy to recognize symptom though.**

# Top 10 IPv6 Problems ::6

## **IPv6 is slow!**

**DNS relay/server implementation in the NAT box drops AAAA requests**

# Top 10 IPv6 Problems ::7

## Longest Distance Routing

The winners for the first annual Longest Distance Routing contest are:

- **2001:256::/32 24541 30071 2018 6149 11537 10764 23911 4538 23910 18011** at 53512 km flowing through Australia, US, Africa, US, and China. Unfortunately, this one is not correct, TENET has a router in NY, and though their network is African these packets are not being shipped to Africa and back to the US again.
- **2001:200:a000::/35 26943 4436 3549 6939, 2516 7660, 22388 11537, 2500** at 45056 km  
**2001:200:a000::/35 19255, 26943, 4436 3549 6939, 2516 7660, 22388 11537, 2500** at 45056 km  
going through The Netherlands, US, Japan, US, and Japan.  
These two take the internal network of Your.org, so these two doesn't count either, although they are getting pretty long!
- But these though are most likely pretty accurate:  
**2001:200:a000::/35 25441, 3257, 3549, 6939, 2516 7660, 22388 11537, 2500** at 40760 km flowing through Ireland, Germany, Netherlands, US, Japan, US and Japan.  
**2001:200:a000::/35 1836, 3549, 6939, 2516 7660, 22388 11537, 2500** at 39500 km flowing through Switzerland, Netherlands, US, Japan, US, and Japan.

<http://www.sixxs.net/news/2007/#grhlongestdistancerouting-0401>

# Top 10 IPv6 Problems ::8

## Subnet anycast address

**<prefix>::/127**

**::0 = subnet anycast address**

**::1 the only IP left**

**This is why one should either use a /126 if one wants to be really minimalist in “wasting” address space, or just use a /64 like advised by the IETF.**

# Top 10 IPv6 Problems ::9

## **L2 Switch doesn't handle multicast properly**

**And even though you are trying only to do unicast IPv6, you need multicast IPv6 for Neighbor Discovery (ND) and Duplicate Address Detection (DAD), Router Advertisements (RA) etc, thus if multicast on L2 doesn't work, IPv6 won't easily work.**

**(generic solution btw is to set the interface to PROMISC mode)**

# Top 10 IPv6 Problems ::a

## 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

# Really Nasty IPv6 Problems

- **Multihoming for “small sites” / endusers**
- **Mobility**
- **Traffic Engineering**
- **Multicast**
- **...**

**But these problems make it fun to do networking, as where would be without a challenge?**

# Questions?

**Jeroen Massar**

JRM1-RIPE

<http://unfix.org/~jeroen/>

[jeroen@unfix.org](mailto:jeroen@unfix.org)

<http://www.sixxs.net/>

[jeroen@sixxs.net](mailto:jeroen@sixxs.net)