Hacking in 2022 – Security in a Post-Scarcity Internet

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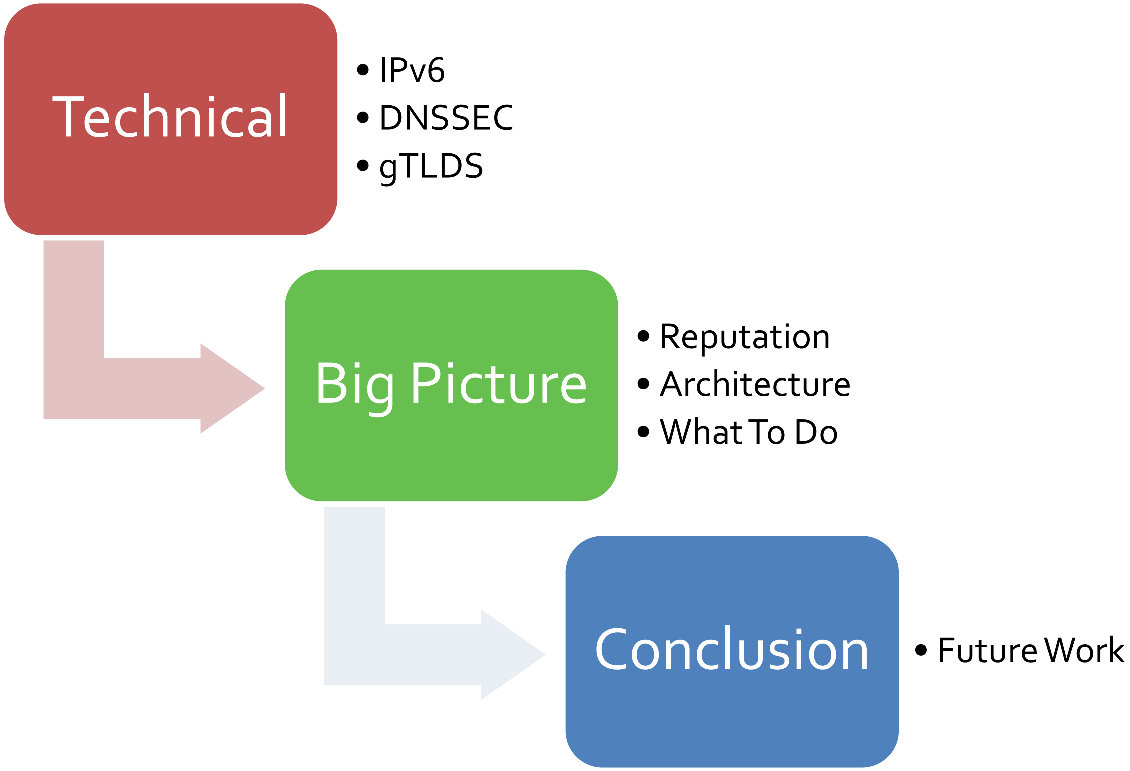
Artemis Internet Inc.

Professional Strategies – S12



Technical

- IPv6
- DNSSEC
- gTLDS

Big Picture

- Reputation
- Architecture
- What To Do

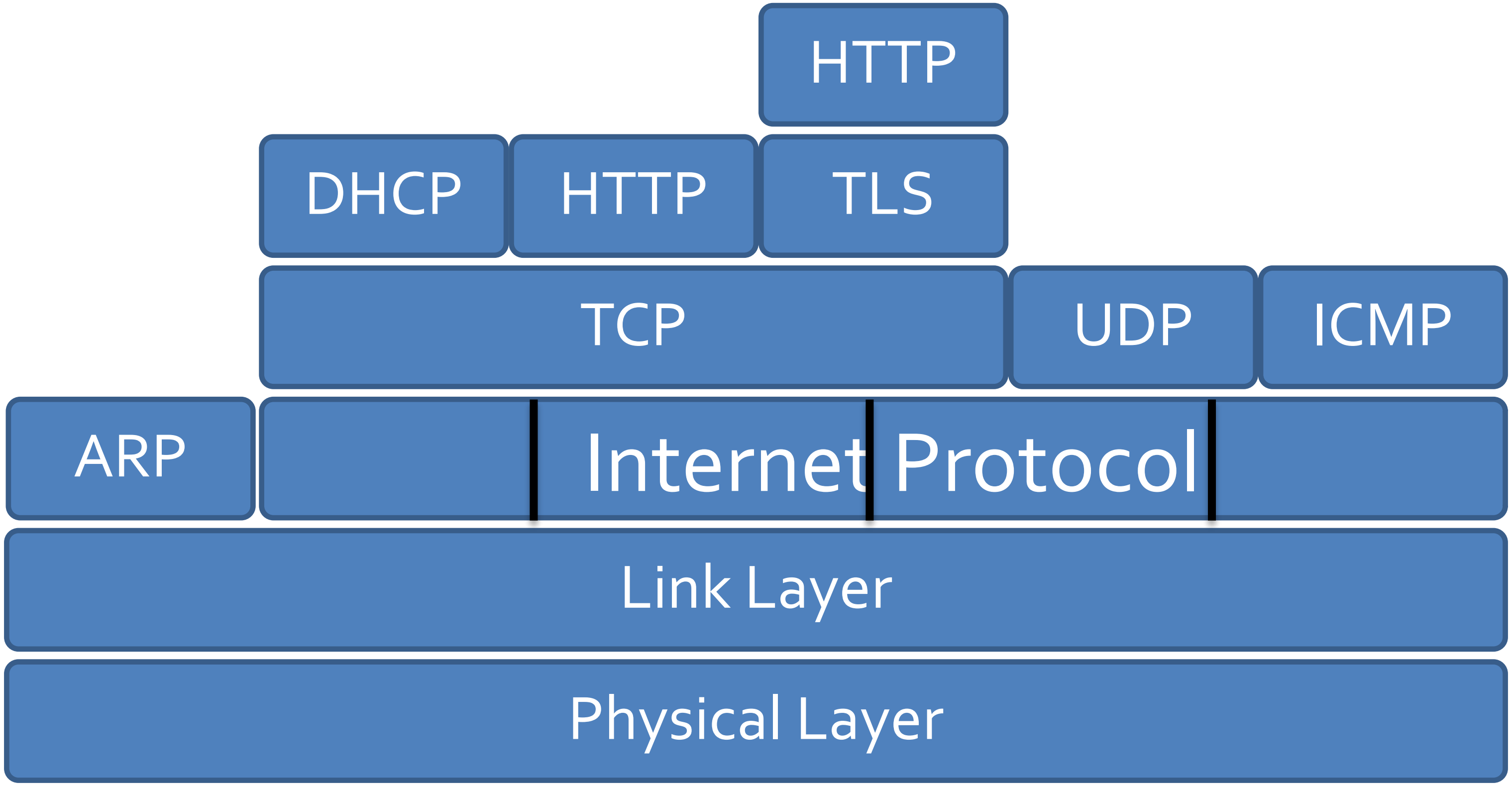
Conclusion

- Future Work

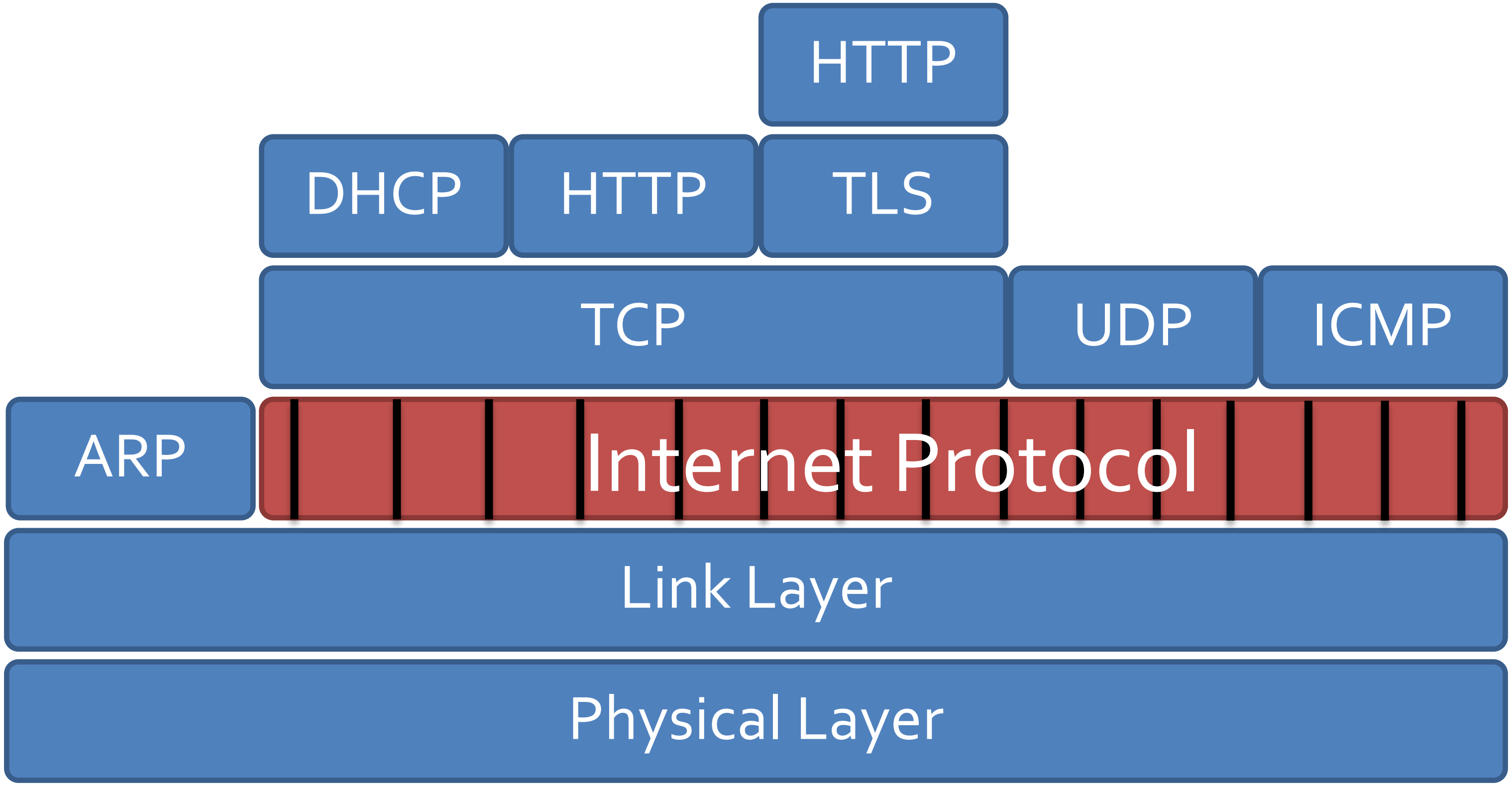
Our Conclusions

1. The Internet infrastructure is undergoing fundamental change for the first time in decades
2. The assumption of scarcity is deeply woven into many security assumptions and products
3. The new Internet will face significant problems with trust on both the client and server side
4. New Enterprise Architectures will look very different
5. Everything you have bought will break

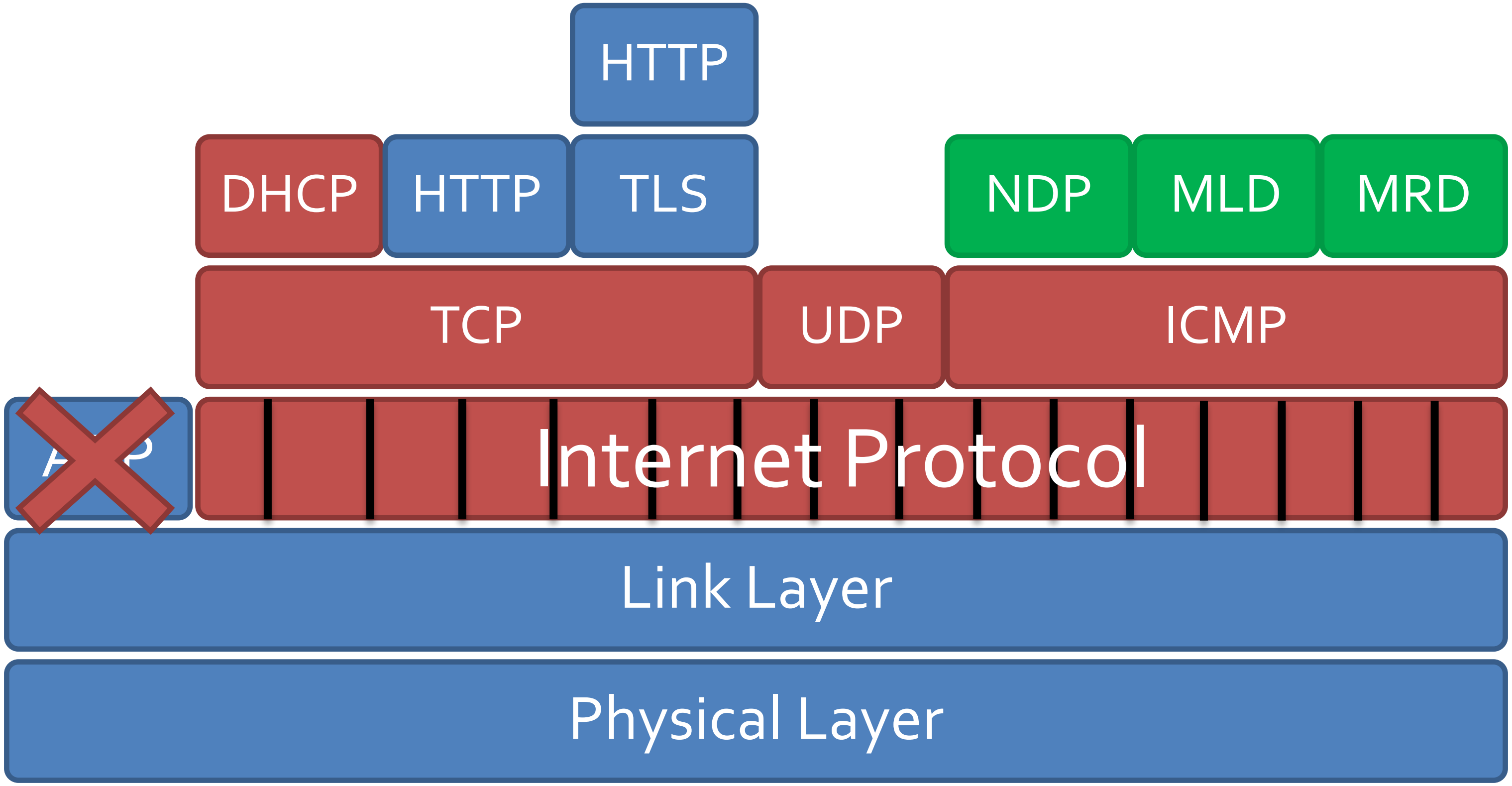
IPv6


HTTP
DHCP
HTTP
TLS
TCP
UDP
ICMP
ARP
Internet Protocol
Link Layer
Physical Layer

The Myth of 12 More Bytes



The Myth of 12 More Bytes



Come Join the Party

Stateless Address Auto-Configuration

- Give Yourself a local address in your subnet
  - Prefix: fe80:0:0:0: :
  - IPv6 Address: fe80::f03c:91ff:fe96:d927

- Ask what network you're in
  - example: 2600:3c03::

- Take your MAC Address, use it in the prefix
  - MAC: f2:3c:91:96:d9:27
  - IPv6 Address: 2600:3c03::f03c:91ff:fe96:d927

Privacy Addresses

- Using your MAC in the last 64 bits identifies you, globally, to every website you visit, no matter where you are
- Super-Mega Evercookie

- RFC 4941 Privacy Addresses
  - Generate a random /64 address
  - Prefer it for outgoing communications

DHCPv6

- Conceptually the same as Original DHCP
- Clients can get more than IP Address

The Default For Windows

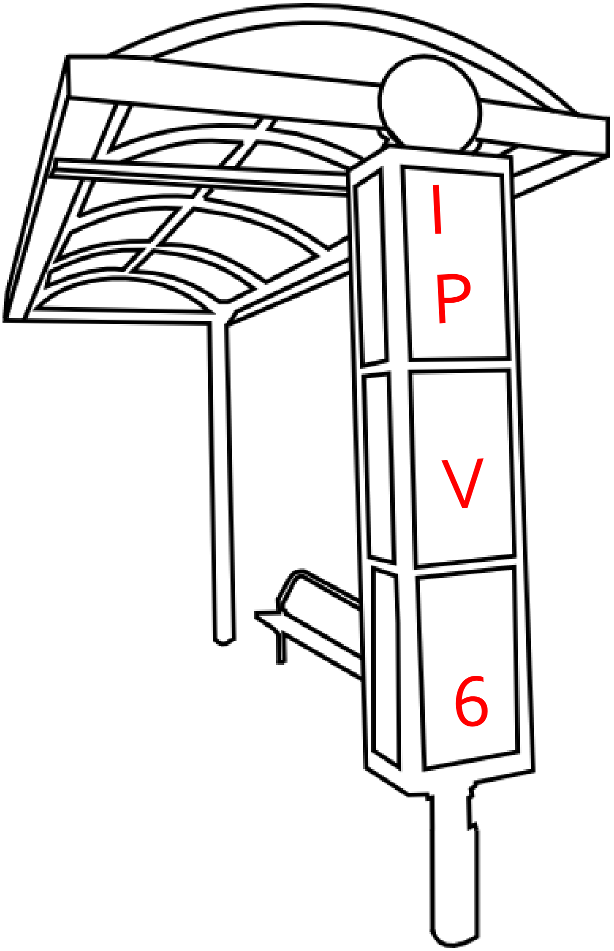
- Windows will happily perform SLAAC
- Windows Prefers IPv6 over IPv4

The Default For Windows

- Windows will happily perform SLAAC
- Windows Prefers IPv6 over IPv4

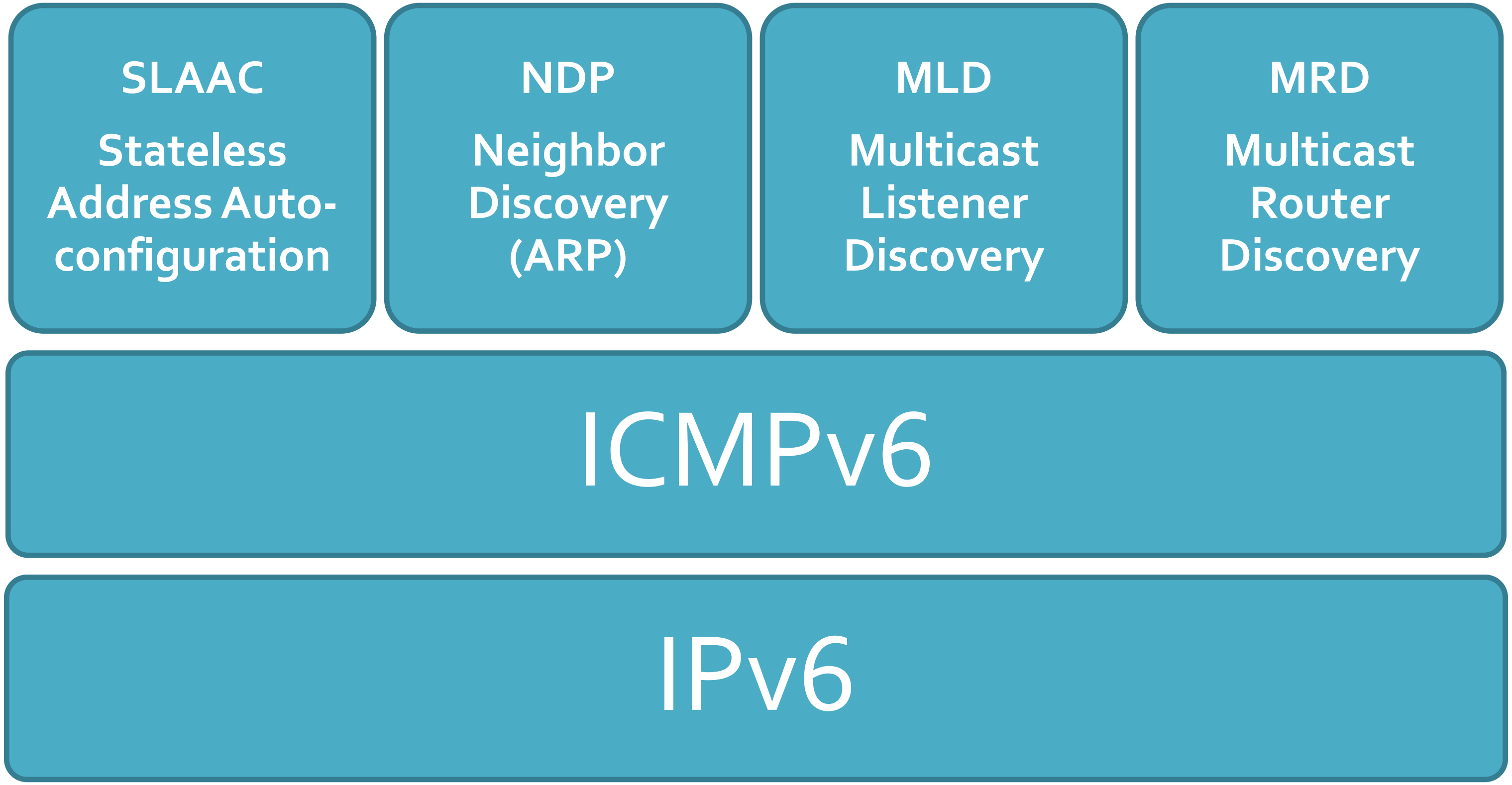
Your computers are just sitting around, waiting for someone to help them talk IPv6

(And it doesn't have to be you.)



ICMPv6

Critical Infrastructure



SLAAC

Stateless Address Auto-configuration

NDP

Neighbor Discovery (ARP)

MLD

Multicast Listener Discovery

MRD

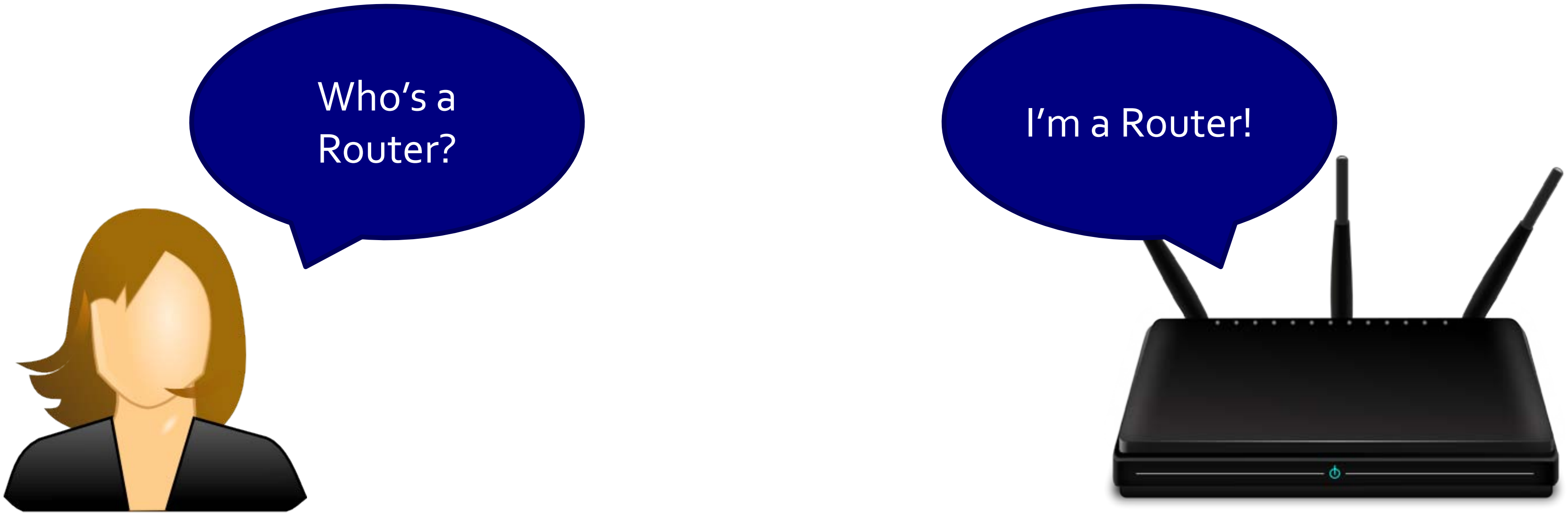
Multicast Router Discovery

ICMPv6

IPv6

ICMPv6 Protocols

Router Discovery

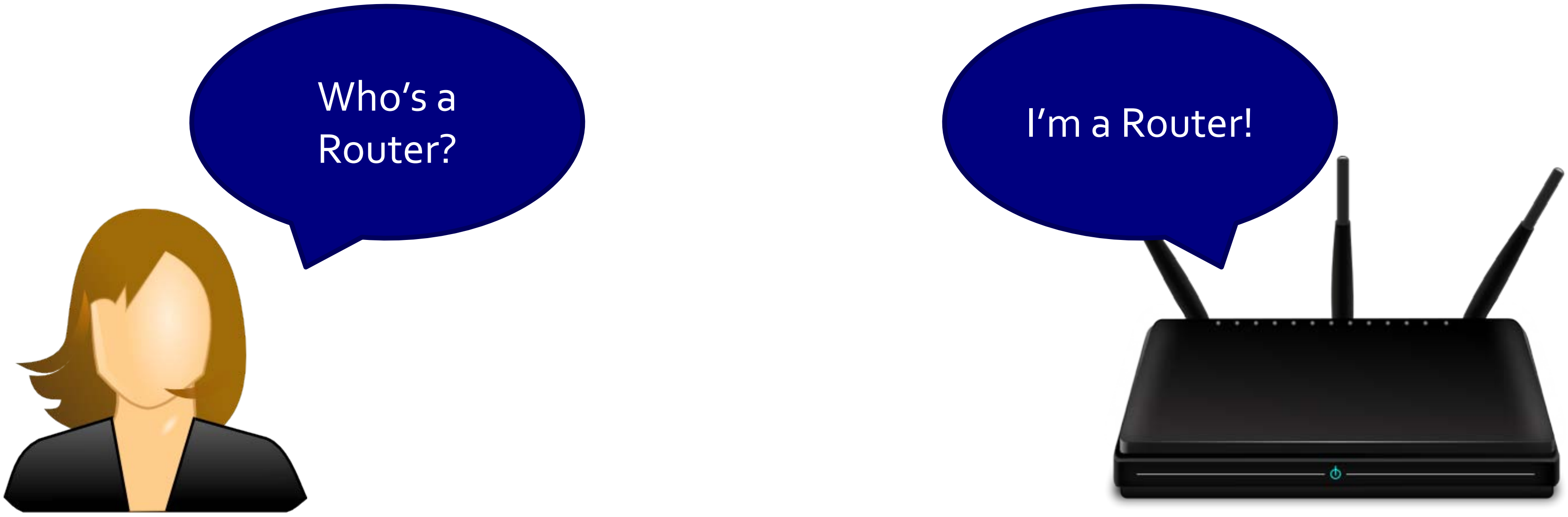


New Protocols
New Protocol Vulnerabilities

(Same Tactics)

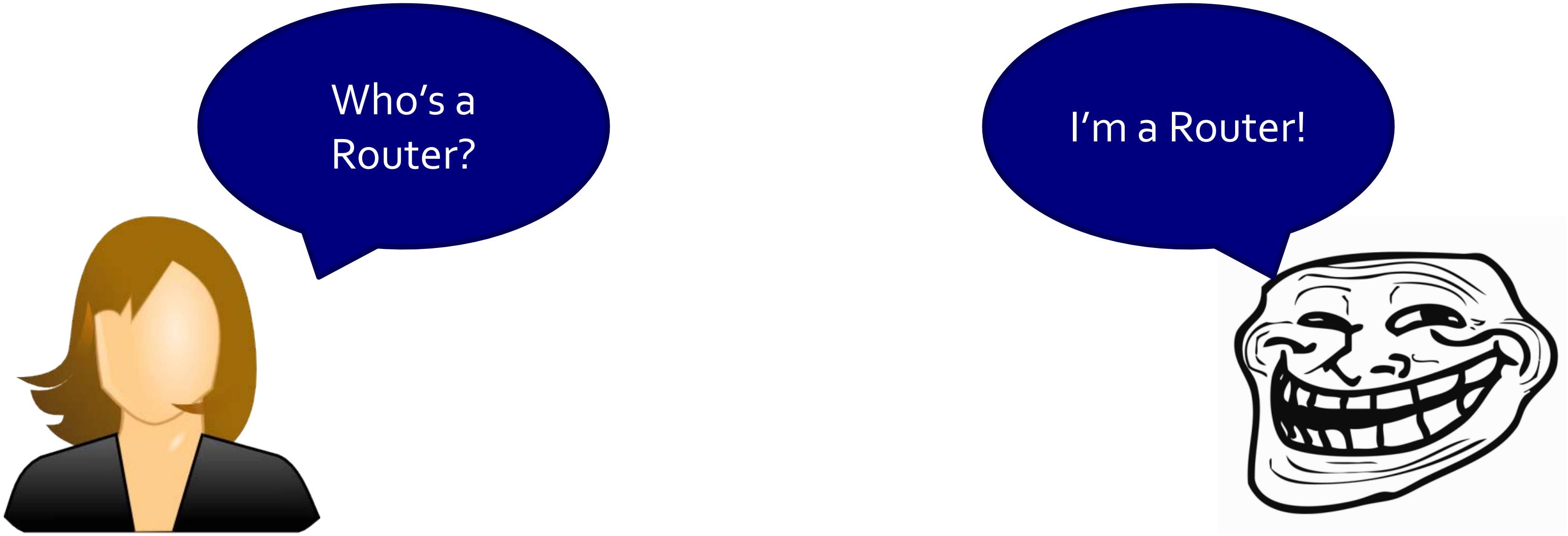
NDP

Router Discovery



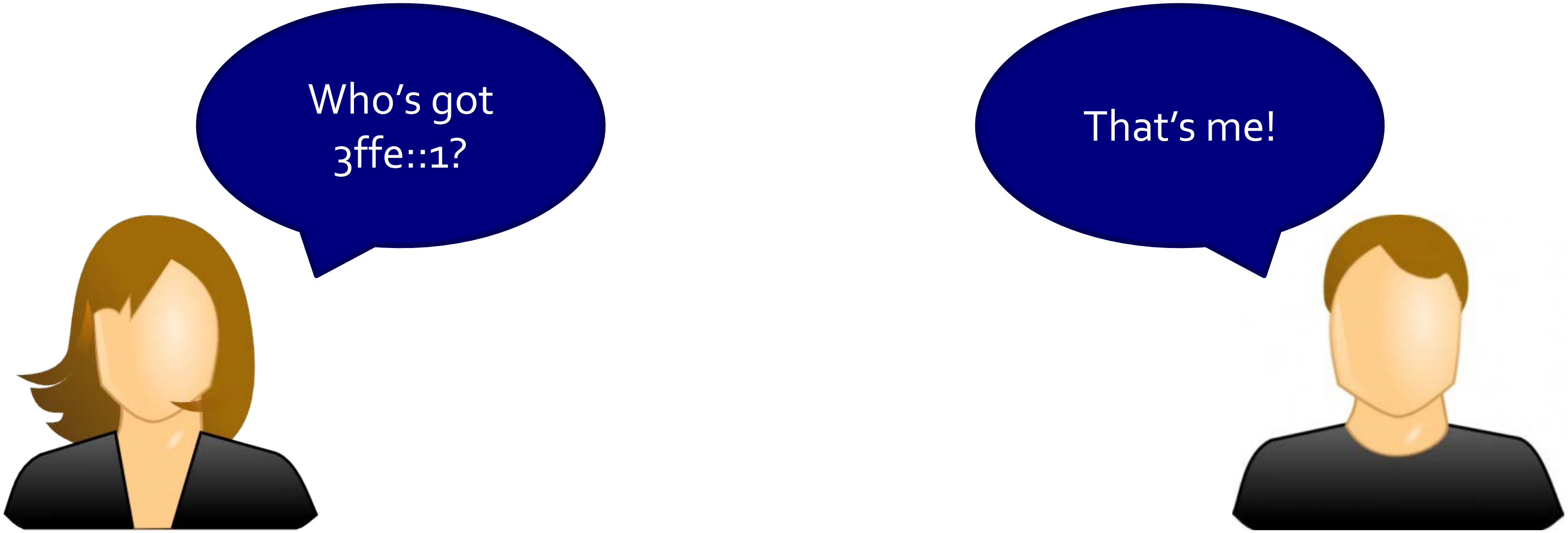
NDP

Router Discovery



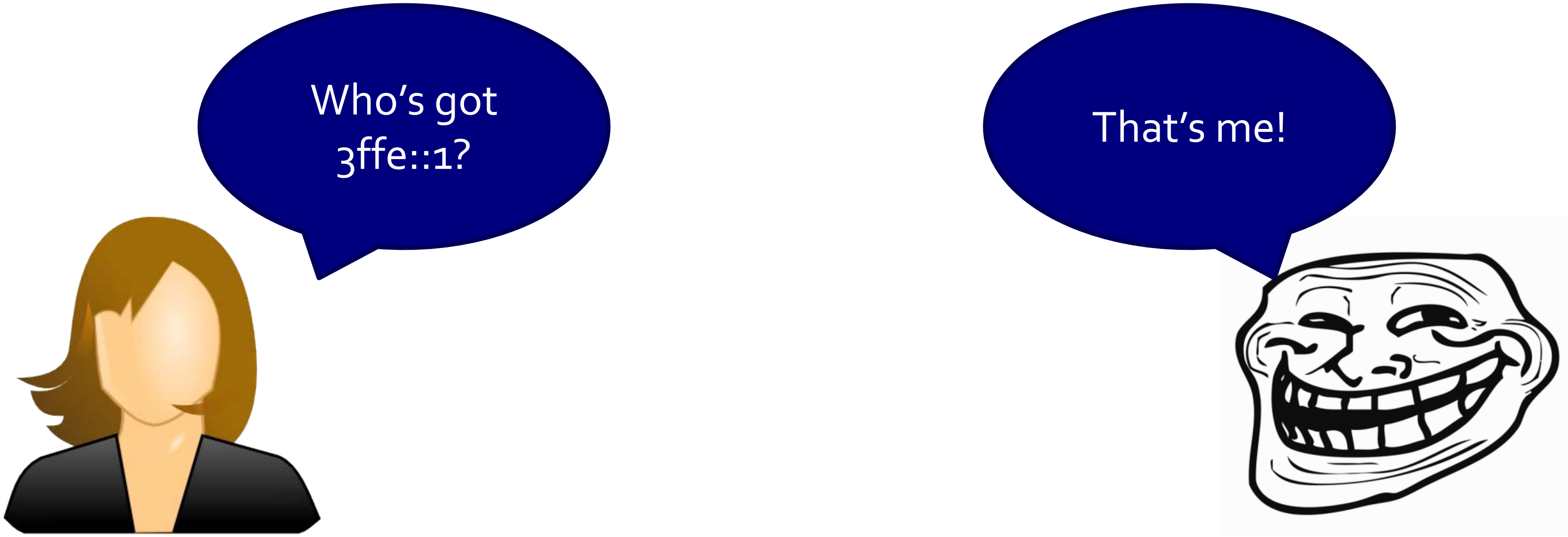
NDP

Neighbor Discovery



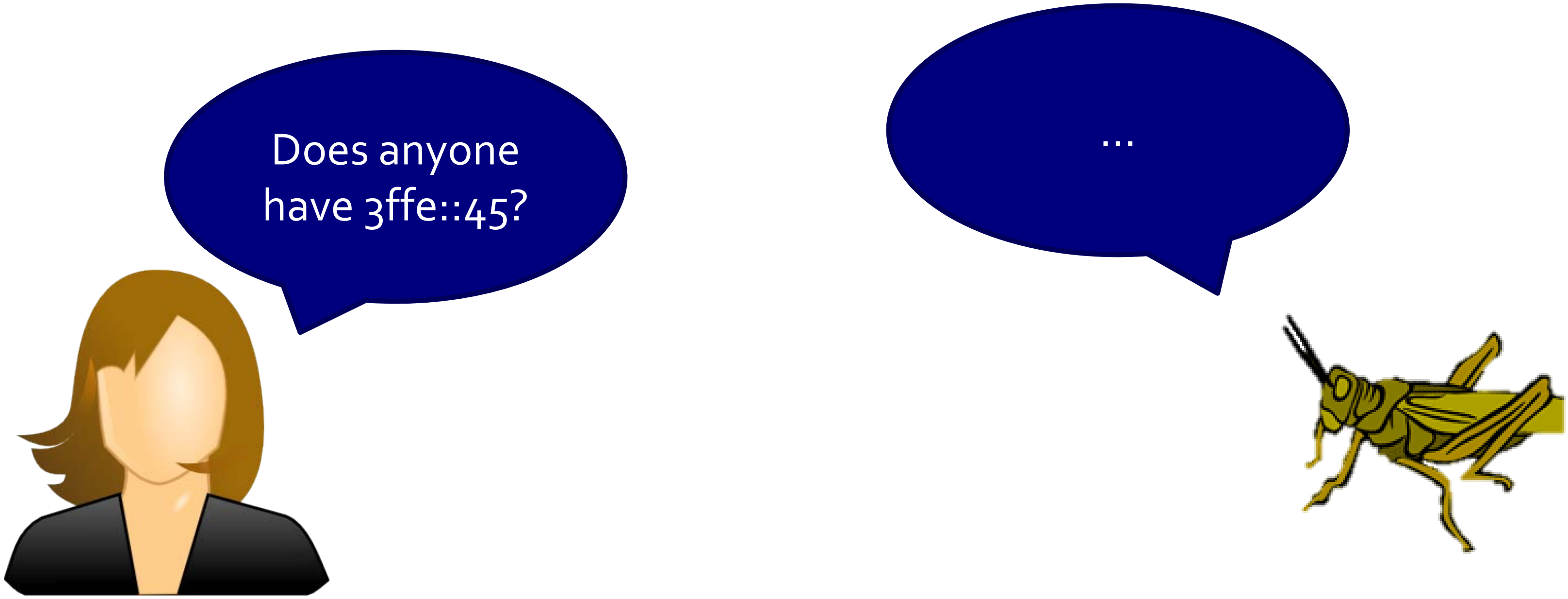
NDP

NDP Spoofing is the New ARP Spoofing



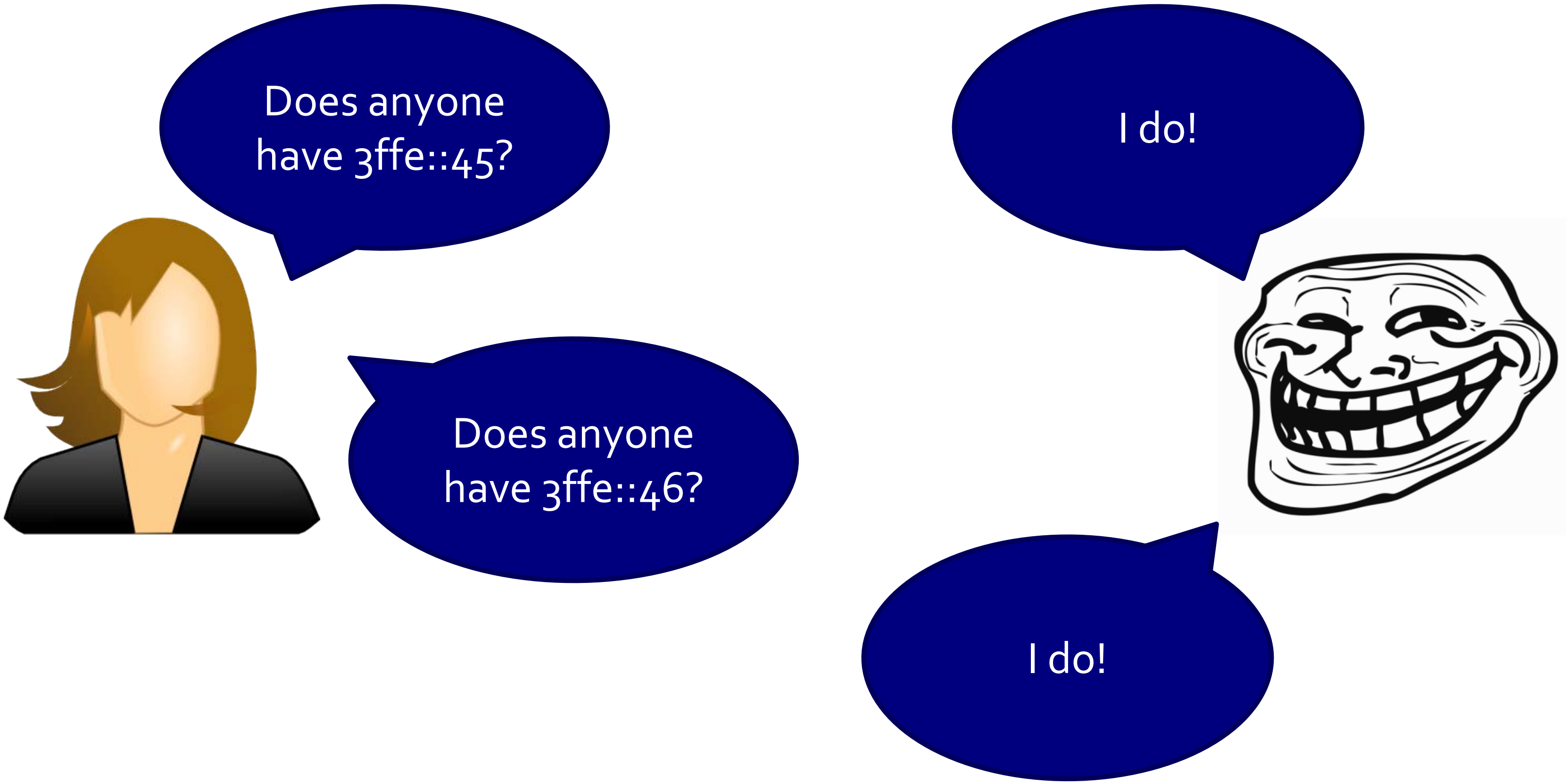
ICMPv6 Protocols

Duplicate Address Detection



ICMPv6 Protocols

Duplicate Address Detection



Does anyone have 3ffe::45?

I do!

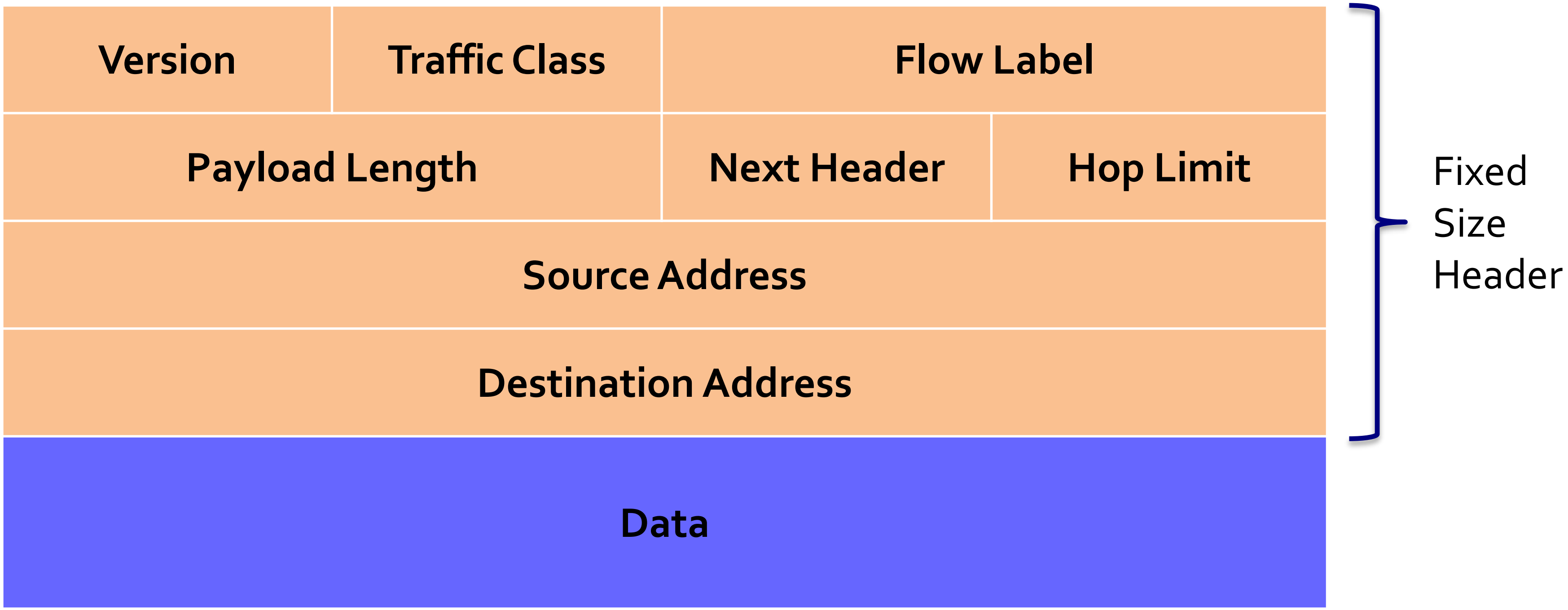
Does anyone have 3ffe::46?

I do!

Extension Headers

Pain in the Firewall

IPv6 Packet Format



Version | Traffic Class | Flow Label

Payload Length | Next Header | Hop Limit

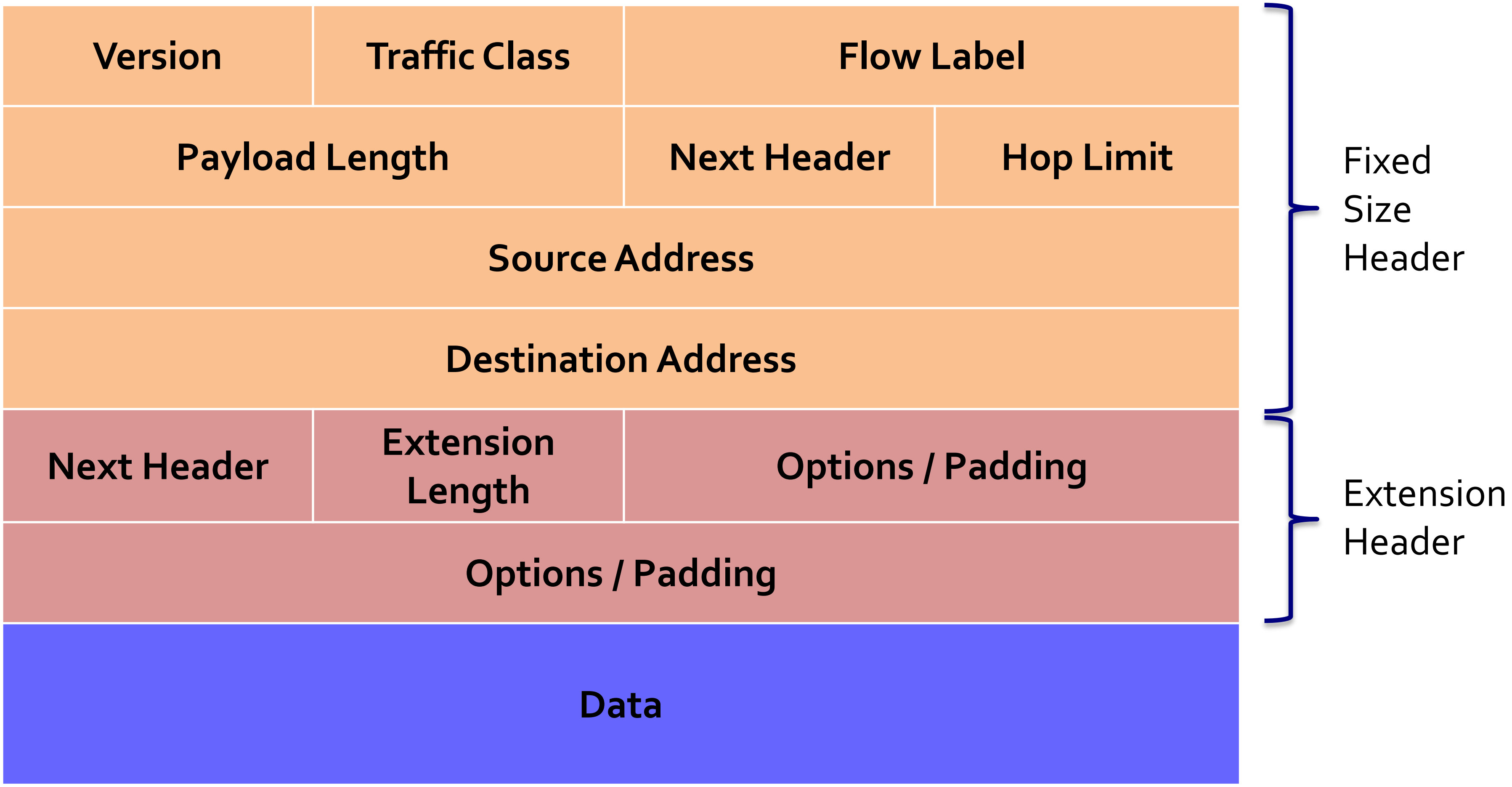
Source Address

Destination Address

Data

Fixed Size Header

IPv6 Packet Format



Version

Traffic Class

Flow Label

Payload Length

Next Header

Hop Limit

Source Address

Destination Address

Next Header

Extension Length

Options / Padding

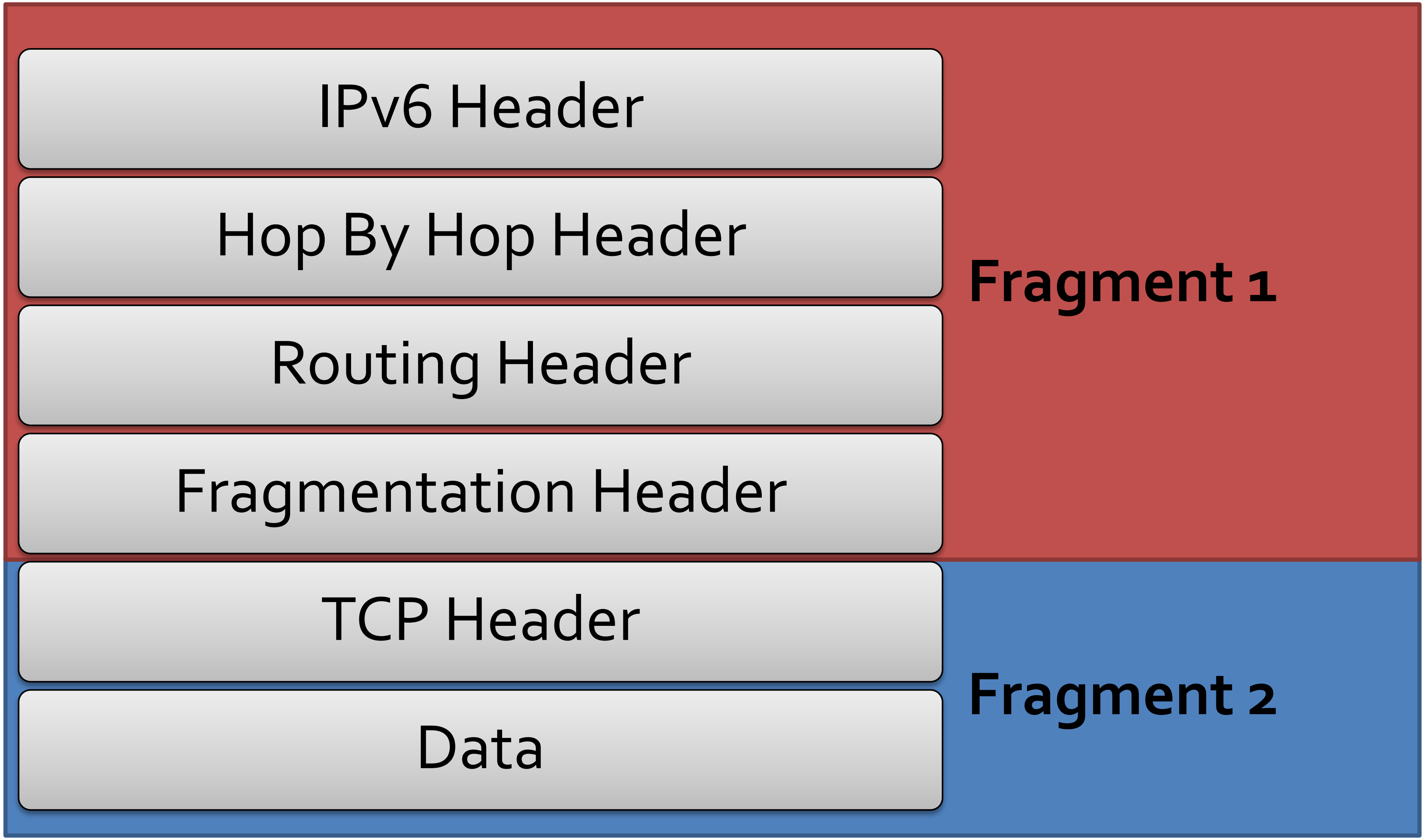
Options / Padding

Data

Fixed Size Header

Extension Header

Extension Headers + Fragmentation



IPv6 Header

Hop By Hop Header

Routing Header

Fragmentation Header

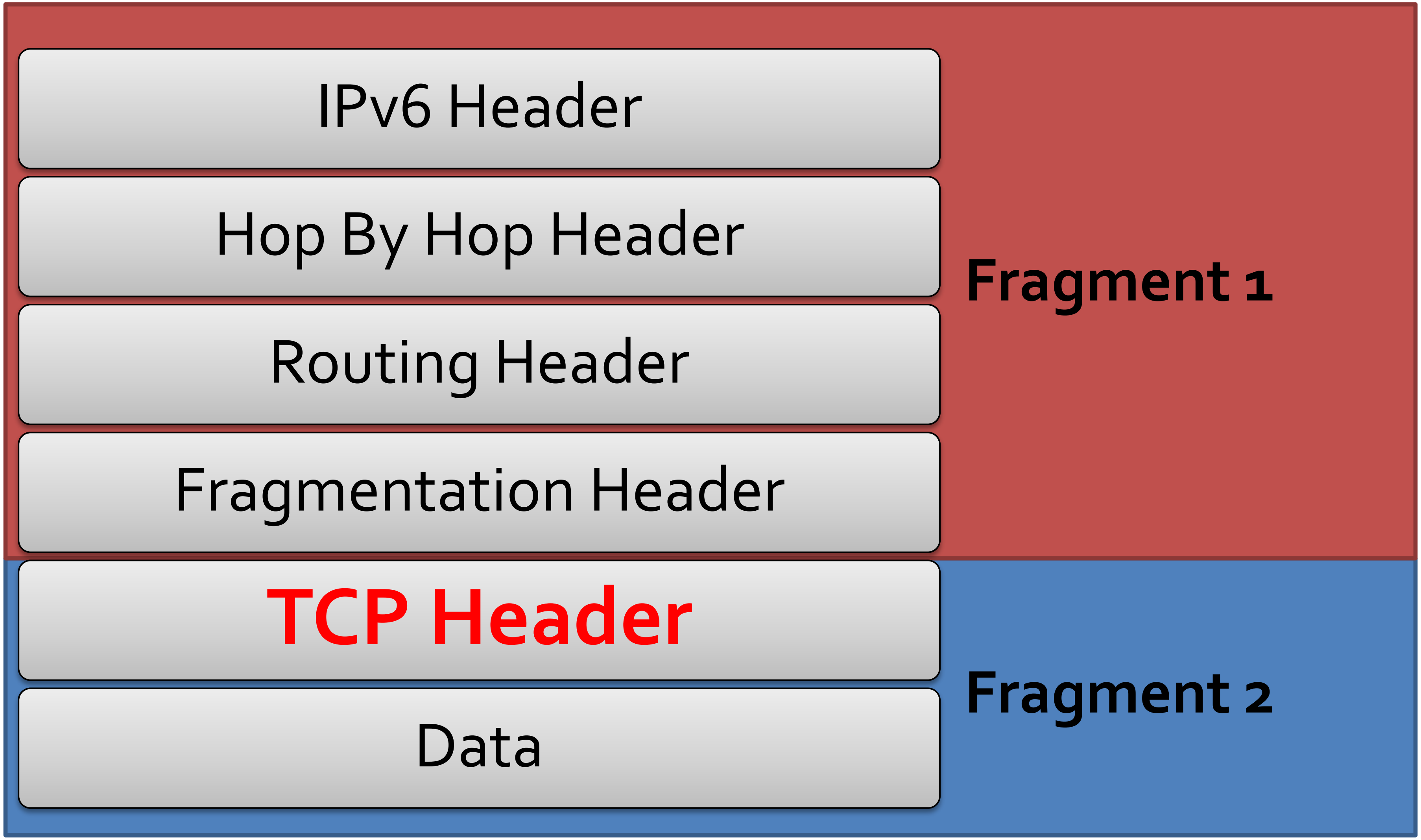
TCP Header

Data

Fragment 1

Fragment 2

Stateless Filtering is Impossible



IPv6 Header

Hop By Hop Header

Routing Header

Fragmentation Header

TCP Header

Data

Fragment 1

Fragment 2

Translation & Transition Mechanisms

They're Such Nice Guys.

Translation & Transition

Transition

IPv6 Island

|

IPv4 Internet

|

IPv6 Island

Translation

IPv6 < -- > IPv4

Transition

6to4

IPv6 Island to IPv4 Network to IPv6 Island

Relies on Nice people to run border routers

6rd or IPv6 Rapid Deployment

6to4 but instead of nice people, it's an ISP running it, applicable only to their customers

ISATAP

Host supporting IPv6 sits on an IPv4 Network

Can talk to IPv6 Internet, but not the reverse

Teredo

Host supporting IPv6 sits on an IPv4 Network

Magic NAT-punching IPv6 –in-IPv4 to a Teredo Service Provider (Can be open, can be paid)

Allows an IPv6 Server to sit in an IPv4 Network

Translation

NAT-PT

- Old, Deprecated
- IPv4 or 6 Clients to IPv6 or 4 Servers
- Has External IPv4 addresses for Internal IPv6 Servers
- Breaks a lot of stuff

NAT64

- IPv6 Clients to IPv4 Servers
- Fakes a IPv6 Address for the IPv4 Server
- I talk to the NAT64 device, it forwards to IPv4
- Pairs with DNS64

And More

Time Limits =(

IPv6 Enumeration Mechanisms

Internet-Based	
MAC Address Guessing using OUI	24-26 Bits
Sequential Address (DHCPv6 or Sysadmin)	8-16 bits
Reverse Mapping ip6.arpa	Very Efficient
Limited to Local Network	
Multicast Echo $^{\text{nmap}}$	0 Bits
ICMPv6 Parameter Problem $^{\text{nmap}}$	0 Bits
Multicast Listener Discovery $^{\text{nmap}}$	0 Bits
SLAAC Fake-out $^{\text{nmap}}$	0 Bits

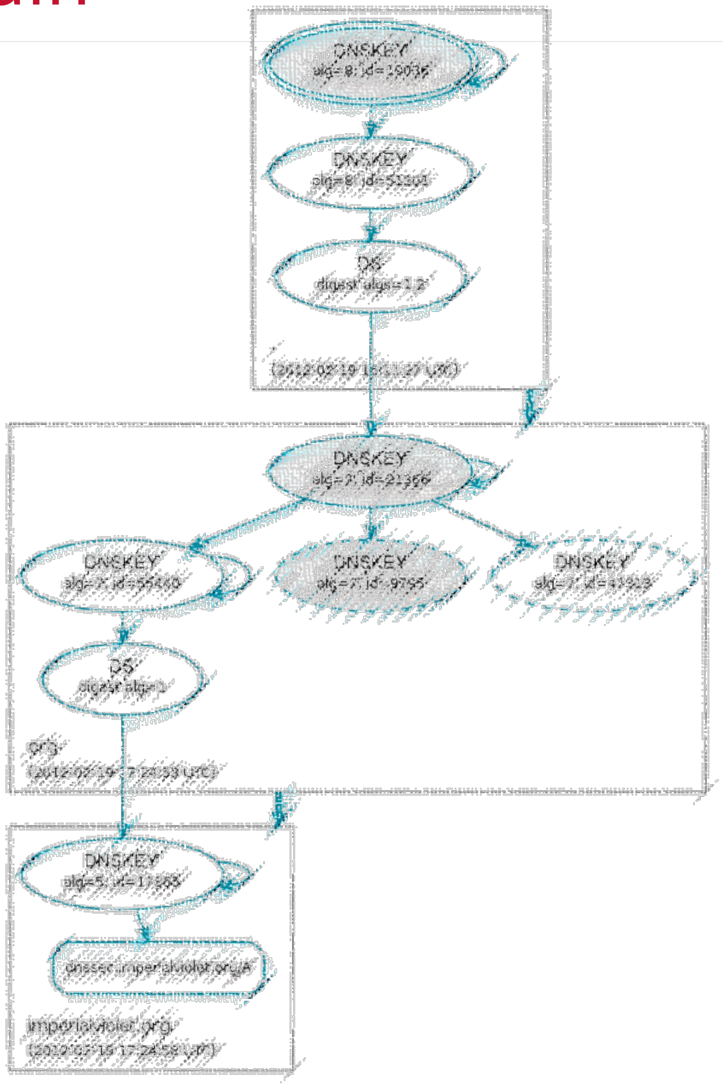
Yet More

- Multicast!
  - Listener Discovery
  - Listener Enumeration
  - Router Discovery
  - Router Enumeration
- Transition Mechanisms
  - 6to4
  - 6rd
  - 4rd
  - Teredo
  - ISATAP
  - 6in4
  - 6over4

- Node Querying
- UDP/TCP Checksum Calculation
- Router, DHCP, and DNS Discovery
- Redirection
- SeND
- New Features in DHCPv6
- Per-Network Consistent-But-Random Addresses

DNS(SEC)

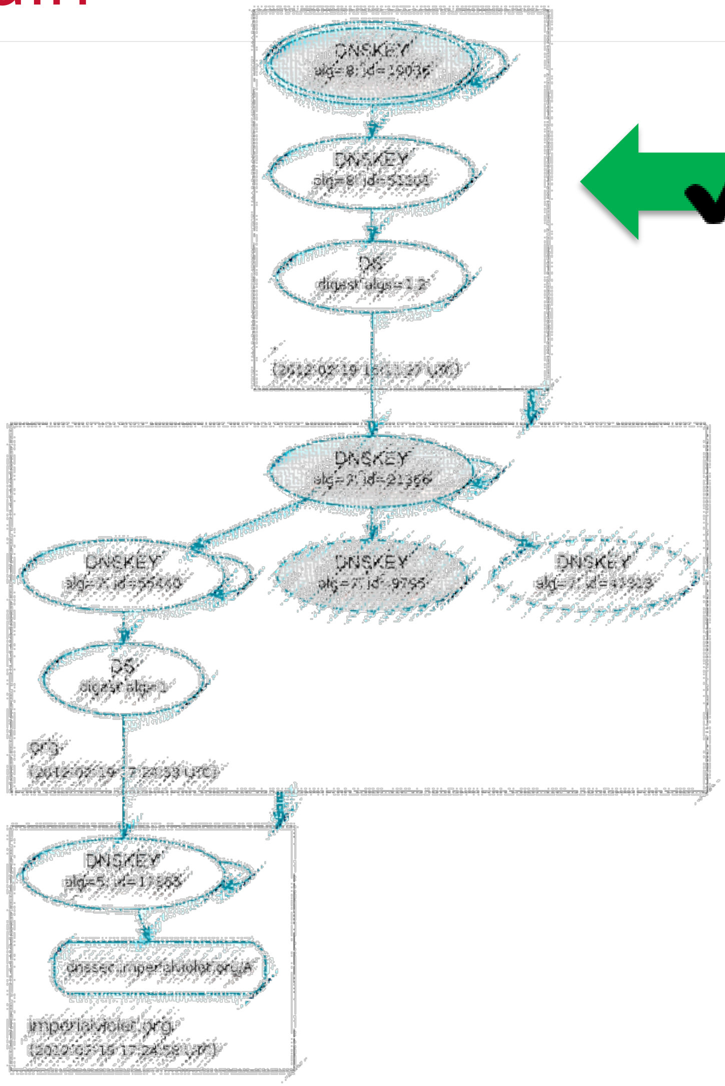
DNSSEC Chain



att.com

?

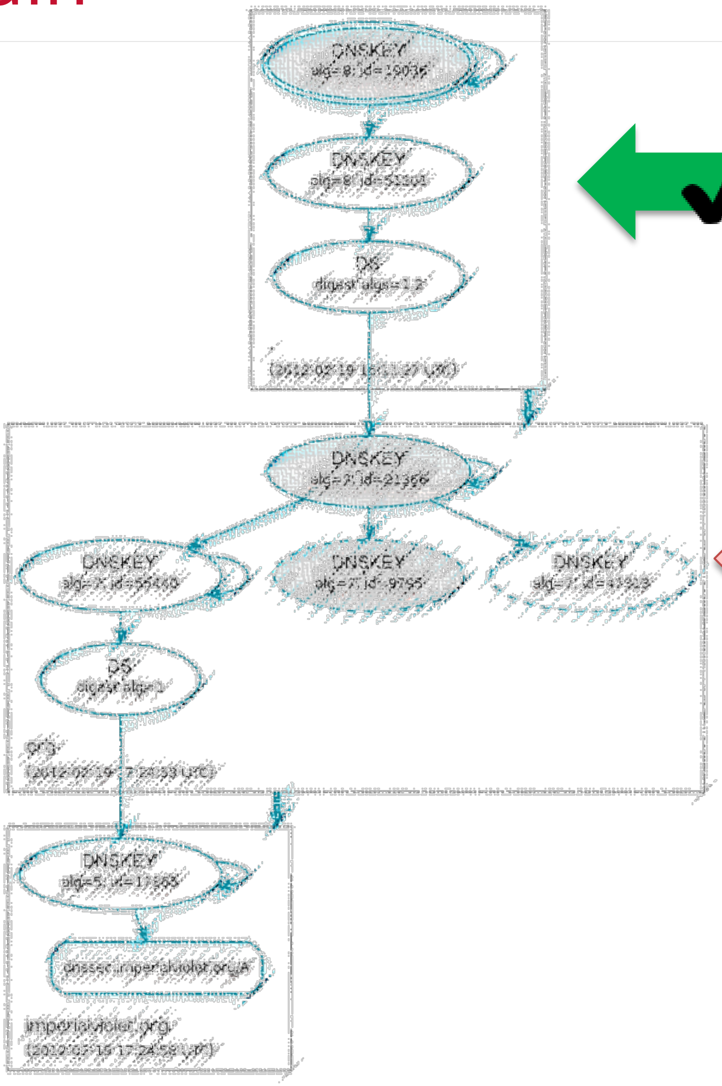
DNSSEC Chain



✓ ICANN

att.com ?

DNSSEC Chain

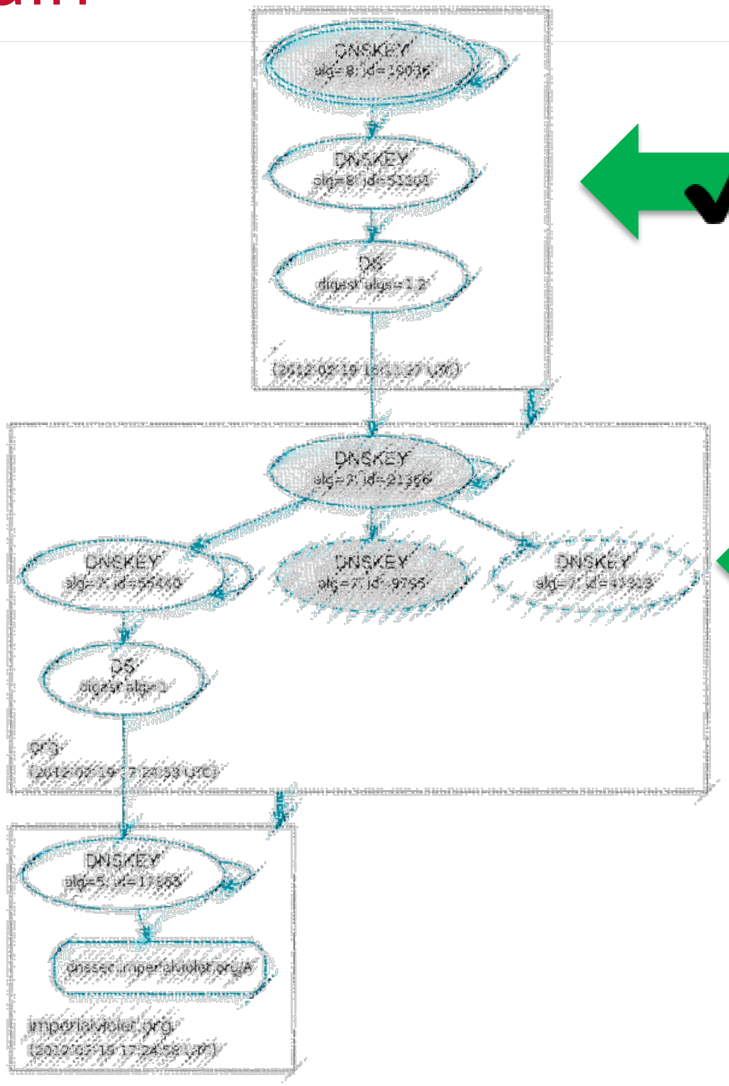


✓ ICANN

? .com
Verisign

att.com ?

DNSSEC Chain

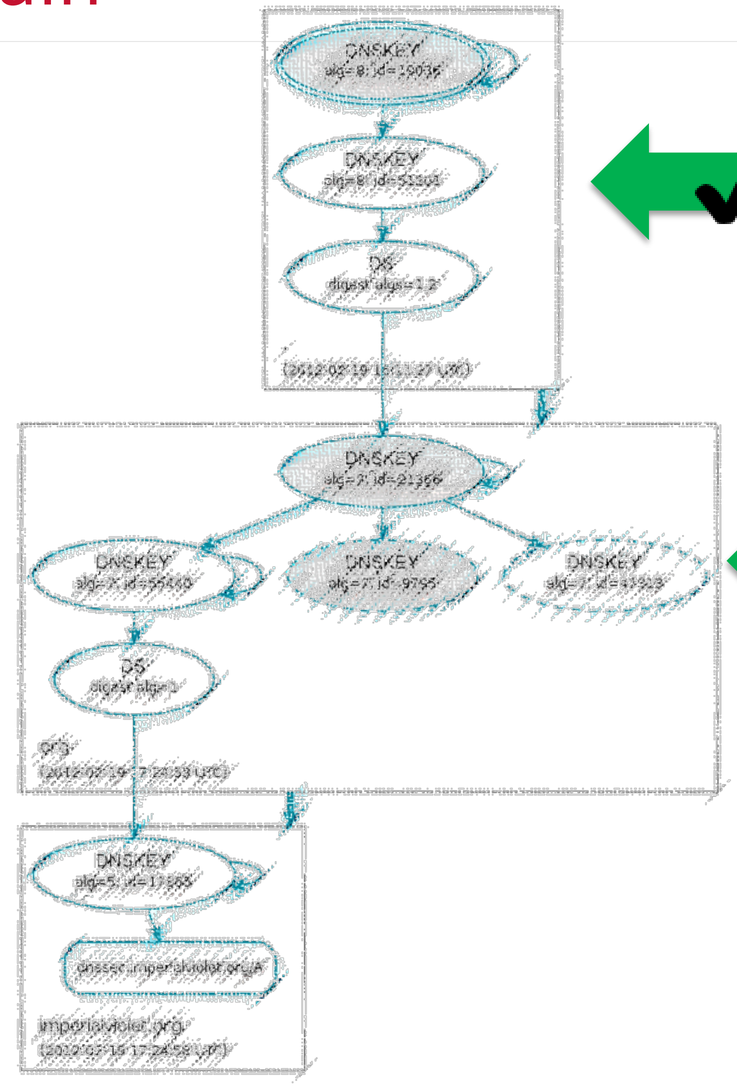


✓ ICANN

✓ .com
Verisign

att.com ?

DNSSEC Chain

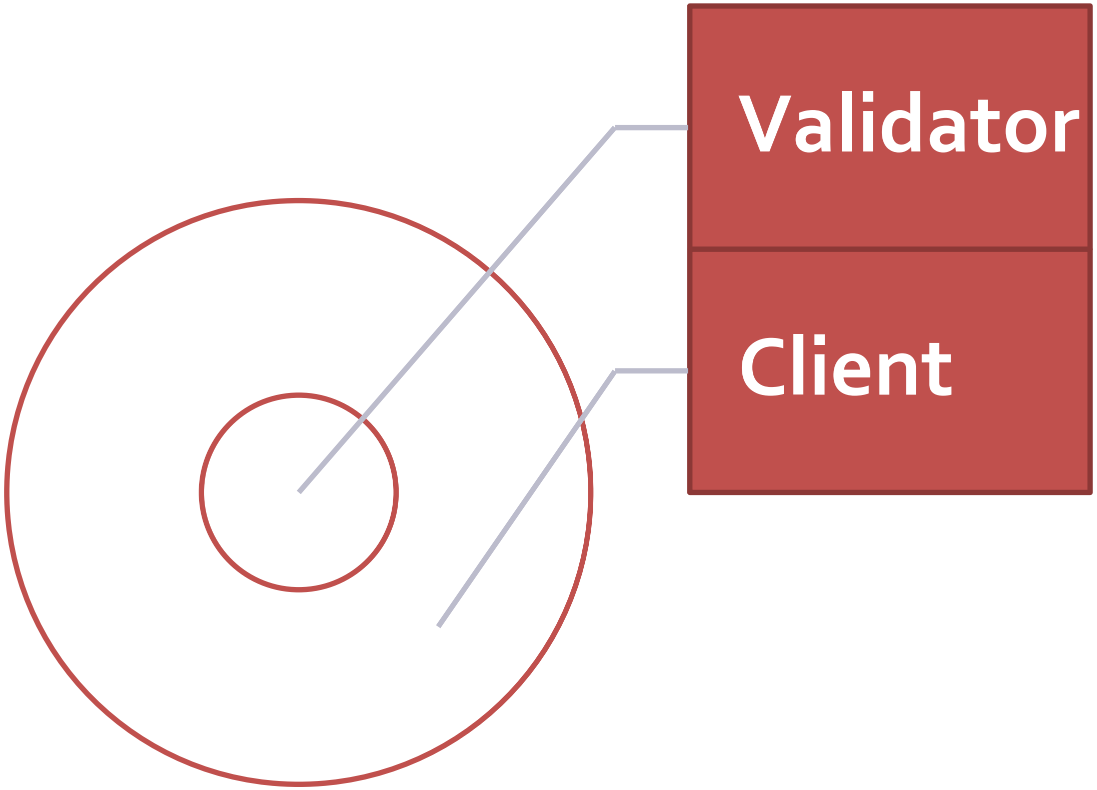


✓ ICANN

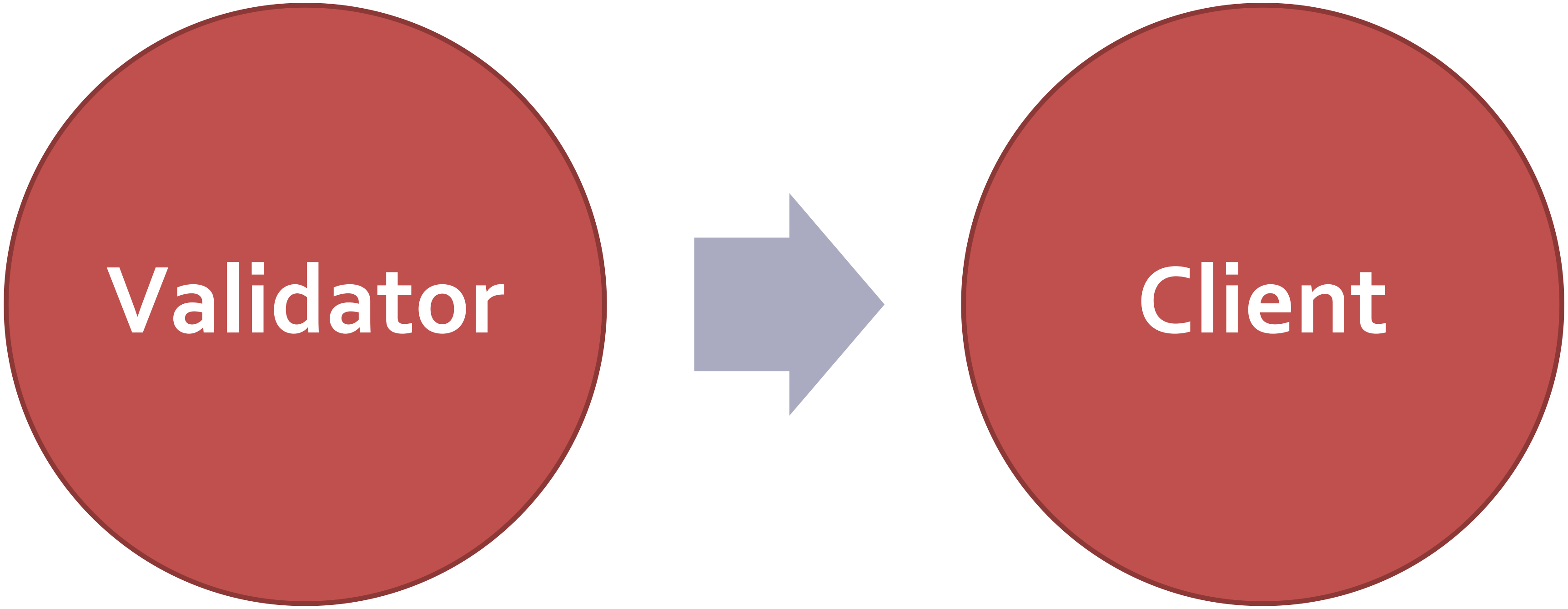
✓ .com Verisign

att.com ✓

Who verifies the signatures?



Who verifies the signatures?



Everything Is Signed

```
$ dig +dnssec nic.cz +short
217.31.205.50
A 5 2 1800 20120719160302 20120705160302
40844 nic.cz.
IWGHqGORGO0jh4UuZnwx1P2qoCGYDOcHLhJBIQVJm
h6+0Fskr6Sh2dgj
E6BHQJQJ9HuzSDCHOvJkH98QkK4ZUgMCLSN5DHuVc
mJ/J/g5VMjeWS3i
NmLQVmcvpizwfYVo7cuCg1OteazB2QH7JRp+/KhR+Q
+P8tNpDZKe2kEN VMQ=
```

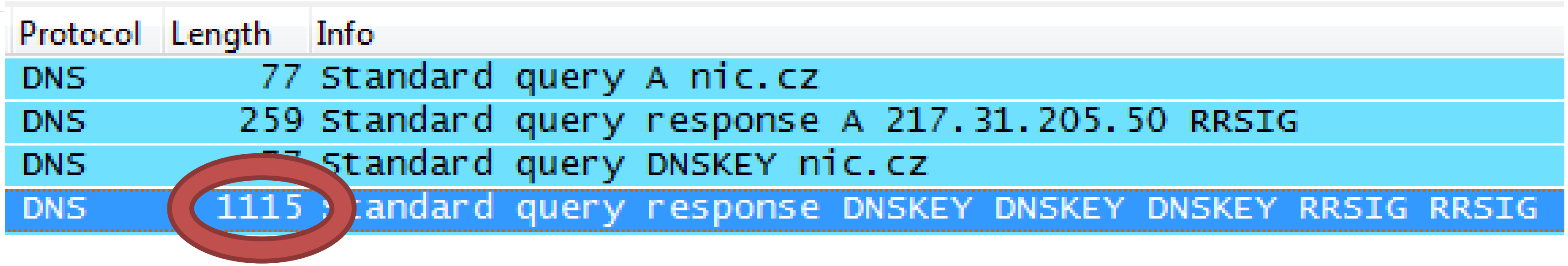
Everything Is Signed

```
$ dig +dnssec nic.cz
;; ANSWER SECTION:
nic.cz.                 1797    IN      A       217.31.205.50
nic.cz.                 1797    IN      RRSIG   A 5 2 1800 20120719160302 20120705160302 40844 nic.cz. IWGHqGORGO0jh4UuZnwx1P2qoCGYDOcHLhJBIQVJmh6+0Fskr6Sh2dgj
E6BHQJQJ9HuzSDCHOvJkH98QkK4ZUgMCLSN5DHuVcmJ/J/g5VMjeWS3i NmLQVmcvpizwfYVo7cuCg1OteazB2QH7JRp+/KhR+Q+P8tNpDZKe2kEN VMQ=


;; AUTHORITY SECTION:
nic.cz.                 1797    IN      NS      a.ns.nic.cz.
nic.cz.                 1797    IN      NS      b.ns.nic.cz.
nic.cz.                 1797    IN      NS      d.ns.nic.cz.
nic.cz.                 1797    IN      RRSIG   NS 5 2 1800 20120719160302 20120705160302 40844 nic.cz. aAWmFODbEaHEt6NxuaIu82wWiL+9jMMH+EvBx4jDS5ViydnSV/lb+hLr
dEZlVgBOSG5VdGKZ2y7cx8fGF8w9/9U1FioVowFfP0dOnZ5ZGAS9dNxm CzHV0+1LiiY0KKSUvPHq9y+thOOwfgkwkFEiofvvRtck1rh8fGfZCFL8 4JY=


;; ADDITIONAL SECTION:
a.ns.nic.cz.            1797    IN      A       194.0.12.1
b.ns.nic.cz.            1797    IN      A       194.0.13.1
d.ns.nic.cz.            1797    IN      A       193.29.206.1
a.ns.nic.cz.            1797    IN      AAAA    2001:678:f::1
b.ns.nic.cz.            1797    IN      AAAA    2001:678:10::1
d.ns.nic.cz.            1797    IN      AAAA    2001:678:1::1
a.ns.nic.cz.            1797    IN      RRSIG   A 5 4 1800 20120719160302 20120705160302 40844 nic.cz. Aj/zemlwTy2FM8+XDZPlDSKhcoKtKSSySugtqrQ8YZx/nOe7i3l/4H3D
XW7cQO/ND1lpW5VR+1RLbsQuovhAcQRtJj47WTkxYwWa4GdWH327aNn2 aklCdCOz6F8bGqZ2Af9EGqIZY+0Rk22FIqZc2qLpNoukI0Hfc0a6OP82 9/E=
b.ns.nic.cz.            1797    IN      RRSIG   A 5 4 1800 20120719160302 20120705160302 40844 nic.cz. XZVf0rEBg1R1j1KHGXt/2lx76s5EbBqfe9a2tU3eyO0MnudsKiPu1VM4
+cBLIgVDUsZMhOaX7i/qHaLAaTa98CucKIQKiwsVVG9kQEWV+OmMrZE3 01xjVd6KNGq77jDyEVz2l6yiTIt/8U7KHDtM3haUXITeyUGJZcJvZ3Ta IOc=
d.ns.nic.cz.            1797    IN      RRSIG   A 5 4 1800 20120719160302 20120705160302 40844 nic.cz. nFN5NWMibodVQYurwwdOlLIQbEWR0hSH+6OJDGRnsCpGGXiWr9VdeAhM
XFWehN/uVa6a+TpwJgnJFYkPzDVrVaFxTGdgNqqTFNcVtwLupbvc6Qq0 Nh6/0yKxbFEkK7n4R0m9Akwnr0BXVkdkpwy3xvZZGlMvfJMq/AKESqlD t3A=
a.ns.nic.cz.            1797    IN      RRSIG   AAAA 5 4 1800 20120719160302 20120705160302 40844 nic.cz. ghUpNuAs+8F08OfPucZg3/P+dOqQRdTYHoZVH8toyEcFqSTU3+yIp7HB
+O9hStK2RASMLi8lonzASZ2YbQRPZXmoBN+zEAZi6s3PIf3EFx7V388A UMowRyTyeh1qvf7fHn0llHDc2K1L4TZ5ZFuUg2PVNBaqcSSdI1mLDHsX AUM=
b.ns.nic.cz.            1797    IN      RRSIG   AAAA 5 4 1800 20120719160302 20120705160302 40844 nic.cz. MxlTDSe0Dkfyzbf9qdDj0Cs0oWrMpzkRsN8g4mfi1uWMuYlHTdUuu9d/
ec27we65x5B/SJJ6+Lb40A030BuuzJyvpuPNvpXh1fFCLZuvNuFPbhs9 MbptJmuEKjutraaA8jnxgK1KLT4kB+Nekf2IrwSC3oxAoyn5wXZJF0Fu /6o=
d.ns.nic.cz.            1797    IN      RRSIG   AAAA 5 4 1800 20120719160302 20120705160302 40844 nic.cz. AIRg88oIb4AR1QYeu5J0VBd6pjgeHI8vWAvJzy7m7O6Mmpn+KldrHu4M
gz7vOYPWZK8qNSvE/lDm7GZ3vERbVvprCwsvzaZCTb8h2wo1VxPx9tVA GQLo2yPTtX9gUqNBMRr/xS7CwyJLVNy3ZJTrQ3G8HyYOyRUVf/SubxPr srI=
```

Signatures Are Large



Protocol	Length	Info
DNS	77	Standard query A nic.cz
DNS	259	Standard query response A 217.31.205.50 RRSIG
DNS	77	Standard query DNSKEY nic.cz
DNS	1115	Standard query response DNSKEY DNSKEY DNSKEY RRSIG RRSIG

- DNS UDP Limit is 512
- EDNS UDP Limit is 4096
- DNS TCP has no limit

- 24 Residential and SOHO routers were tested
- 18 of 24 Devices tested couldn’t support EDNS
- 23 of 24 Devices tested couldn’t support TCP
  - http://www.icann.org/en/groups/ssac/documents/sac-053-en.pdf

Everything Is Signed - Including No’s

Where is doesntexist.att.com?

There is no doesntexist.att.com

RRSIG(“There is no doesntexist.att.com”, ATT-Key$_{ZSK}$)

Denial of Service

Where is doesntexist1.att.com?

There is no doesntexist1.att.com

RRSIG("There is no doesntexist1.att…", ATT-Key$_{ZSK}$)

Where is doesntexist2.att.com?

There is no doesntexist2.att.com

RRSIG("There is no doesntexist2.att…", ATT-Key$_{ZSK}$)

Where is doesntexist3.att.com?

There is no doesntexist3.att.com

RRSIG("There is no doesntexist3.att…", ATT-Key$_{ZSK}$)

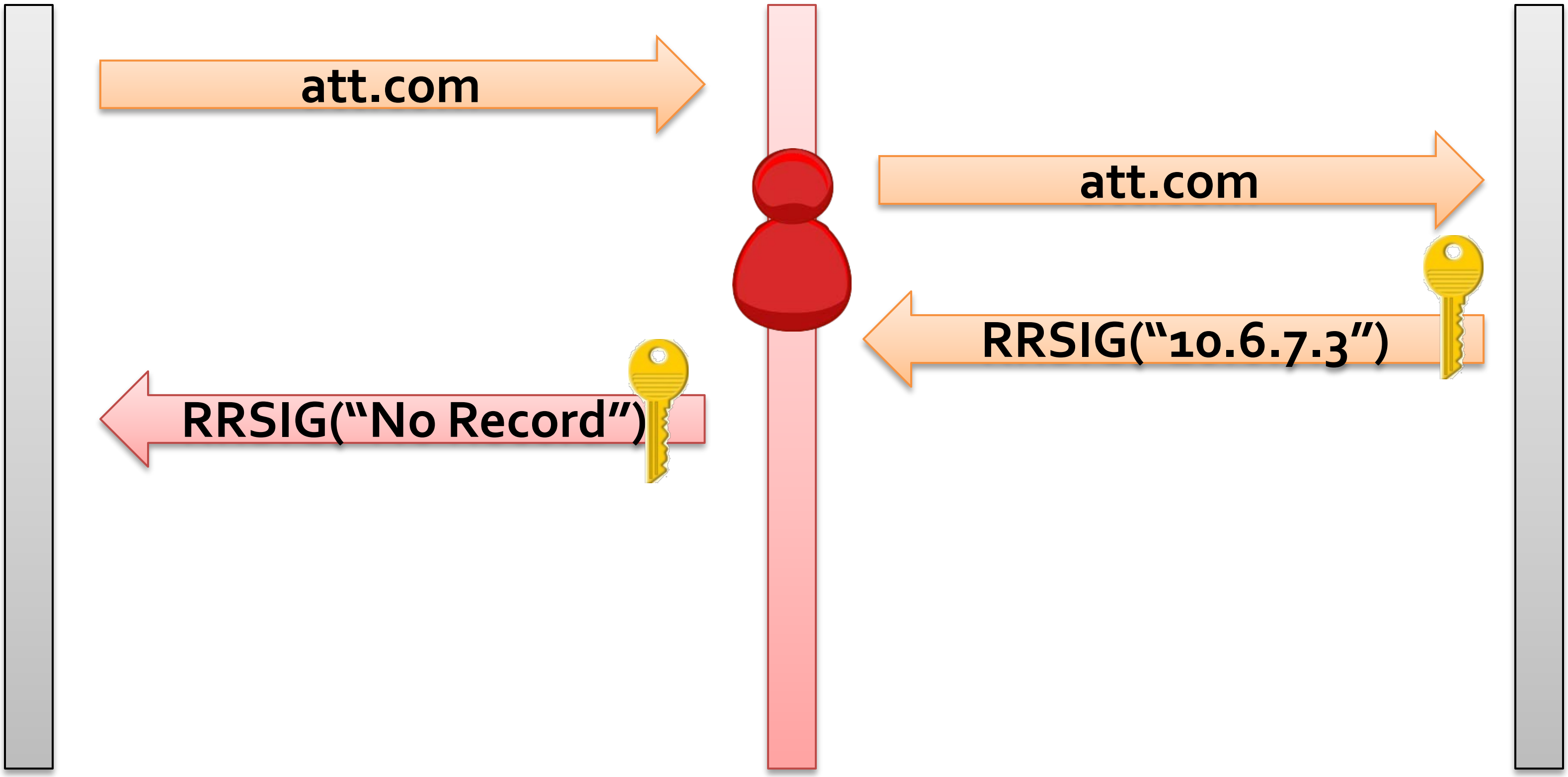
Sign a Single Response?

Where is doesntexist.att.com?

No Record

RRSIG("No Record", ATT-Key$_{ZSK}$)

Man in the Middle



Sign The Ranges

Where is doesntexist.att.com?

There is nothing between admin.att.com and keyserver.att.com

RRSIG("There is nothing between…", ATT-Key$_{ZSK}$)

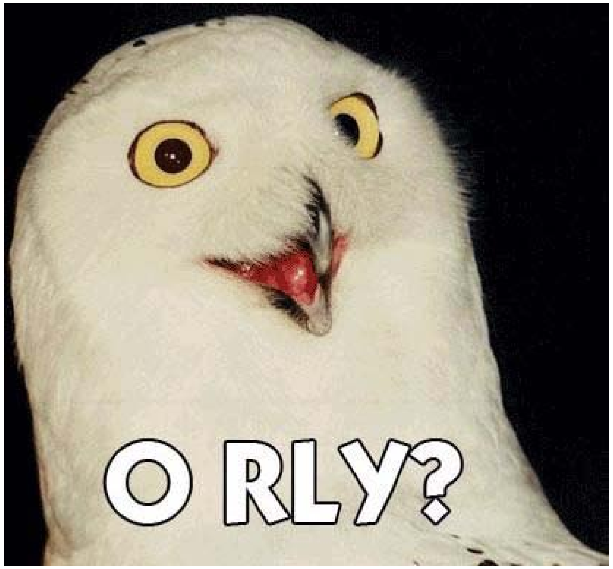
Called NSEC

Information Disclosure

Where is doesntexist.att.com?

There is nothing between admin.att.com and keyserver.att.com

RRSIG(“There is nothing between…”, ATT-Key$_{ZSK}$)



Hash, then Sign The Ranges

Where is doesntexist.att.com?

doesntexist.att.com -> hash it -> da739562…..

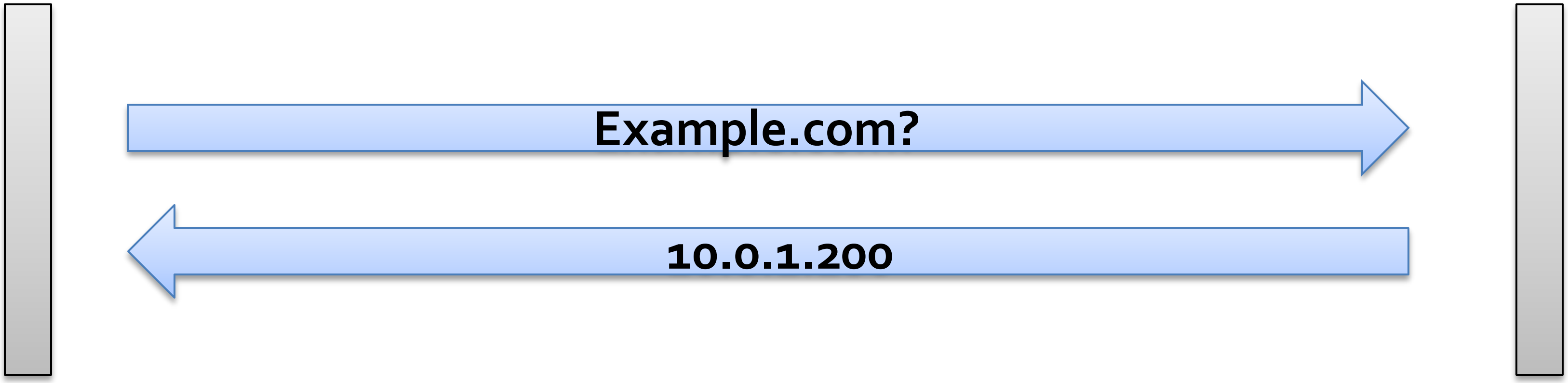
There is nothing between a847629…. and ff572645….

RRSIG("There is nothing between…", ATT-Key$_{ZSK}$)

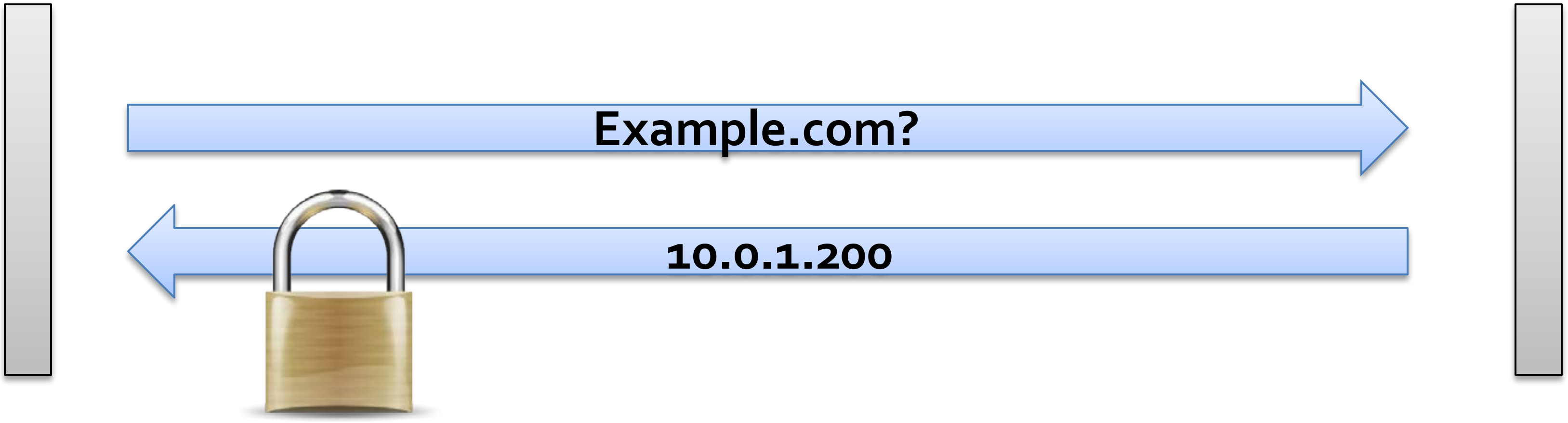
Called NSEC3!

‘Put It In DNSSEC’

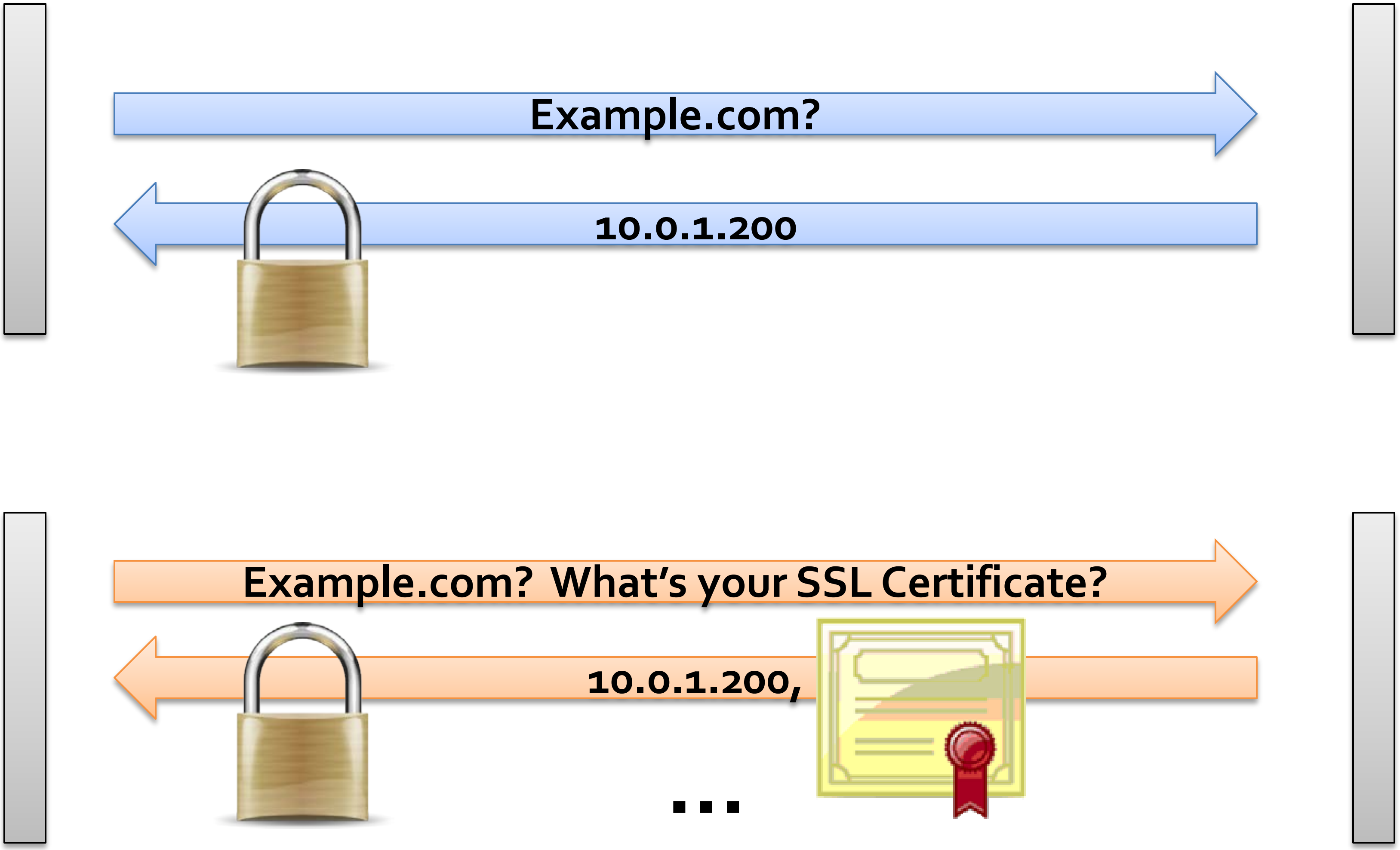
Shoving Stuff in DNSSEC



Shoving Stuff in DNSSEC



Shoving Stuff in DNSSEC



Example.com?

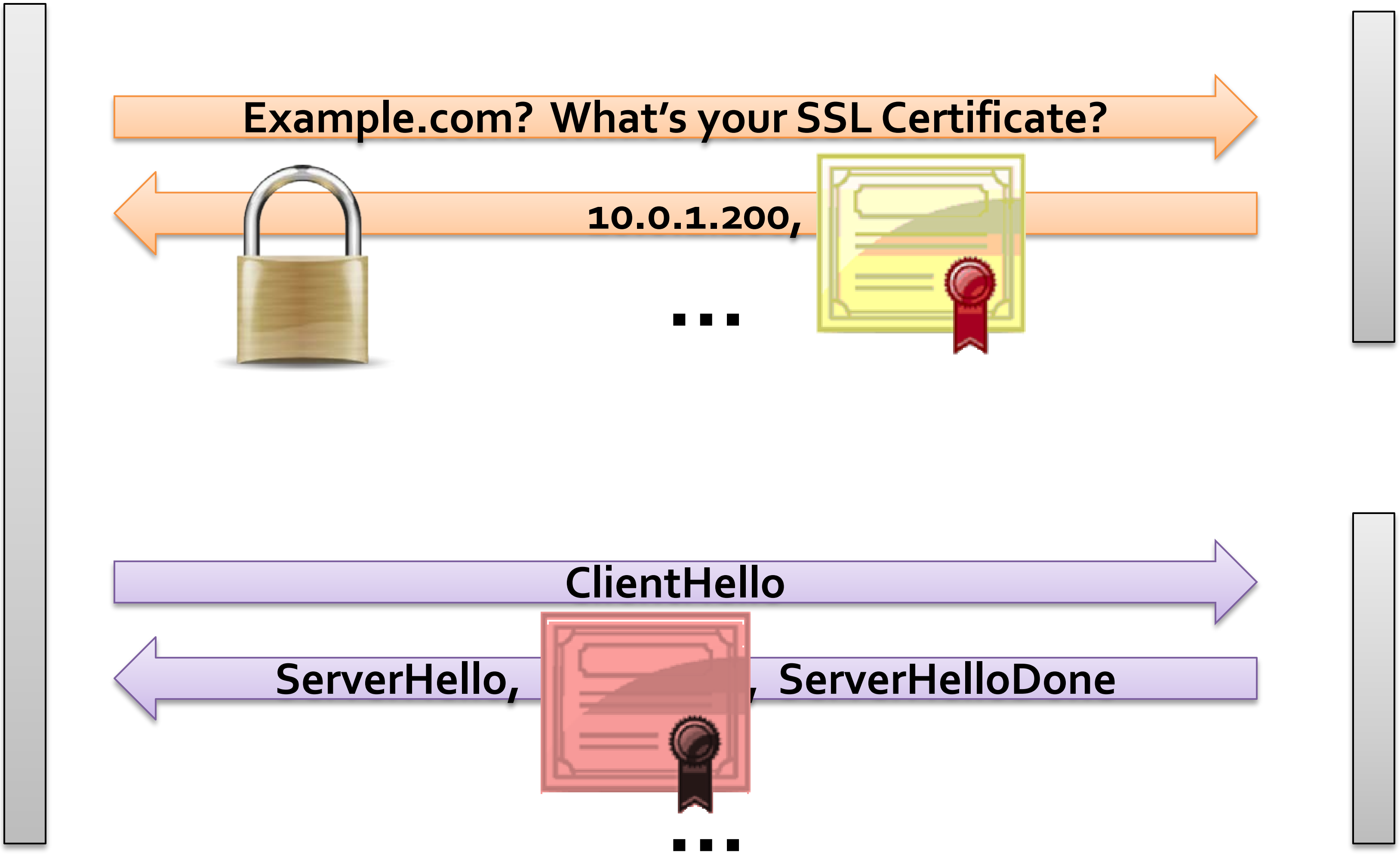
10.0.1.200

Example.com? What's your SSL Certificate?

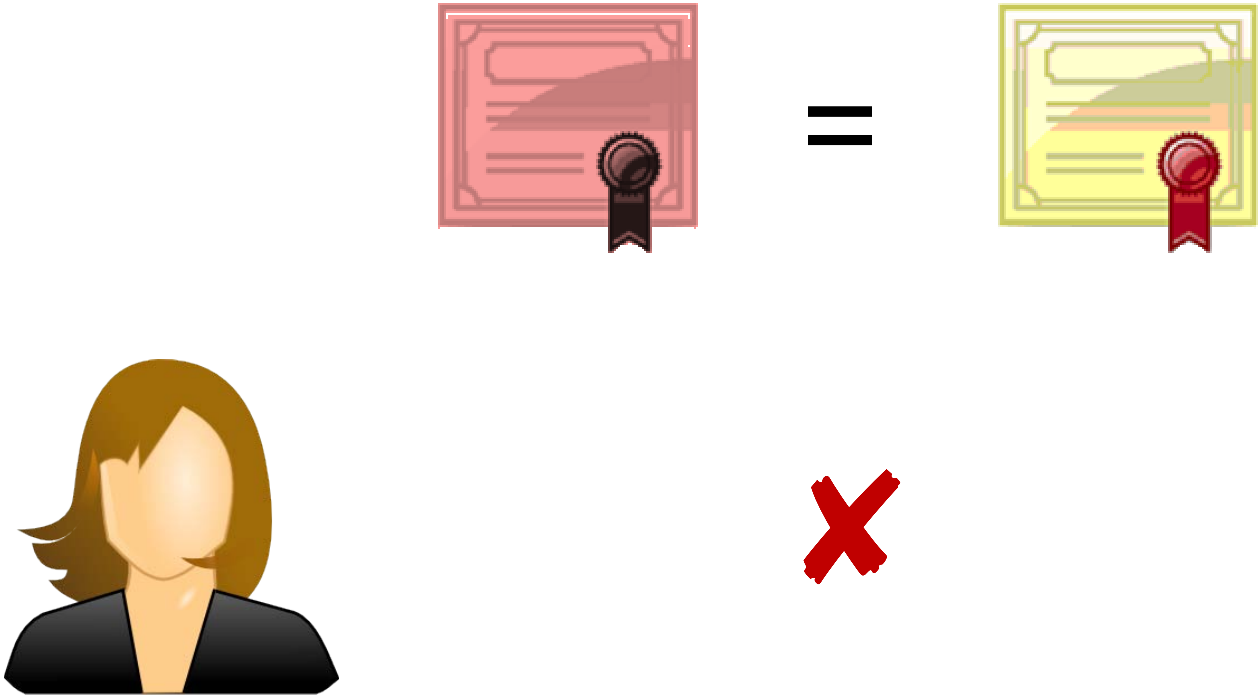
10.0.1.200,

…

Shoving Stuff in DNSSEC



Shoving Stuff in DNSSEC



Bootstrapping Security

SSL Certs (DANE)

Product Update Checks

SSL Certs (DANE)

Product Update Checks

SSH

- ssh -o "VerifyHostKeyDNS yes”
- RFC 4255

OpenPGP

- gpg --auto-key-locate pka

S/MIME

- draft-hoffman-dane-smime-03

Domain Policy Framework

- Our attempt to unify several DNS security languages into one, extensible meta-language
- Takes advantage of new gTLD program to build special new neighborhood
- Combines a per-gTLD base policy with policy in DNS:

```
Base Policy:       DPFv=1;HTLS=12;DNSSEC=2;STLS=1;
Received Policy:   DPFv=2;HTLS=13;STLS=0;
Resultant Policy:   DPFv=2;HTLS=13;DNSSEC=2;STLS=1;
```

DOMAINPOLICY
working group

DomainPolicy.org

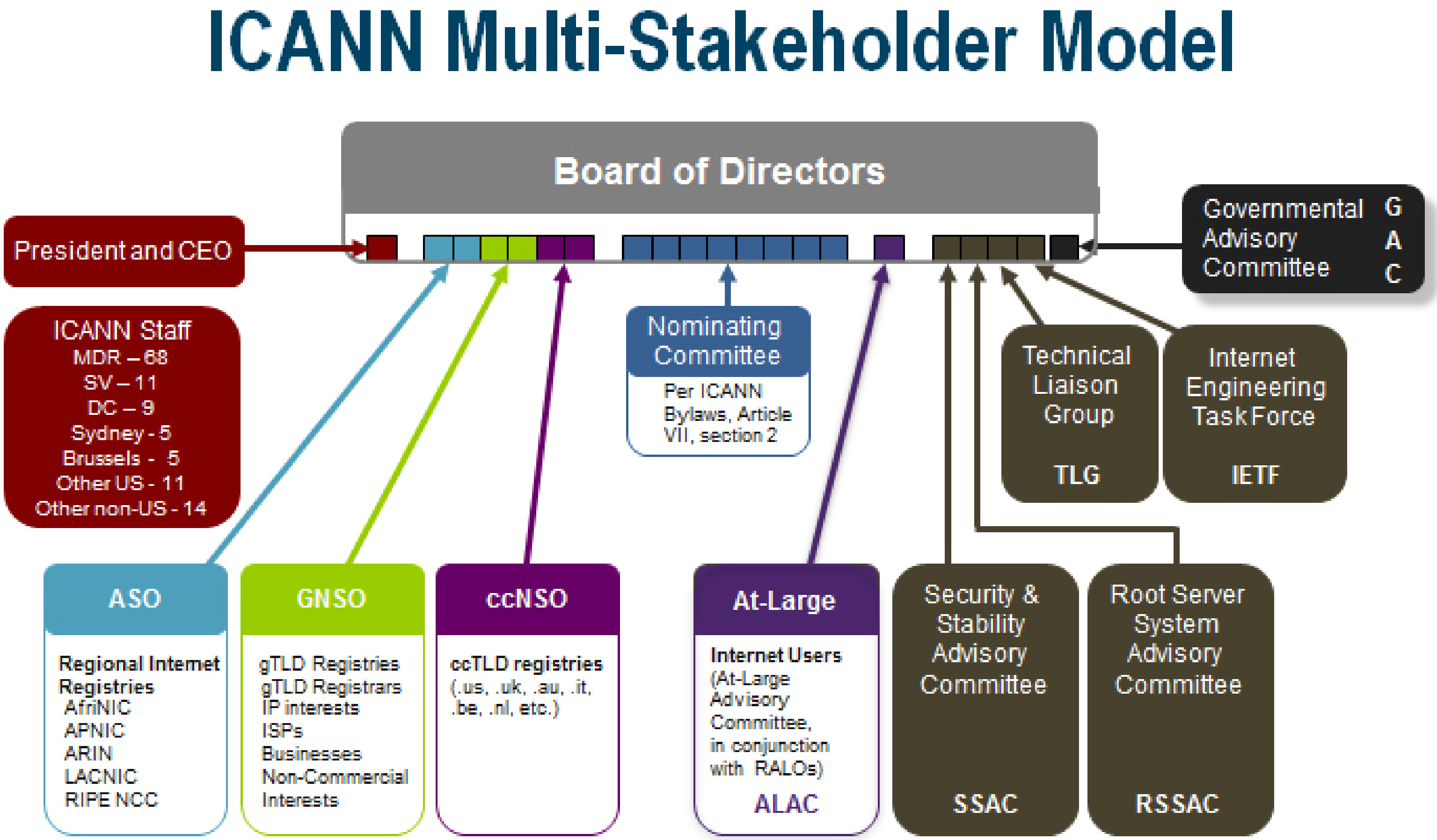
New gTLDs

.com .org .net

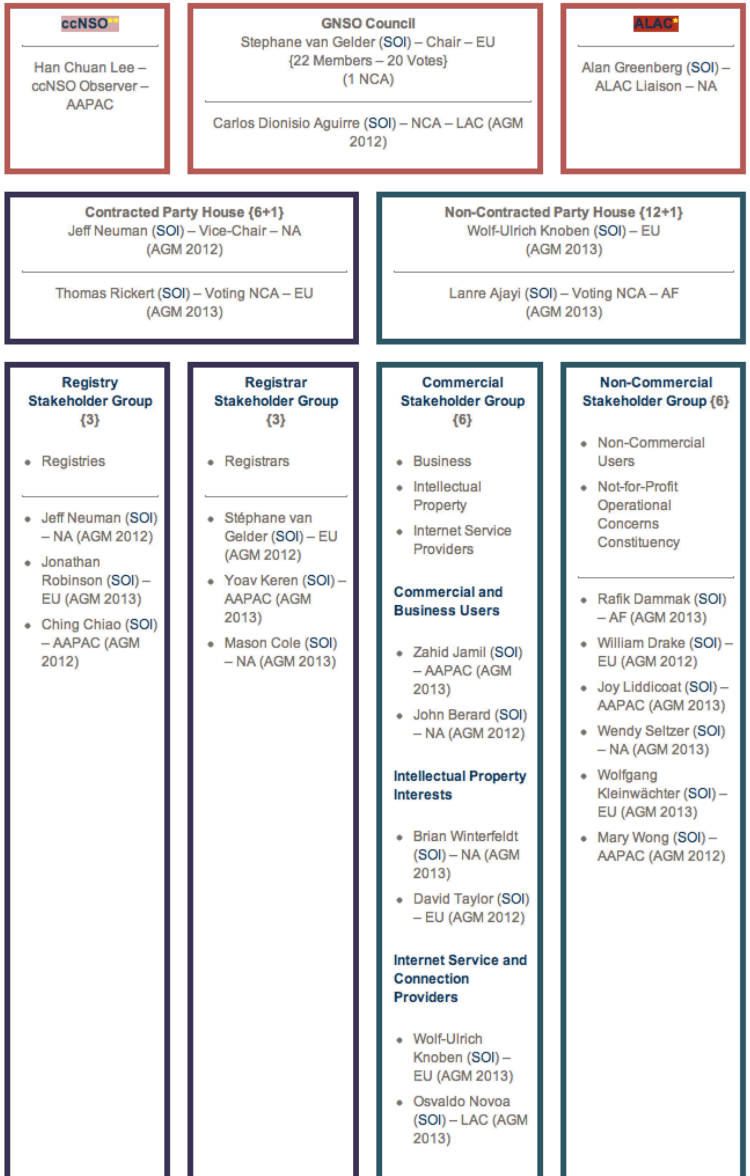
.biz .museum .coop

.whatever .you .like

Where ICANN Ended Up



Where ICANN Ended Up



ccNSO

Han Chuan Lee – ccNSO Observer – AAPAC

GNSO Council

Stephane van Gelder (SOI) – Chair – EU
{22 Members – 20 Votes}
(1 NCA)

Carlos Dionisio Aguirre (SOI) – NCA – LAC (AGM 2012)

ALAC

Alan Greenberg (SOI) – ALAC Liaison – NA

Contracted Party House {6+1}

Jeff Neuman (SOI) – Vice-Chair – NA (AGM 2012)

Thomas Rickert (SOI) – Voting NCA – EU (AGM 2013)

Non-Contracted Party House {12+1}

Wolf-Ulrich Knoben (SOI) – EU (AGM 2013)

Lanre Ajayi (SOI) – Voting NCA – AF (AGM 2013)

Registry Stakeholder Group {3}

- Registries

- Jeff Neuman (SOI) – NA (AGM 2012)
- Jonathan Robinson (SOI) – EU (AGM 2013)
- Ching Chiao (SOI) – AAPAC (AGM 2012)

Registrar Stakeholder Group {3}

- Registrars

- Stéphane van Gelder (SOI) – EU (AGM 2012)
- Yoav Keren (SOI) – AAPAC (AGM 2013)
- Mason Cole (SOI) – NA (AGM 2013)

Commercial Stakeholder Group {6}

- Business
- Intellectual Property
- Internet Service Providers

Commercial and Business Users

- Zahid Jamil (SOI) – AAPAC (AGM 2013)
- John Berard (SOI) – NA (AGM 2012)

Intellectual Property Interests

- Brian Winterfeldt (SOI) – NA (AGM 2013)
- David Taylor (SOI) – EU (AGM 2012)

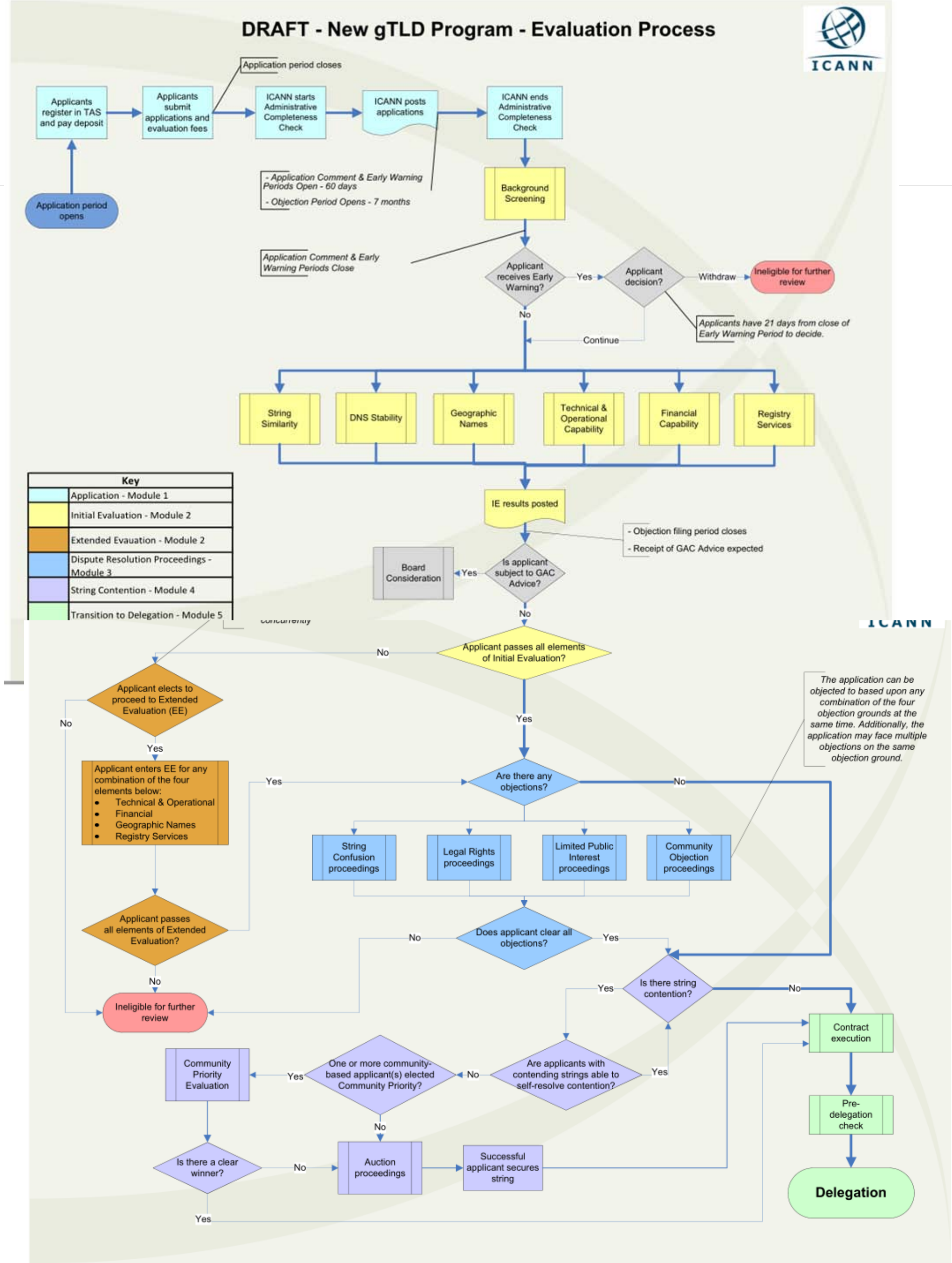
Internet Service and Connection Providers

- Wolf-Ulrich Knoben (SOI) – EU (AGM 2013)
- Osvaldo Novoa (SOI) – LAC (AGM 2013)

Non-Commercial Stakeholder Group {6}

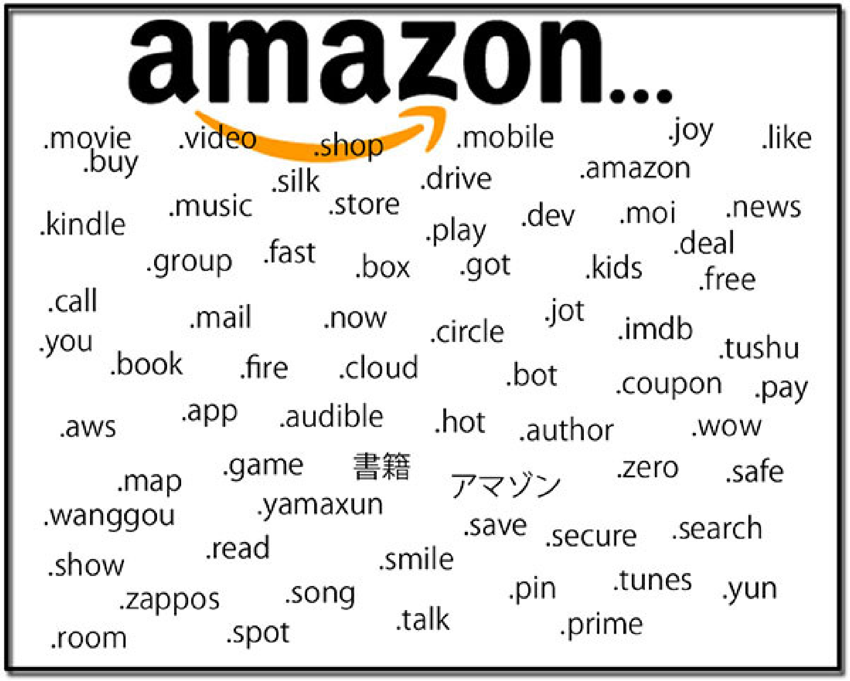
- Non-Commercial Users
- Not-for-Profit Operational Concerns Constituency

- Rafik Dammak (SOI) – AF (AGM 2013)
- William Drake (SOI) – EU (AGM 2012)
- Joy Liddicoat (SOI) – AAPAC (AGM 2013)
- Wendy Seltzer (SOI) – NA (AGM 2013)
- Wolfgang Kleinwächter (SOI) – EU (AGM 2013)
- Mary Wong (SOI) – AAPAC (AGM 2012)


DRAFT - New gTLD Program - Evaluation Process
ICANN
Application period closes
Applicants register in TAS and pay deposit
Applicants submit applications and evaluation fees
ICANN starts Administrative Completeness Check
ICANN posts applications
ICANN ends Administrative Completeness Check
Application period opens
- Application Comment & Early Warning Periods Open - 60 days
- Objection Period Opens - 7 months
Background Screening
Application Comment & Early Warning Periods Close
Applicant receives Early Warning?
Yes
Applicant decision?
Withdraw
Ineligible for further review
Applicants have 21 days from close of Early Warning Period to decide.
No
Continue
String Similarity
DNS Stability
Geographic Names
Technical & Operational Capability
Financial Capability
Registry Services
Key
Application - Module 1
Initial Evaluation - Module 2
Extended Evauation - Module 2
Dispute Resolution Proceedings - Module 3
String Contention - Module 4
Transition to Delegation - Module 5
IE results posted
- Objection filing period closes
- Receipt of GAC Advice expected
Board Consideration
Yes
Is applicant subject to GAC Advice?
No
concurrently
Applicant passes all elements of Initial Evaluation?
No
Applicant elects to proceed to Extended Evaluation (EE)
No
Yes
Applicant enters EE for any combination of the four elements below:
Technical & Operational
Financial
Geographic Names
Registry Services
Yes
Are there any objections?
No
The application can be objected to based upon any combination of the four objection grounds at the same time. Additionally, the application may face multiple objections on the same objection ground.
String Confusion proceedings
Legal Rights proceedings
Limited Public Interest proceedings
Community Objection proceedings
Applicant passes all elements of Extended Evaluation?
Does applicant clear all objections?
No
Yes
No
Ineligible for further review
Is there string contention?
Yes
No
Contract execution
Community Priority Evaluation
Yes
One or more community-based applicant(s) elected Community Priority?
No
Are applicants with contending strings able to self-resolve contention?
Yes
No
Pre-delegation check
Is there a clear winner?
No
Auction proceedings
Successful applicant secures string
Delegation
Yes

.bugatti

Competition and Public Interest



amazon...

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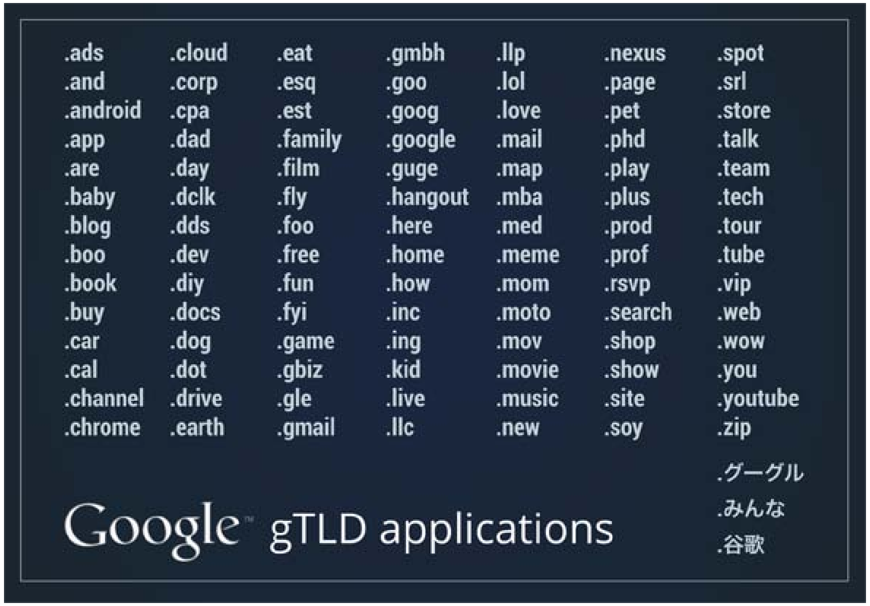

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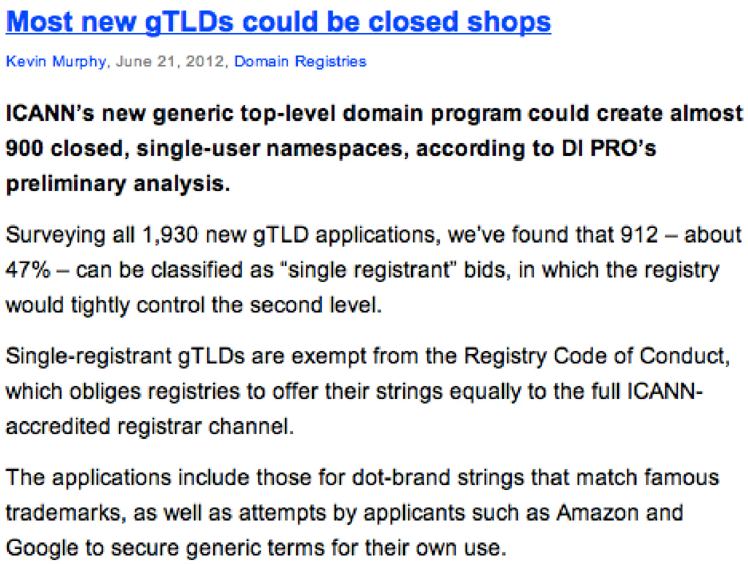
Google™ gTLD applications

Competition and Public Interest



Most new gTLDs could be closed shops

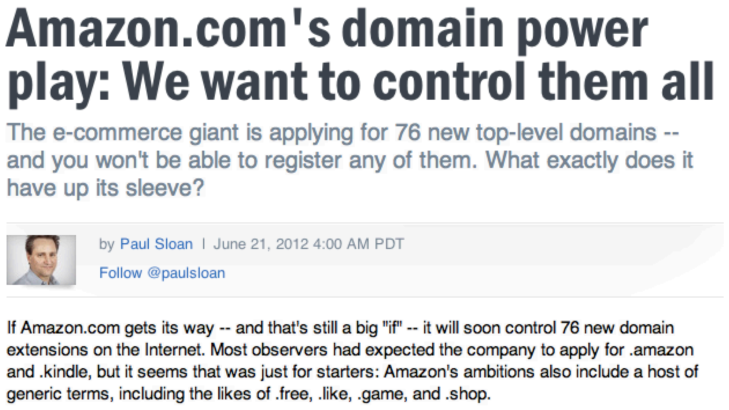
Kevin Murphy, June 21, 2012, Domain Registries

ICANN's new generic top-level domain program could create almost 900 closed, single-user namespaces, according to DI PRO's preliminary analysis.

Surveying all 1,930 new gTLD applications, we've found that 912 – about 47% – can be classified as "single registrant" bids, in which the registry would tightly control the second level.

Single-registrant gTLDs are exempt from the Registry Code of Conduct, which obliges registries to offer their strings equally to the full ICANN-accredited registrar channel.

The applications include those for dot-brand strings that match famous trademarks, as well as attempts by applicants such as Amazon and Google to secure generic terms for their own use.



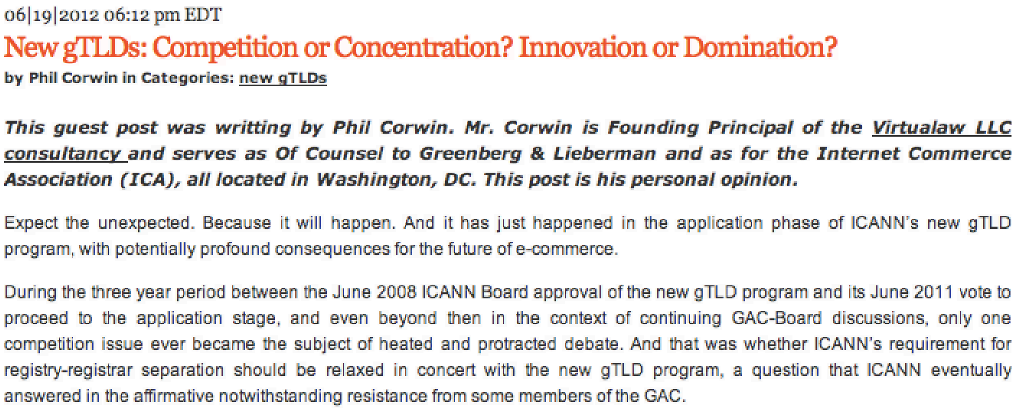
Amazon.com's domain power play: We want to control them all

The e-commerce giant is applying for 76 new top-level domains -- and you won't be able to register any of them. What exactly does it have up its sleeve?

by Paul Sloan | June 21, 2012 4:00 AM PDT

Follow @paulsloan

If Amazon.com gets its way -- and that's still a big "if" -- it will soon control 76 new domain extensions on the Internet. Most observers had expected the company to apply for .amazon and .kindle, but it seems that was just for starters: Amazon's ambitions also include a host of generic terms, including the likes of .free, .like, .game, and .shop.



06|19|2012 06:12 pm EDT

New gTLDs: Competition or Concentration? Innovation or Domination?

by Phil Corwin in Categories: new gTLDs

This guest post was writting by Phil Corwin. Mr. Corwin is Founding Principal of the Virtualaw LLC consultancy and serves as Of Counsel to Greenberg & Lieberman and as for the Internet Commerce Association (ICA), all located in Washington, DC. This post is his personal opinion.

Expect the unexpected. Because it will happen. And it has just happened in the application phase of ICANN's new gTLD program, with potentially profound consequences for the future of e-commerce.

During the three year period between the June 2008 ICANN Board approval of the new gTLD program and its June 2011 vote to proceed to the application stage, and even beyond then in the context of continuing GAC-Board discussions, only one competition issue ever became the subject of heated and protracted debate. And that was whether ICANN's requirement for registry-registrar separation should be relaxed in concert with the new gTLD program, a question that ICANN eventually answered in the affirmative notwithstanding resistance from some members of the GAC.

Top Level Websites

- Supposed to be outlawed
- How do you represent them
  - http://ai
  - http://ai.
  - http://ai/
- How does this interact with certificate authorities?
  - We could have bought *.bugatti for less than $10K

Existing A records:

- AC has address 193.223.78.210
- AI has address 209.59.119.34
- BT has address 192.168.42.202
- CM has address 195.24.205.60
- DK has address 193.163.102.24
- GG has address 87.117.196.80

The Big Picture

- **The Death of Reputation**
- **Redesigning Enterprise Networks and Attacks**
- **External Attacks and Enumeration**
- **Product Promises and Failures**

The End of Scarcity

The Death of Reputation

Scarcity makes certain assumptions reasonably true:

- An individual user has a high attachment rate for a small number of IPs
- A trademarked domain name has likely been taken by the most recognizable holder
- IP spoofing is highly limited in full-connection situations

Uses of IP Reputation

- Anti-Fraud and Adaptive Authentication
    - RSA, SilverTail, EnTrust
- DDoS Prevention and Rate Limiting
    - Arbor Networks, RadWare, every load balancer
- IDS, SIEM and Event Correlation
    - ArcSight, Splunk, Sourcefire

A simple example:

```
rate_filter
        gen_id 135, sig_id 1,
        track by_src,
        count 100, seconds 1,
        new_action drop, timeout 10
```

Per IP

How can you Adapt?

Switch to “Network Reputation”

- Intelligent detection of subnetting
- Correlation to other data to determine flows
- Positive, not negative reputation
- Con: One bad actor could DoS a popular network
- Con: State table will need to be ginormous, creates another DoS

Filter out network bogons

- Reverse BGP lookups
- Central databases of assigned and utilized spaces

Implement intelligent egress filtering

- Subnet limits no longer good enough, need stateful tracking of assigned IPs

Domain Reputation

- A lot of security thinking goes into securing this relationship:

www.paypal.com <-> 173.0.84.2

- This is also an important mapping:

www.paypal.com <-> The Real PayPal with all the Money

- With 1400 potential new gTLDs, this mapping becomes more difficult for consumers to keep in their head

WhoTF is paypal.rugby?

Domain Reputation Protection

- ICANN nGTLD Rules
  - You need to be heavily engaged right now, coming to ICANN meetings
  - Should be possible to derail .yourbrand via official objection process
- Trademark Clearing House
  - Required part of first 90 days of registration
  - Any trademark works, rules and implementation are in flux
- Sunrise Period
  - Required window for existing gTLD and trademark owners to step to the front of line
  - Easiest and cheapest way to get your gTLD
  - Only lasts 30 days, you'll need to be ready
- URS
  - Mechanism for suspending (but not taking) second level domains
  - Much more IP-friendly than existing WIPO process
  - Nobody wants to run this for $500/name

A word you will hear often

Homograph!

http://paypal.com http://paypal.com

xn--fsquooa.xn—g8w231d xn--fsquooa.xn--g6w251d

PunyCode

http://مثال.إختبار

xn--mgbhofb.xn--kgbechtv

http://例子.測試

xn--fsquooa.xn--g6w251d

http://пример.испытание

xn--e1afmkfd.xn--80akhbyknj4f

http://דוגמה.טעסט

xn--fdbk5d8ap9b8a8d.xn--debaoad

Browser Homograph Handling

Internet Explorer

- System language settings
- Does not allow mixed characters

Chrome

- Browser language settings
- Does not allow mixed character sets

Firefox

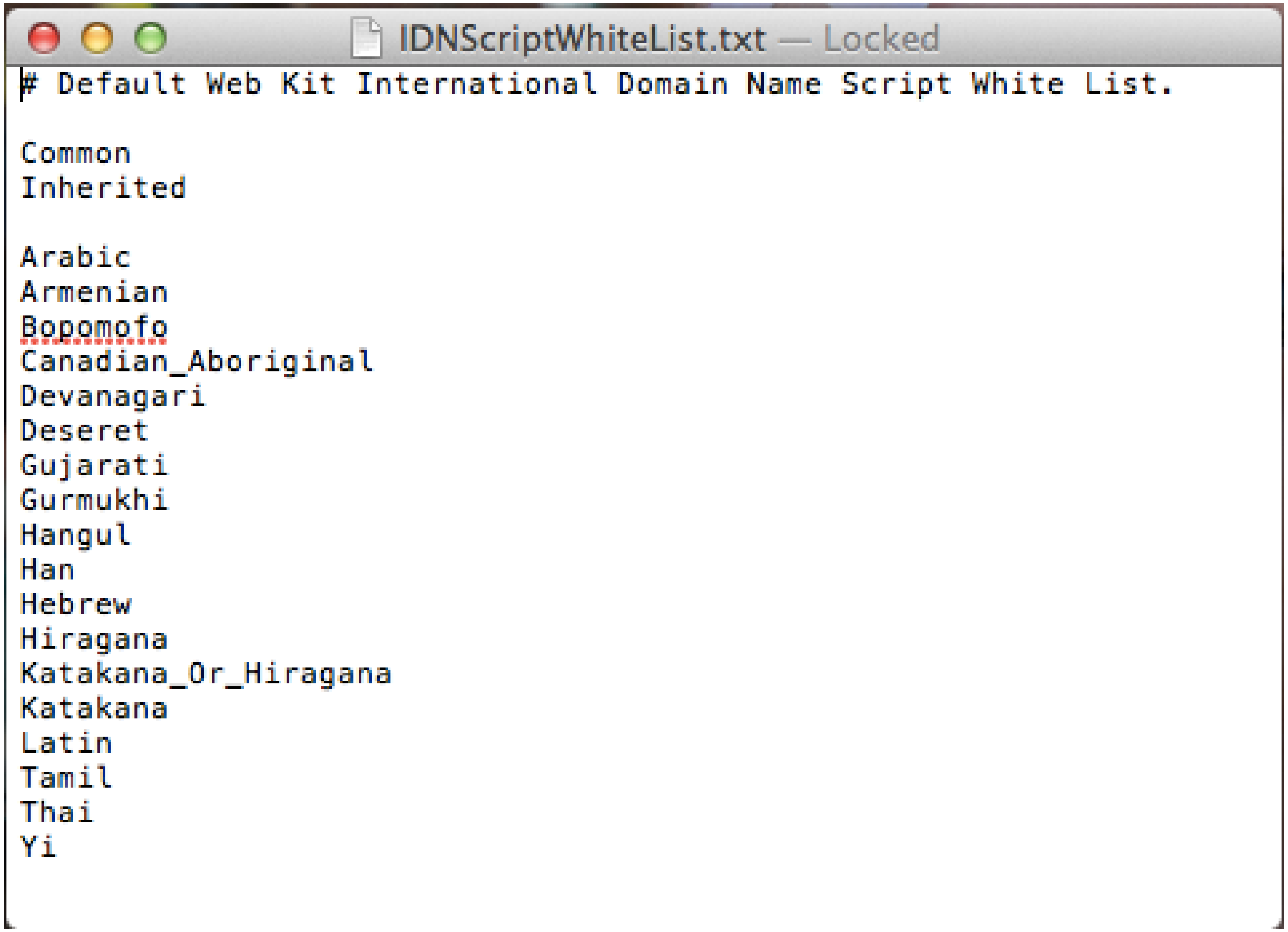
- Whitelists TLDs, changing

Opera

- Whitelists TLDs

Safari…

Safari Character White List



```
# Default Web Kit International Domain Name Script White List.

Common
Inherited

Arabic
Armenian
Bopomofo
Canadian_Aboriginal
Devanagari
Deseret
Gujarati
Gurmukhi
Hangul
Han
Hebrew
Hiragana
Katakana_Or_Hiragana
Katakana
Latin
Tamil
Thai
Yi
```

Enterprise Architecture

IPv6 is intended to restore the “end-to-end principal”

Will it?

True IPv6 Enterprises would include:

1. Publicly addressable end-points
2. Firewalls doing actual firewalling
3. NAT64 mechanisms for IPv4 access
4. VPN with sticky addresses, like DirectAccess

Will this happen?

Probably not… more likely:

1. Mix of real IPv6 and NAT

- Both IP versions running end-to-end for a while, causing lots of access control headaches
- Large scale NAT64 for native IPv6 clients

2. Lots of public addressing with private routing

- Using a real prefix doesn't mean you allow public routing.
- Controls should include null route tables for specific subnet netmask and firewall rules

3. Proxies will become even more important for egress control

- Proliferation of network identities makes it important to create artificial checkpoints
- Proxies can provide authentication and logging not based on IP4/6 address

Pros and Cons for Attackers

Pros:

- Likelihood of routable end-points that can be attacked directly (80's style)
- ARP Spoofing becomes at least 6 new link local attacks
- Easier to hide attacks, internal compromised machines, control channels
- Multiple IP identities slows down incident response

Cons:

- Finding machines via random IP scanning impossible
- 100% coverage of routable space not possible
- DNSSEC provides some protections if properly deployed

Future Work

You should submit these talks in 2013:

- "Denial of Service via IPv6 State Exhaustion"
- "Using and Abusing IPv6 Multicast for Fun and Profit"
- "I Want All the Internets: Hacking with Translation and Transition Mechanisms"
- "This Crap Broke: A Study of Major Vendor Products in an all IPv6/DNSSEC World"
- "IPv6 Covert Channels"

Thank You

Alex Stamos

alex@artemis.net

Artemis Internet