

BGP route hijacking

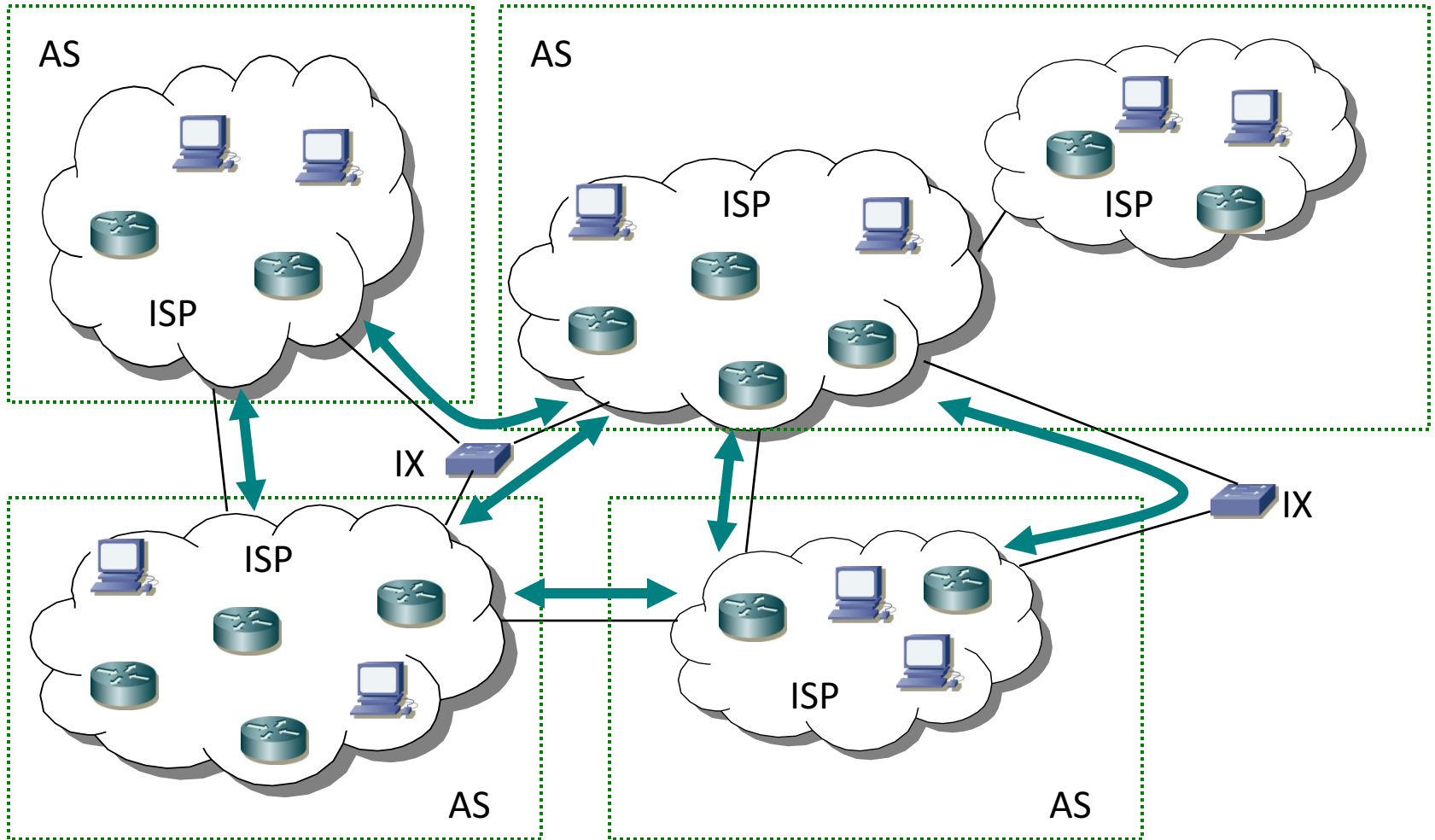
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IP address

- Most abuse reports are based on source IP address, as it's considered as the identifier and the locator of the corresponding host on the internet.
- But it's not always true...

BGP?



Mis-announcements

- BGP announcements without authority
 - Mostly it's believed as mistakes like typo, leakage of test and other mis-configurations
 - We are observing a bunch of this stuff
- It has been said there are intentional BGP hijacking by malicious folks, and here is the cases....

Starting with a post to JANOG ML

- [janog:12845] IJ to the white courtesy phone.
 - Notifying strange BGP announcements
 - Also stating the prefix was listed at the Spamhaus SBL

- Thanks for the heads-up!

The /16 IPv4 prefix

- Transferred to IJ recently
 - on 21/Oct/2014
- IJ kept it in stock for future use
 - IJ didn't start to announce it at that time ☹
 - WHOIS information at JPNIC was updated, but no IRR registration ☹
- An ISP in U.S. started to announce the IP block as 2 x /17s on 5/Jan/2015
 - No, IJ didn't ask that

To stop the wrong announcements

- IJ contacted the announcing ISP immediately
 - E-mail to their NOC followed by a phone call
 - Started BGP announcements by ourselves
- The first contact:
 - Got ACK and the person on the call agreed to deal with the announcements, but nothing was happened in the next 48 hours
- The second contact:
 - Convinced the (different) person on the call, and got a **ticket #** to track the progress of handling
 - The announcements were finally stopped 😊

Lesson learned #1

- Ask for a ticket #
 - especially in case the ISP has a ticket system to track their jobs
- Keep WHOIS DB up-to-date
 - To prove your correctness
 - I sent our WHOIS information to the NOC by e-mail, and also asked the NOC person to query the prefix by himself

The progress

- 4/Feb/2015 - The post to JANOG
 - The first contact to the ISP
- 6/Feb/2015 - The second contact to the ISP
- 7/Feb/2015 - The routes were withdrawn
- 12/Feb/2015 - Contacted Spamhaus to delist
- 13/Feb/2015 - The prefix was delisted from SBL

Bringing in IP spaces to ISP

- A customer of the ISP submitted a LoA (Letter of Authority) to use the prefix, and asked the ISP to originate the BGP announcements
- **No, IJ didn't submit such a document**

An Example of Letter of Authority

	<Company Name> <Address>
<date>	
To: <the Customer>	
We authorize <the Customer> or <the ISP> to announce the following IP blocks -	
<IP address blocks>	
This authorization shall be valid until revoked by us in writing or by e-mail from <e-mail address>.	
I may be contacted at <Tel#> or <e-mail address>	
Sincerely, <signature> <signer's name in print> <Company Name>	

The actual LoA looks ... strange

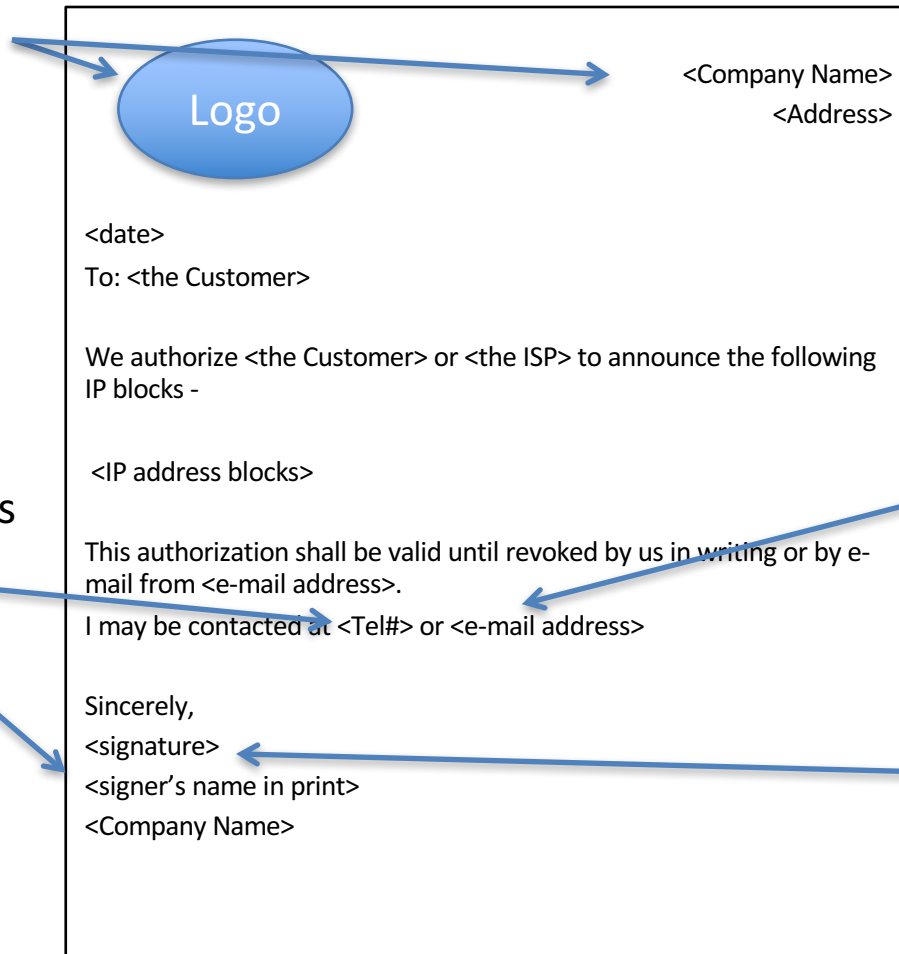
- The company name was a family company of the previous resource holder
- Suspicious
 - The domain name used as a contact e-mail address was different from the actual one
 - The domain name was newly registered in 2014
 - The Tel# was wrong - missing a country code
 - As the previous holder registered it wrongly at the whois DB before

Visited the previous resource holder

- Met a person who was previously the contact person of their whois DB entry
 - and also his name was used as a signer in the LoA
- **No, he didn't sign the document**, and their company wasn't aware of the LoA and even the domain name which was used in the LoA
- **A fake LoA!!**

The fake LoA

Copied from a web site of a family company of the previous resource holder

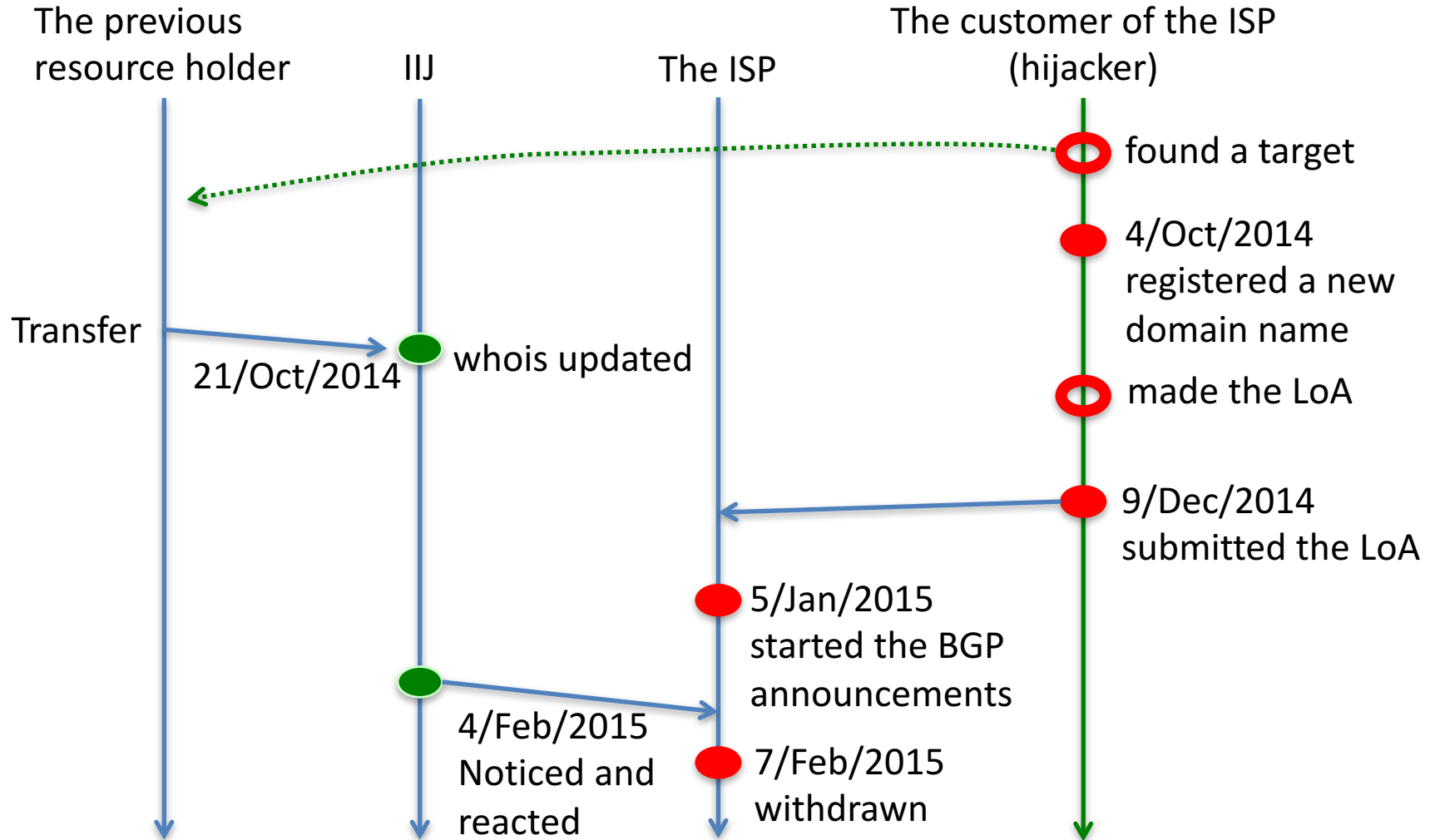


Copied from previous whois DB entry

Registered a new domain name looks like related to the organization

A fake signature

Timeline



The hijacker

- We don't know how they used the network
 - No evidence so far
 - No spam compliant related to the prefix
- After stopping the announcement, they started to use 'the next' prefix by using the same technique - by submitting a fake LoA 😞
 - It was noticed and stopped by the actual resource holder a few months later

Another case

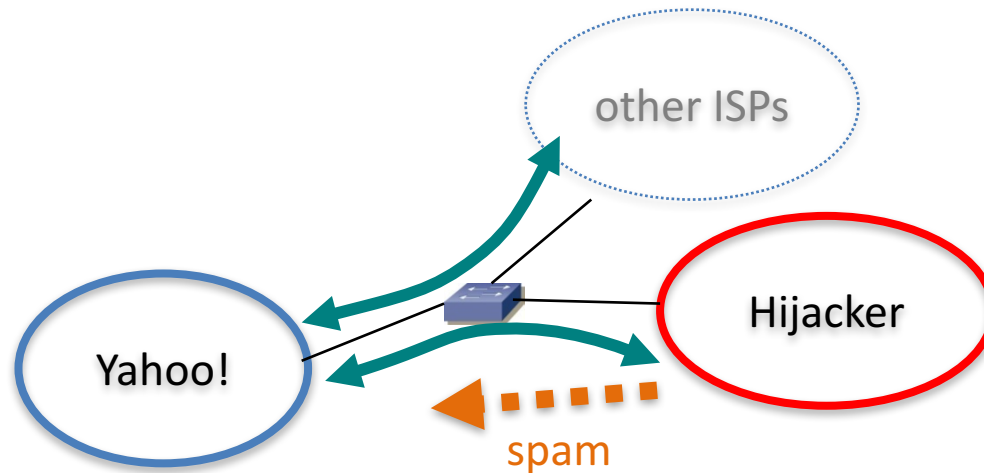
- Invisible Hijacking
 - https://ripe72.ripe.net/presentations/45-Invisible_Hijacking.pdf
- Started to receive reports from spamcop
 - it continued even though they put filter whole outbound port 25

Not in the global routing table

- They checked with public looking-glass services like RIPE RIS and route-views
 - No suspicious announcement
- A clue, all reports were related to Yahoo! mail
 - Contacted the Yahoo! and finally found suspicious BGP announcements

IXP

- The hijacker established a peering with Yahoo! at IXP and announced more specifics to get a reachability (to the Yahoo! network only)



How is this possible?

- Becoming a customer is easy
 - as long as the customer pays, most operators are happy with that
- Spoofing ASN at IXP is easy
 - IXP is providing simple L2 service, so they don't care which ASNs and prefixes are used to exchange routing information
- Open peering policy also helps
 - some big operators have an open peering policy, and happy to peer with anyone at IXPs

The current situation

- Ran out IPv4 Free Space
 - getting difficult to get enough IPv4 space
- IP reputation database
 - to avoid access from/to malicious activities
- Aaaaah, the situation probably motivates malicious folks to hijack a prefix more and more...

Weak points

- Customers bringing in their IP space
 - WHOIS, RPKI?
- Transit customers
 - WHOIS, IRR?, RPKI?
- Peering partners
 - IRR?, RPKI?

Summary

- Intentional BGP-hijacking are happening
 - Hijackers pay money to buy a network service
 - People assume some kind of implicit trust relationship for customers, hijacker use the trust to convince others to announce their BGP announcements
- We need a strong infrastructure to prove our number resources

BACKUP slides

looking back

- IJ should announce all holding prefixes
 - We changed our policy to announce all of them
 - Before announcements, IJ registers route objects to IRRs - JPIRR and RADB. By registering a route object at JPIRR, a route monitoring service named 'keiro bugyo' automatically starts to monitor malicious announcement related to the route object. 😊
- The ISP should carefully check IP blocks before announcements
 - As whois DB was already changed - indicating IJ as a resource holder at that time

WHOIS

- WHOIS command
 - Which WHOIS server should I use for starting?
 - whois.iana.org ?
 - Modern command hopefully handles it well
 - Are you familiar with CLI? windows users?
- Web based WHOIS gateway
 - Which one should I use?
 - Starting with <http://whois.iana.org/> ?

finding a resource holder by WHOIS

- IANA -> RIR -> (NIR ->) LIR
 - Think about regions which do not have NIRs, and probably some people are not aware of it
- Allocations and Assignments
 - Can you distinguish these on whois?
- ERXs and inter-RIR transfers
 - IANA -> RIR -> RIR -> (NIR ->) LIR
 - It seems each IR uses own expression to indicate a reference for further information

whois at IANA

```
$ whois -h whois.iana.org '160.13.0.0'  
% IANA WHOIS server  
% for more information on IANA, visit http://www.iana.org  
% This query returned 1 object
```

```
refer:      whois.arin.net
```

```
inetnum:    160.0.0.0 - 160.255.255.255
```

```
organisation: Administered by ARIN
```

```
status:     LEGACY
```

```
whois:      whois.arin.net
```

```
changed:    1993-05
```

```
source:     IANA
```

whois at ARIN

```
$ whois -h whois.arin.net '160.13.0.0'
```

```
#
# ARIN WHOIS data and services are subject to the Terms of Use
# available at: https://www.arin.net/whois_tou.html
#
# If you see inaccuracies in the results, please report at
# http://www.arin.net/public/whoisinaccuracy/index.xhtml
#

#
# Query terms are ambiguous. The query is assumed to be:
# "n 160.13.0.0"
#
# Use "?" to get help.
#

#
# The following results may also be obtained via:
#
# http://whois.arin.net/rest/nets;q=160.13.0.0?showDetails=true&showARIN=false&showNonArinTopLevel
# Net=false&ext=netref2
#

NetRange: 160.11.0.0 - 160.30.255.255
CIDR: 160.24.0.0/14, 160.11.0.0/16, 160.30.0.0/16, 160.28.0.0/15, 160.12.0.0/14, 160.16.0.0/13
NetName: APNIC-ERX-160-11-0-0
NetHandle: NET-160-11-0-0-1
Parent: NET160 (NET-160-0-0-0-0)
NetType: Early Registrations, Transferred to APNIC
OriginAS:
Organization: Asia Pacific Network Information Centre (APNIC)
RegDate: 2004-04-05
Updated: 2009-10-08
Comment: This IP address range is not registered in the ARIN database.
Comment: This range was transferred to the APNIC Whois Database as
Comment: part of the ERX (Early Registration Transfer) project.
Comment: For details, refer to the APNIC Whois Database via
Comment: WHOIS.APNIC.NET or http://wq.apnic.net/apnic-bin/whois.pl
Comment:
Comment: ** IMPORTANT NOTE: APNIC is the Regional Internet Registry
Comment: for the Asia Pacific region. APNIC does not operate networks
Comment: using this IP address range and is not able to investigate
Comment: spam or abuse reports relating to these addresses. For more
Comment: help, refer to http://www.apnic.net/apnic-info/whois_search2/abuse-and-spamming
Ref: http://whois.arin.net/rest/net/NET-160-11-0-0-1
```

```
ResourceLink: http://wq.apnic.net/whois-search/static/search.html
ResourceLink: whois.apnic.net
```

```
OrgName: Asia Pacific Network Information Centre
OrgId: APNIC
Address: PO Box 3646
City: South Brisbane
StateProv: QLD
PostalCode: 4101
Country: AU
RegDate:
Updated: 2012-01-24
Ref: http://whois.arin.net/rest/org/APNIC
```

```
ReferralServer: whois://whois.apnic.net
ResourceLink: http://wq.apnic.net/whois-search/static/search.html
```

```
OrgAbuseHandle: AWC12-ARIN
OrgAbuseName: APNIC Whois Contact
OrgAbusePhone: +61 7 3858 3188
OrgAbuseEmail: search-apnic-not-arin@apnic.net
OrgAbuseRef: http://whois.arin.net/rest/poc/AWC12-ARIN
```

```
OrgTechHandle: AWC12-ARIN
OrgTechName: APNIC Whois Contact
OrgTechPhone: +61 7 3858 3188
OrgTechEmail: search-apnic-not-arin@apnic.net
OrgTechRef: http://whois.arin.net/rest/poc/AWC12-ARIN
```

```
#
# ARIN WHOIS data and services are subject to the Terms of Use
# available at: https://www.arin.net/whois_tou.html
#
# If you see inaccuracies in the results, please report at
# http://www.arin.net/public/whoisinaccuracy/index.xhtml
#
```

whois at APNIC

```
$ whois -h whois.apnic.net '160.13.0.0'  
% [whois.apnic.net]  
% Whois data copyright terms http://www.apnic.net/db/dbcopyright.html
```

```
% Information related to '160.13.0.0 - 160.13.255.255'
```

```
inetnum: 160.13.0.0 - 160.13.255.255  
netname: IJ  
descr: Internet Initiative Japan Inc.  
descr: lidabashi Grand Bloom,  
descr: 2-10-2 Fujimi, Chiyoda-ku,  
descr: Tokyo, 102-0071 Japan  
country: JP  
admin-c: JNIC1-AP  
tech-c: JNIC1-AP  
status: ALLOCATED PORTABLE  
remarks: Email address for spam or abuse complaints : abuse-contact@ij.ad.jp  
mnt-irt: IRT-JPNIC-JP  
mnt-by: MAINT-JPNIC  
mnt-lower: MAINT-JPNIC  
changed: hm-changed@apnic.net 20050712  
changed: ip-apnic@nic.ad.jp 20141021  
source: APNIC
```

```
irt: IRT-JPNIC-JP  
address: Urbannet-Kanda Bldg 4F, 3-6-2 Uchi-Kanda  
address: Chiyoda-ku, Tokyo 101-0047, Japan  
e-mail: hostmaster@nic.ad.jp  
abuse-mailbox: hostmaster@nic.ad.jp  
admin-c: JNIC1-AP  
tech-c: JNIC1-AP  
auth: # Filtered  
mnt-by: MAINT-JPNIC  
changed: abuse@apnic.net 20101108  
changed: hm-changed@apnic.net 20101111  
changed: ip-apnic@nic.ad.jp 20140702  
source: APNIC
```

```
role: Japan Network Information Center  
address: Urbannet-Kanda Bldg 4F  
address: 3-6-2 Uchi-Kanda  
address: Chiyoda-ku, Tokyo 101-0047,Japan  
country: JP  
phone: +81-3-5297-2311  
fax-no: +81-3-5297-2312  
e-mail: hostmaster@nic.ad.jp  
admin-c: JI13-AP  
tech-c: JE53-AP  
nic-hdl: JNIC1-AP  
mnt-by: MAINT-JPNIC  
changed: hm-changed@apnic.net 20041222  
changed: hm-changed@apnic.net 20050324  
changed: ip-apnic@nic.ad.jp 20051027  
changed: ip-apnic@nic.ad.jp 20120828  
source: APNIC
```

```
% Information related to '160.13.0.0 - 160.13.15.255'
```

```
inetnum: 160.13.0.0 - 160.13.15.255  
netname: IJNET  
descr: IJ Internet  
country: JP  
admin-c: JP00010080  
tech-c: JP00010080  
remarks: This information has been partially mirrored by APNIC from  
remarks: JPNIC. To obtain more specific information, please use the  
remarks: JPNIC WHOIS Gateway at  
remarks: http://www.nic.ad.jp/en/db/whois/en-gateway.html or  
remarks: whois.nic.ad.jp for WHOIS client. (The WHOIS client  
remarks: defaults to Japanese output, use the /e switch for English  
remarks: output)  
changed: apnic-ftp@nic.ad.jp 20150417  
changed: apnic-ftp@nic.ad.jp 20150424  
source: JPNIC
```

```
% This query was served by the APNIC Whois Service version 1.69.1-APNICv1r7-SNAPSHOT (WHOIS4)
```

whois at JPNIC

```
$ whois -h whois.nic.ad.jp '160.13.0.0 /e'  
[ JPNIC database provides information regarding IP address and ASN. Its use ]  
[ is restricted to network administration purposes. For further information, ]  
[ use 'whois -h whois.nic.ad.jp help'. To only display English output,    ]  
[ add '/e' at the end of command, e.g. 'whois -h whois.nic.ad.jp xxx/e'.  ]
```

Network Information:

```
a. [Network Number]      160.13.0.0/20  
b. [Network Name]       IJNET  
g. [Organization]       IJ Internet  
m. [Administrative Contact]  JP00010080  
n. [Technical Contact]    JP00010080  
p. [Nameserver]         dns0.iij.ad.jp  
p. [Nameserver]         dns1.iij.ad.jp  
[Assigned Date]         2015/04/17  
[Return Date]  
[Last Update]           2015/04/24 11:47:06(JST)
```

Less Specific Info.

Internet Initiative Japan Inc.

[Allocation] 160.13.0.0/16

More Specific Info.

No match!!

whois at JPNIC again

```
$ whois -h whois.nic.ad.jp '160.13.0.0/16 /e'  
[ JPNIC database provides information regarding IP address and ASN. Its use ]  
[ is restricted to network administration purposes. For further information, ]  
[ use 'whois -h whois.nic.ad.jp help'. To only display English output,    ]  
[ add '/e' at the end of command, e.g. 'whois -h whois.nic.ad.jp xxx/e'.  ]
```

Network Information:

```
[Network Number]      160.13.0.0/16  
[Network Name]  
[Organization]       Internet Initiative Japan Inc.  
[Administrative Contact]  JP00010080  
[Technical Contact]    JP00010080  
[Abuse]               abuse-contact@ij.ad.jp  
[Allocated Date]      2014/10/21  
[Last Update]         2014/10/21 15:04:47(JST)
```

Less Specific Info.

```
-----  
No match!!
```

More Specific Info.

```
-----  
IJJ Internet  
    IJNET [Assignment]          160.13.0.0/20  
IJJ Internet  
    IJNET [Assignment]          160.13.16.0/24  
[...]
```


allocations

- It's already complicated
 - and getting more complicated
- IR whois is not so human friendly nor machine friendly
 - You need to train engineers about every whois DB's expressions, history of the Internet, the current resource policies. Yes, it's important though...
 - And probably that's why we have IRRs to register routing related information
- We need something better to prove our holding resources

RPKI

- Public Key Infrastructure for Number Resources
 - Such as IP addresses and AS numbers
 - A digital certificate can prove that you are the current resource holder of specific number resource
 - You can add digital signature to your documents like LoA or transfer agreement
- You can issue ROAs to indicate originating AS for prefixes

lesson learned #2

- Announce all holding prefixes
 - Register route objects to an IRR for reference
- IR whois is ... complicated
 - Hierarchy, ERXs and transfers
 - Assignments and allocations in the same DB
- RPKI is the next choice for us
 - We need to promote RPKI more, and train engineers to be aware of public-key cryptography
 - Signing and verifying by using public-key cryptography is a key technology now days