Recent advances in IPv6 insecurities

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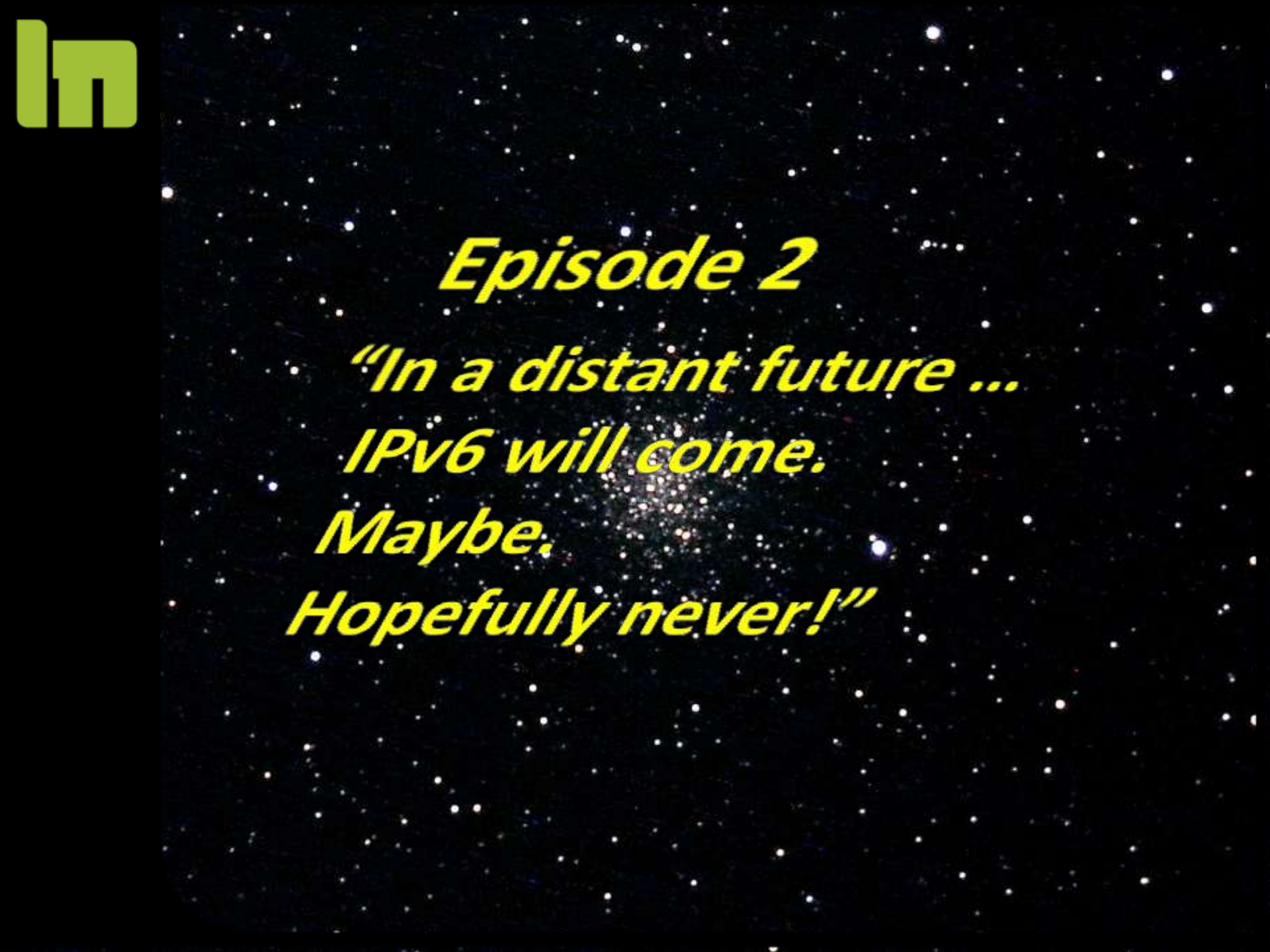
Hello, my name is


Episode 2
"In a distant future ...
IPv6 will come.
Maybe.
Hopefully never!"

The future is here already

Let’s start with the basics

IPv4

4 octets

4.294.967.296 addresses

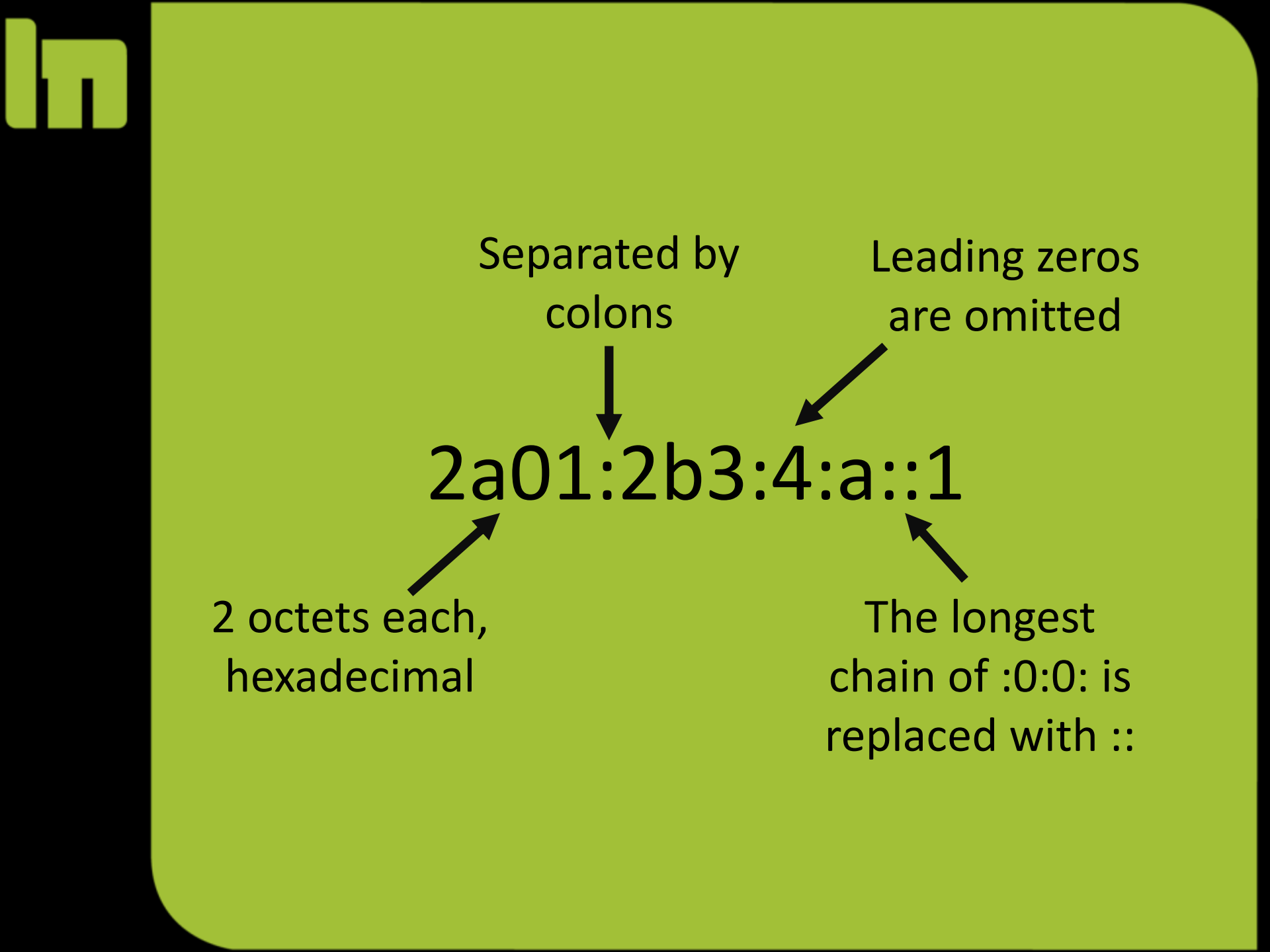
192.168.1.1

IPv6

16 octets

340.282.366.920.938.463.463.374
.607.431.768.211.456 addresses

2a01:2b3:4:a::1


Separated by colons
Leading zeros are omitted
2a01:2b3:4:a::1
2 octets each, hexadecimal
The longest chain of :0:0: is replaced with ::

Subnets are /64

4.294.967.296 x the size of the Internet!

No broadcasts

Multicasts, but they are local only

Features!

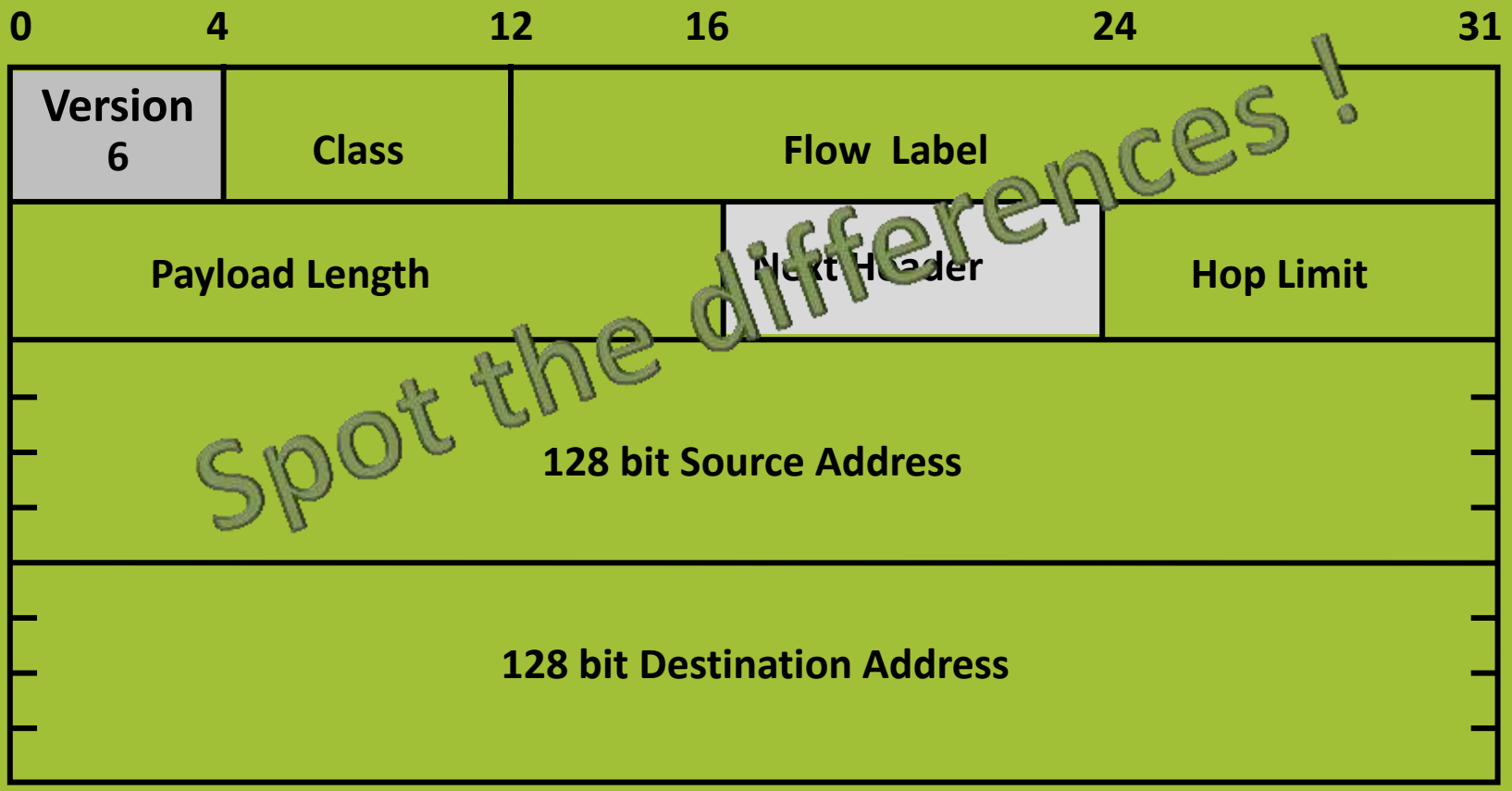
Autoconfiguration

IPSEC

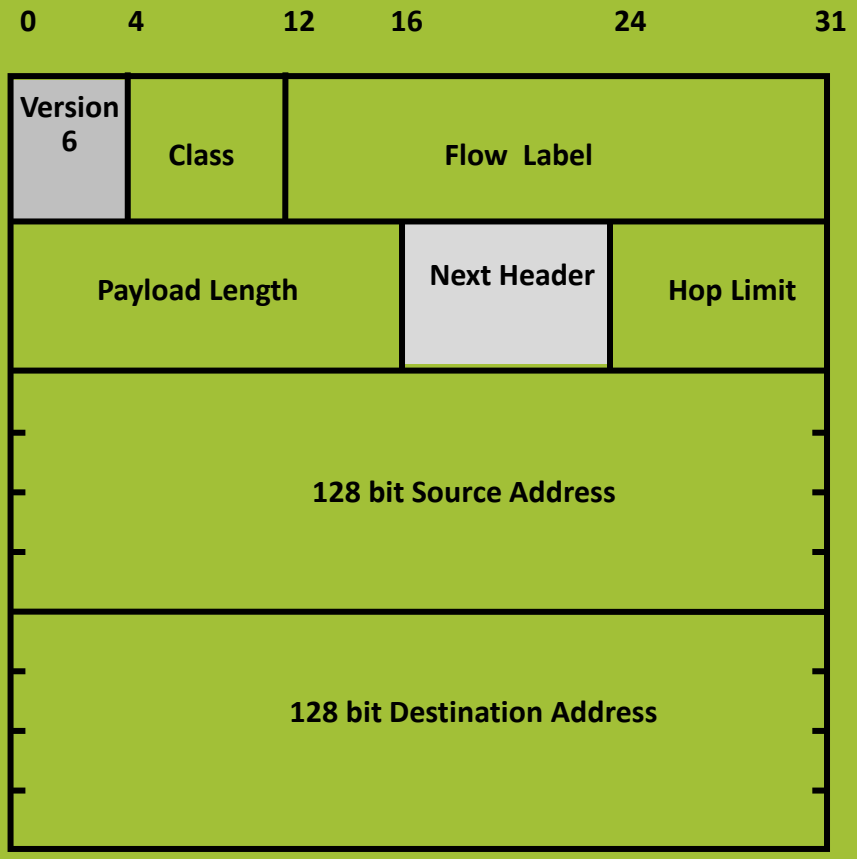
Mobility

Enough addresses!

IPv6 header layout



IPv6 header layout



- No header length
- No identification
- No checksum
- No fragmentation
- No options

Every option is an extension header

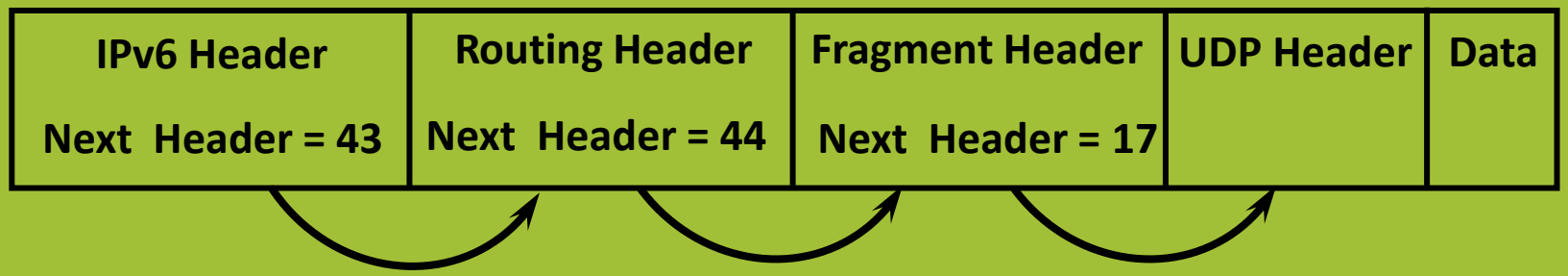
Fragmentation

Source routing

IPSEC

Destination Options

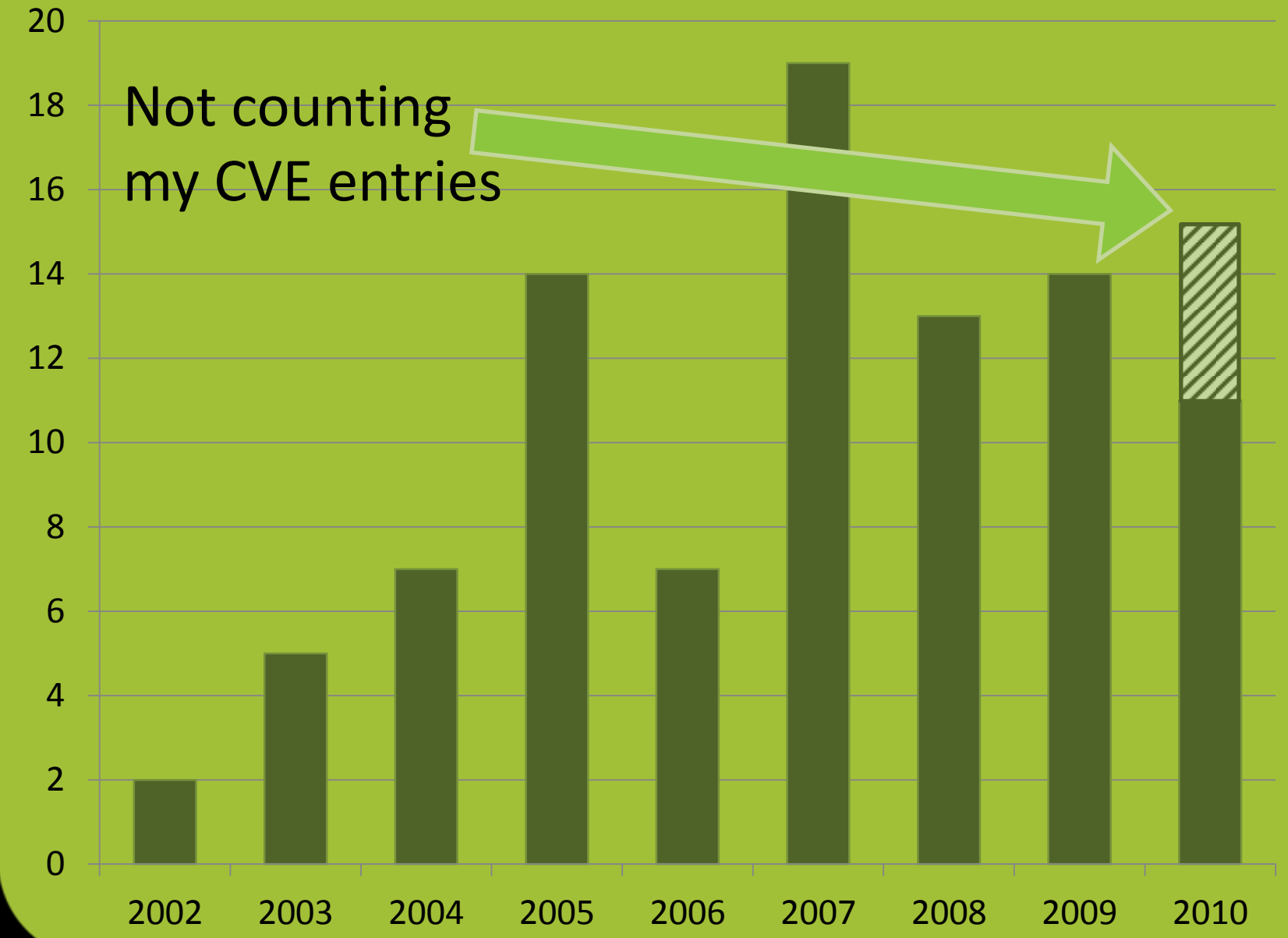
…


IPv6 Header
Next Header = 43
Routing Header
Next Header = 44
Fragment Header
Next Header = 17
UDP Header
Data

IPv6 is much simpler than IPv4

… in theory.

IPv6 Vulnerabilities (CVE)




Kids, in 2005 ...

The THC-IPv6 Attack Toolkit

ARP Spoofing => ND spoofing

1. NS:
   ICMP Type = 135
   Src = A
   Dst = All-Nodes Mulitcast
   Query= Who-has IP B?

parasite6:
Answers to every NS, claims to be every system on the LAN ☺

2. NA:
   ICMP Type = 136
   Src = B
   Dst = A
   Data= MAC

Duplicate Address Detection DOS

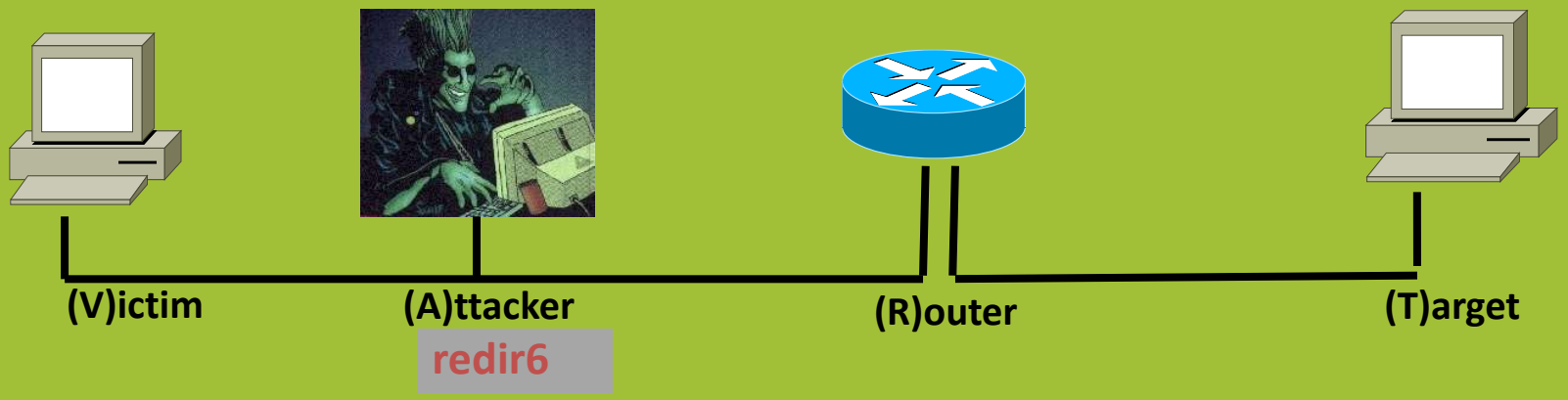
1. NS:
   ICMP Type = 135
   Src = :: (unspecified)
   Dst = All-Nodes Mulitcast Address
   query= Who-has IP A?

dos-new-ipv6:
Answer to every NS, claim to be every system on the LAN ☺

2.
No reply if nobody owns the IP address.

MITM with Redirects

MITM with Redirects



DHCP => Autoconfiguration

1. RS:
   ICMP Type = 133
   Src = ::
   Dst = FF02::2
   query= please send RA

fake_router6:
Sets any IP as default router, defines network prefixes and DNS servers ☺

2. RA:
   ICMP Type = 134
   Src = Router Link-local Address
   Dst = FF02::1
   Data= options, prefix, lifetime, autoconfig flag, DNS


new and improved!

Kick the default router!

1. Send own RA

2. Spoof RA of default router with 0 lifetime

3. Resend own RA just to be sure ☺

We are getting back
to this one

Kill all routers and clients think everything is local

(it’s in the standard)

RA => Systems become dual stack

- Can be port scanned on IPv6
  - No filtering on IPv6? Full port access
- Prefer IPv6
  - Will use your tunnel / MITM

How about announcing remote network addresses local?

(Paypal, …)

RA flooding!

Cisco ASA/PIX, Cisco IOS
Windows 2008, 7, Vista
old Linux
more… ?

Cisco:

Just fixed for IOS, ASA soon (CSCti24526 , CSCti33534)

Microsoft

"We consider this issue to be by design. [and will not fix this]"

Even Apple got this problem right!

“Remote alive scans (ping scans) as we know them are unfeasible on IPv6”

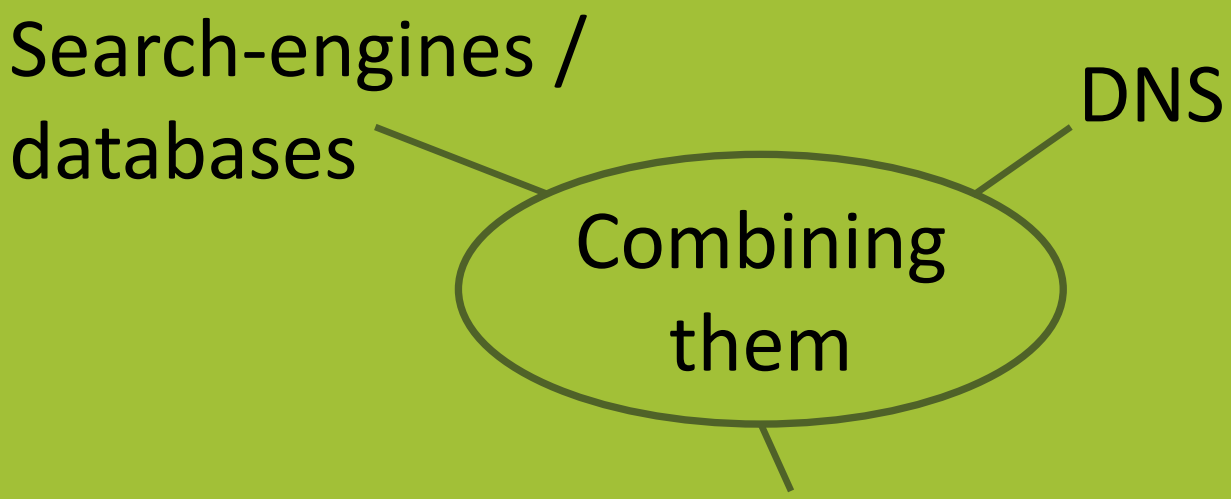
some jerk

(OK, that was me in 2005)

How to identify remote systems?

~~Broadcasts~~

~~Scan the whole range~~



Search Engines

Dumped various IPv6 directories

↓

14.651 possible domains & subdomains identified

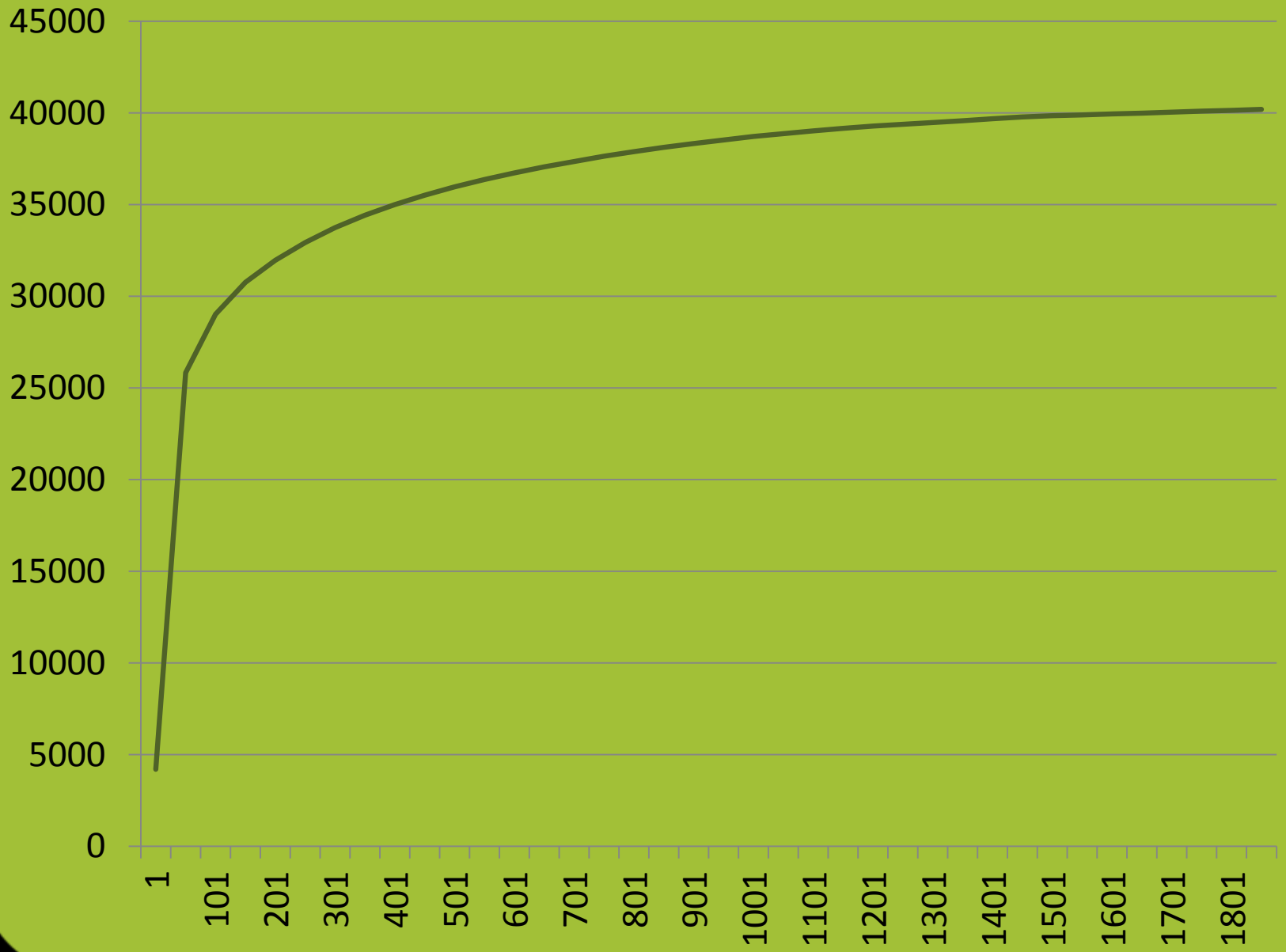
DNS

14.651 domains
bruteforcing 3000 hostnames

↓

40.193 DNS entries found
1.846 unique hostnames found

DNS Hostnames



DNS Results

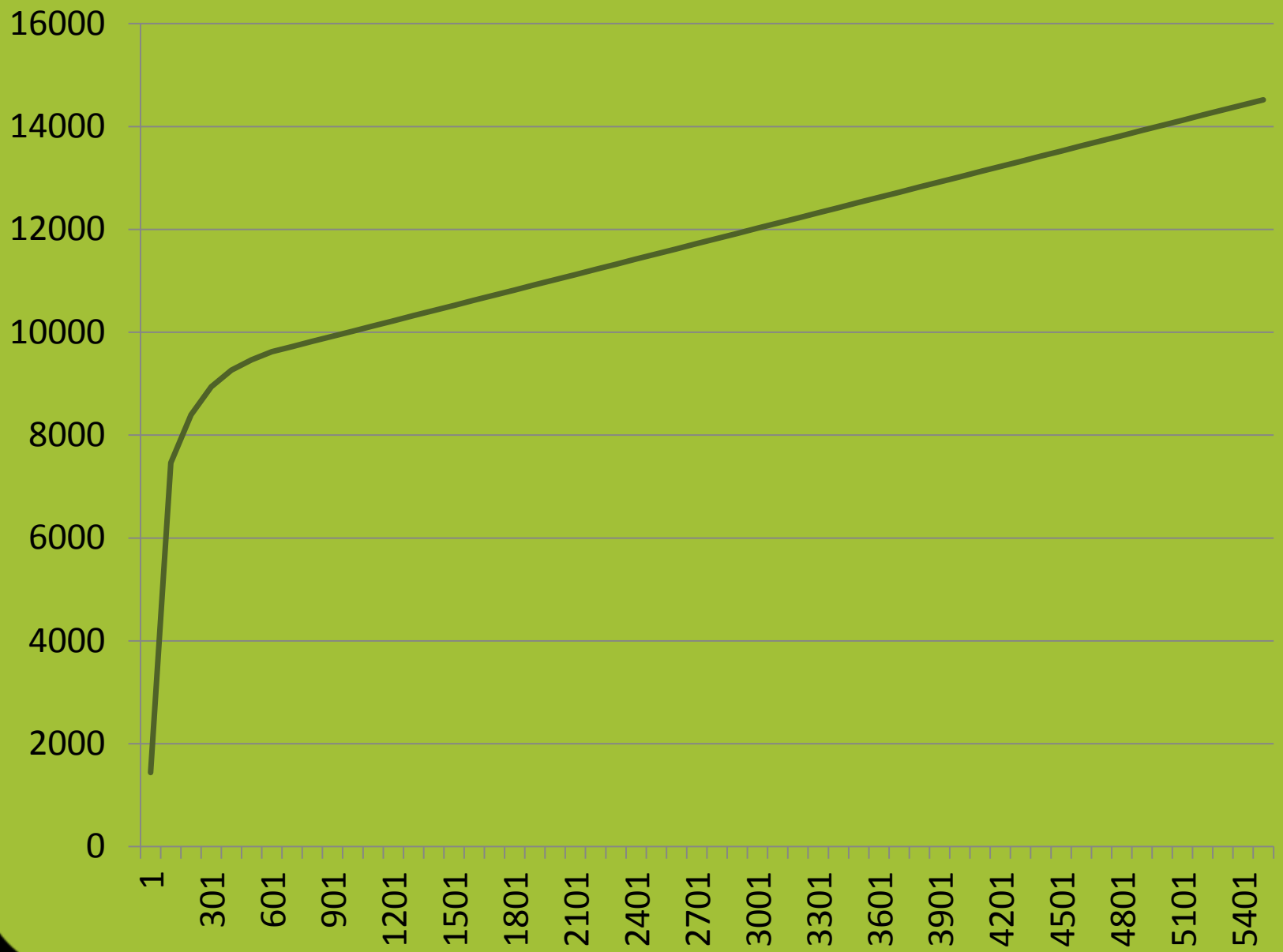
14.456 unique IPv6 addresses found

↓

12.942 networks

5434 unique host addresses

IPv6 Host Addresses



Host addresses analysis

Autoconfiguration

- MAC address ⇒ ~24 bit key space per vendorID
- Privacy option ⇒ bad luck
- Fixed random ⇒ bad luck

by hand

- Pattern ⇒ got one, got all
- Random ⇒ bad luck

DHCP

- Sequential
- Got one, got all
- Usually easy to find

by hand

::1, ::2, ::3, …

::service_port

::1:service_port, ::2:service_port, …

::service_port:1, ::service_port:2, …

The IPv4 address

Funny stuff (::b00b:babe, etc.)

etc.

DHCP

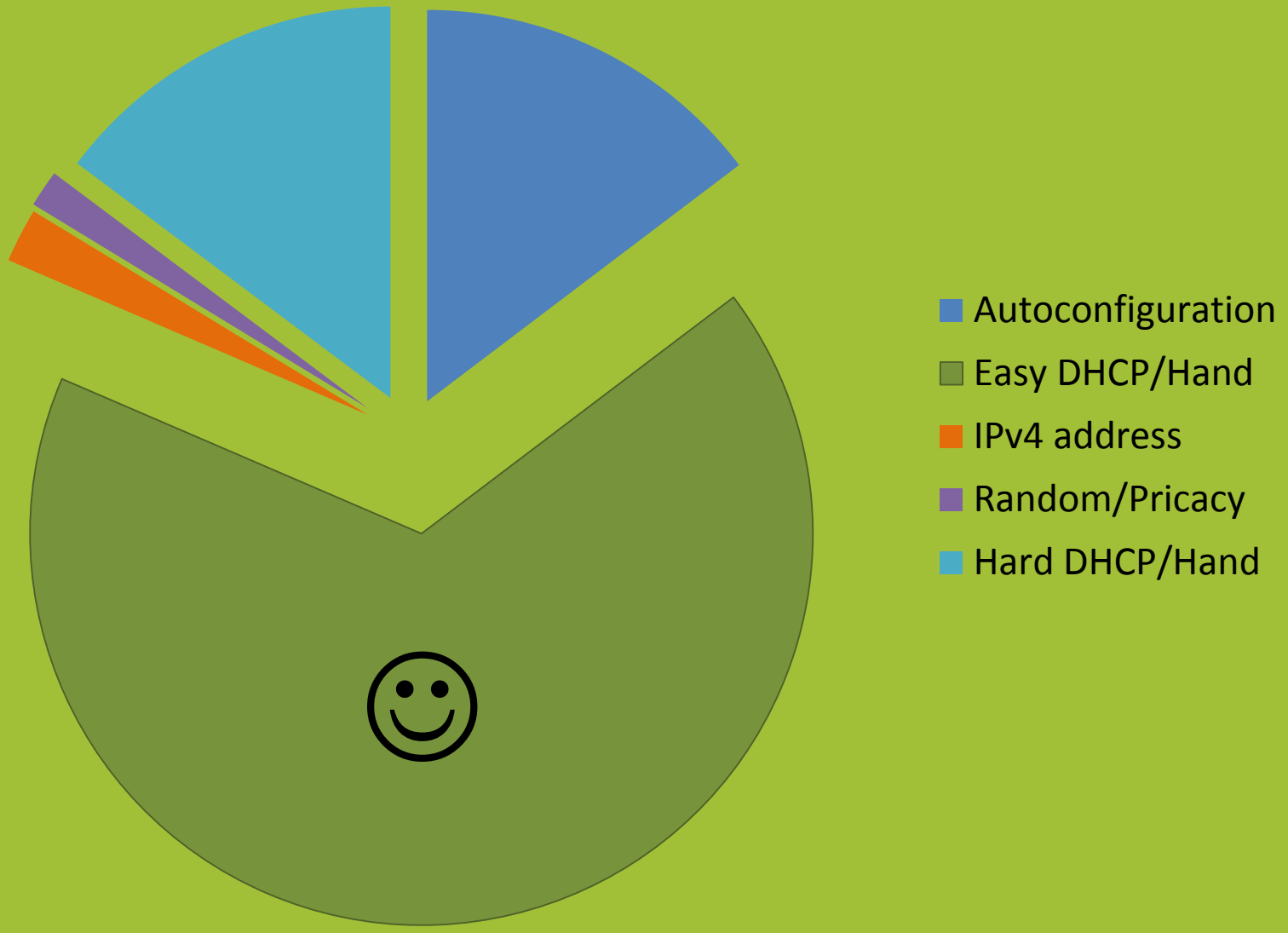
::1000-2000

::100-200

::1:0-1000

::1:1000-2000

IPv6 Host Address Distribution



Alive Scanning

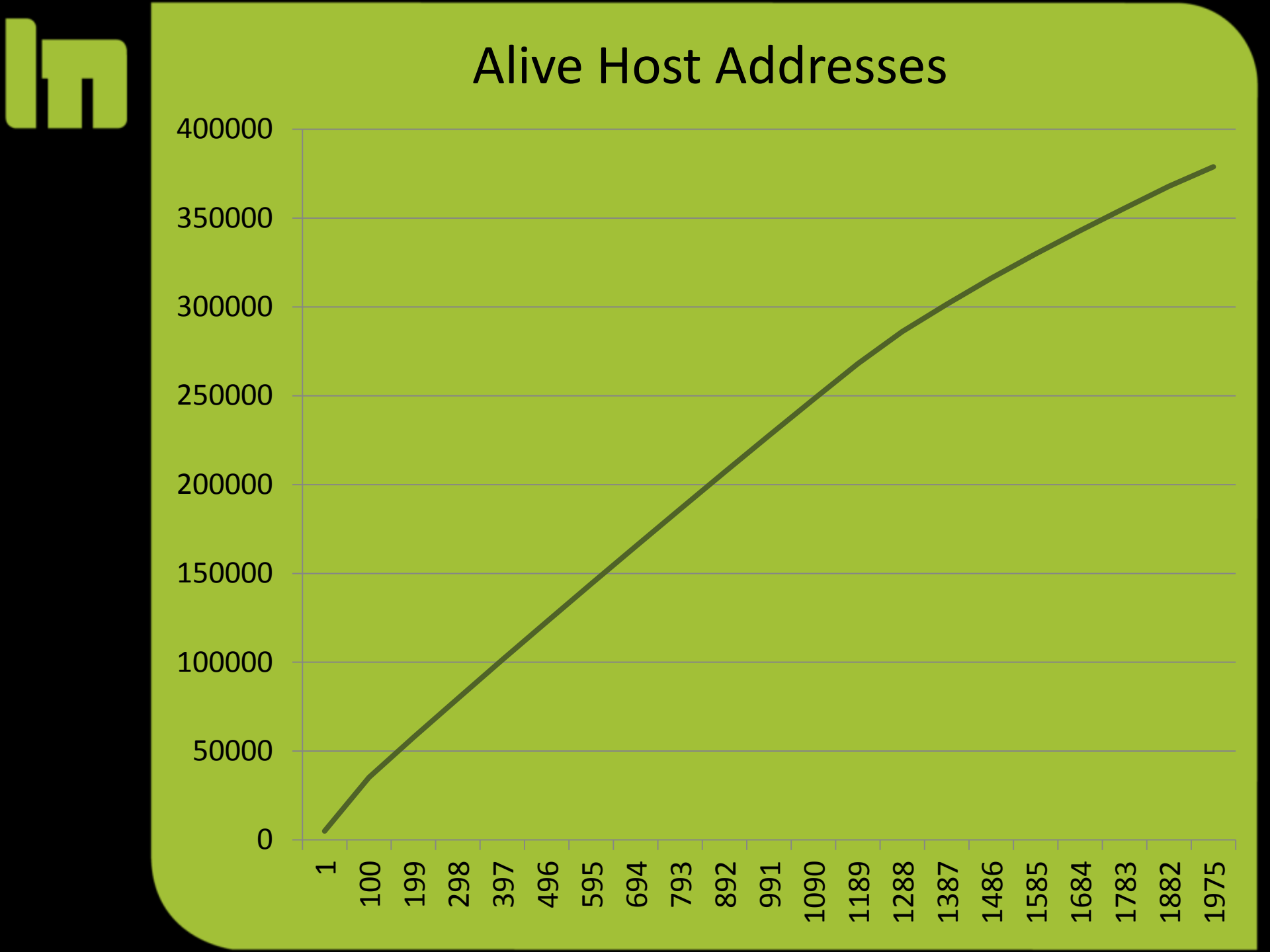
12.942 networks
bruteforcing 2000 host addresses

↓

379.223 alive systems

↓

7.895 networks
1975 unique host addresses


Alive Host Addresses
400000
350000
300000
250000
200000
150000
100000
50000
0
1
100
199
298
397
496
595
694
793
892
991
1090
1189
1288
1387
1486
1585
1684
1783
1882
1975

Alive Scanning

379.223 alive systems

↓

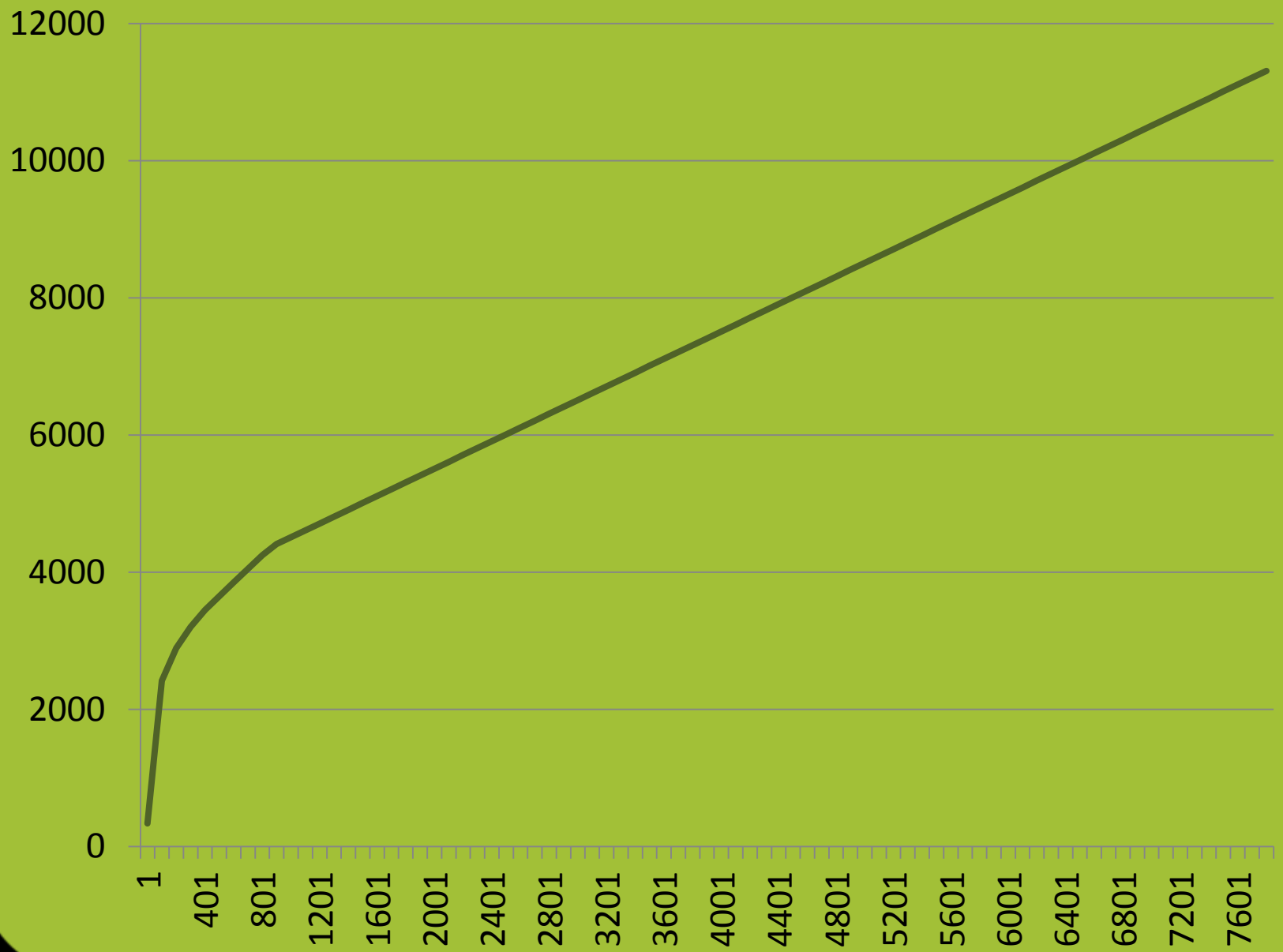
13.402 reverse DNS entries

↓

3.922 unique domains

7.860 unique hostnames

DNS Reverse Hostnames



```
do {
   new_dns=dns_brute(new_alive);
   new_alive=alive_brute(new_dns);
} while (new_dns || new_alive)
```

Conclusion

DNS bruteforcing: 90% of systems in DNS with 1900 words

Conclusion

Alive bruteforcing: 66% of systems with 2000 addresses

scanned in 1-20 seconds

Conclusion

Combined (and use of brain)
~90-95% of hosts are found


THERE IS MORE!

Taking over the Multicast Listener Discovery Protocol for fun and denying multicast traffic

How does MLD work?

Sends periodically MLD general query messages

MLD Report: “I am a multicast DNS server” to all routers

DNS multicast traffic flows to the network

Sends specific address query message

MLD Report: “I am (still) a multicast DNS server”

Spoofs “A” MLD Done message

☹

First we want to become the MLD query router

```
if (router1 < router2)
   master(router1);
```

Sends periodically MLD general query messages

MLD Report: “I am a multicast DNS server” to all routers

DNS multicast traffic flows to the network

Spoofs MLD general query message as fe80::

Spoofs “A” MLD Done message

Problem: We must send an MLD general query message regularly

Solution:

Spoof query message with multicast all-router MAC address!

Spoof MLD general query message as fe80::

Spoofs “A” MLD Done message

Send general query as fe80:: with special MAC


Anybody sniffing?

Send a ping to the target with an unused multicast MAC address

(Windows, Linux, more?)

Side channels in IPv6?

IPv6 **is** a side channel.

Don’t be scared.

IPv6

complex

intellectual challenge

tired … ?

be an explorer!

Join researching IPv6!

How to get IPv6 to your home (1/4)

1. Create an account at Sixxs: http://www.sixxs.net/
2. Request tunnel (static if possible for you, heartbeat otherwise)
3. Request a subnet (a week later)

How to get IPv6 to your home (2/4)

4. a) Configure a static tunnel:

```
ip tunnel add sixxs mode sit local [Your IPv4 Endpoint] remote [Sixxs IPv4 Endpoint]
ip link set sixxs up
ip link set mtu 1280 dev sixxs
ip tunnel change sixxs ttl 64
ip -6 addr add [Your IPv6 Endpoint]/[Prefix Length] dev sixxs
ip -6 ro add default via [Your IPv6 endpoint] dev sixxs
```

How to get IPv6 to your home (3/4)

4. b) Configure a heartbeat tunnel:

a) Install aiccu

b) Configure aiccu.conf:

```
username xxxx-SIXXS
password xxxxxxxxx
tunnel_id T<your tunnel id>
daemonize true
automatic true
ipv6_interface sixxs
```

c) Start aiccu

How to get IPv6 to your home (4/4)

5. Configure your local network card

```
ip -6 addr add [Your IPv6 subnet]::1/[Prefix Length] dev eth0
```

6. Use fake_router6 for your local subnet:

```
fake_router6 eth0 <Your IPv6 subnet>::/<Prefix Length>
2a01:4f8:100:2283::2
```

What is new in thc-ipv6 since the 2005-2007 release?

- DNS6 bruteforcer
- More payloads for fake_router6
- Implementation test-case tool
- Fast traceroute6
- Fuzzer for IPv6
- Flood tools for RA and NA
- Several library bugfixes & enhancements

What is new in the current thc-ipv6 source state?

- alive6 rewritten with 250% new functionality
- Flood & spoofing for all multicast protocols
- DHCPs6 spoofer
- DHCPc6 flooder
- DNS6 spoofer
- … more new tools than fit the slide
- Enhancements for all previous tools
- Several library bugfixes & enhancements

How to get access to the current thc-ipv6 source code state?

Send in patches and new tools!

Small and limited updates will still get into the public version.

Complete public release in ~2011.

http://www.thc.org/thc-ipv6

Central information resource for IPv6 security (wiki, forum, news):

www.ipv6security.info

www.ipv6hacking.info

(Online after Xmas 2010)

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Thanks!

And have fun exploring IPv6!

☺