

# APNIC eLearning: Internet Routing Registry

**APNIC**

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# Overview

- What is Routing Policy
- IRR Database & Objects
- Routing Policy Documentation in IRR Database
- RPSL (Routing Policy Specification Language)
- IRRToolSet to Generate Router Configuration

# What is Routing Policy

- Public description of the relationship between external BGP peers
- Can also describe internal BGP peer relationship
- Usually registered at an IRR (Internet Routing Registry) such as RADB or APNIC

# Benefit of Routing Policy

- Who are my BGP peers
- What routes are
  - Originated by a peer
  - Imported from each peer
  - Exported to each peer
  - Preferred when multiple routes exist
- What to do if no route exists

# Why Define a Routing Policy

- Documentation
- Provides routing security
  - Can peer originate the route?
  - Can peer act as transit for the route?
- Allows automatic generation of router configurations
- Provides a debugging aid
  - Compare policy versus reality

# Internet Routing Registry (IRR)

- Number of public databases that contain routing policy information which mirror each other:
  - APNIC, RIPE, RADB, JPIRR, Level3
  - <http://www.irr.net/>
- Stability and consistency of routing – network operators share information
- Both public and private databases
- These databases are independent – but some exchange data
  - only register your data in one database
- List of Routing Registry
  - <http://www.irr.net/docs/list.html>

# Internet Routing Registry (IRR)

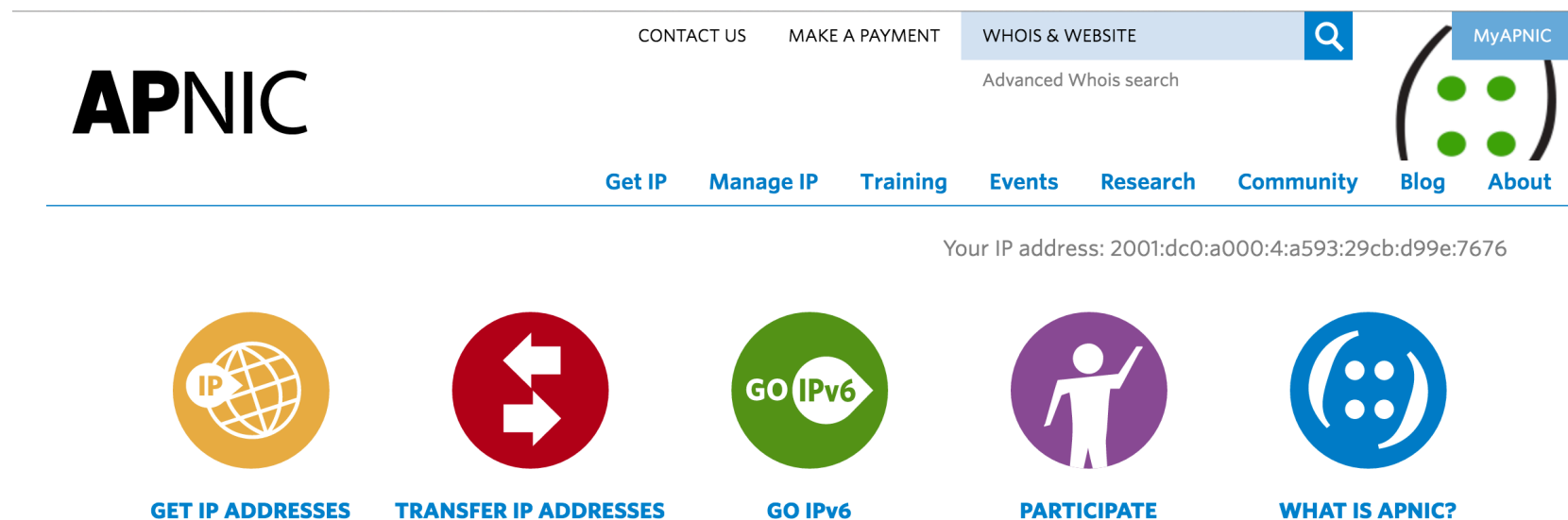
- IRRs are used in at least three distinct ways
  - To publish your own routing intentions
  - To construct and maintain routing filters and router configurations
  - Diagnostic and information service for more general network management

# IRR Objects Query

- whois query from CLI

```
whois -h whois.apnic.net 2406:6400::/32
```

- You can search from APNIC website also



The screenshot shows the APNIC website homepage. At the top, there's a navigation bar with links: CONTACT US, MAKE A PAYMENT, WHOIS & WEBSITE (highlighted), and a search icon. Below the navigation bar, the APNIC logo is on the left, and a 'MyAPNIC' button is on the right. A search bar with the text 'Advanced Whois search' is also present. Below the navigation bar, there's a row of links: Get IP, Manage IP, Training, Events, Research, Community, Blog, and About. Below this row, the text 'Your IP address: 2001:dc0:a000:4:a593:29cb:d99e:7676' is displayed. At the bottom, there are five circular icons with corresponding text: 'GET IP ADDRESSES' (orange icon with a globe and 'IP'), 'TRANSFER IP ADDRESSES' (red icon with two arrows), 'GO IPv6' (green icon with 'GO IPv6'), 'PARTICIPATE' (purple icon with a person), and 'WHAT IS APNIC?' (blue icon with a button).

APNIC is the Regional Internet Registry administering IP addresses for the Asia Pacific



# IRR Objects Query Flags

- IRR supports a number of flag option
  - ! RADB Query Flags
  - - RIPE/BIRD Query Flags

- **-i** flags for inverse query

```
whois -h whois.apnic.net -i mnt-by MAINT-AU-  
APNICTRAINING
```

[All the objects with a matching **mnt-by** attribute]

```
whois -h whois.apnic.net -i origin as17821
```

[**route** and **route6** objects with a matching **origin** attribute]

- **-q** flag for Informational queries

```
whois -h whois.apnic.net -q sources
```

[list of sources]

# IRR Objects Query Flags

- -K flags for primary keys of an object are returned

```
whois -h whois.apnic.net -K 2406:6400::/32
```

- IRRd (IRR Daemon) supports service side set expansions (as-set and route-set)

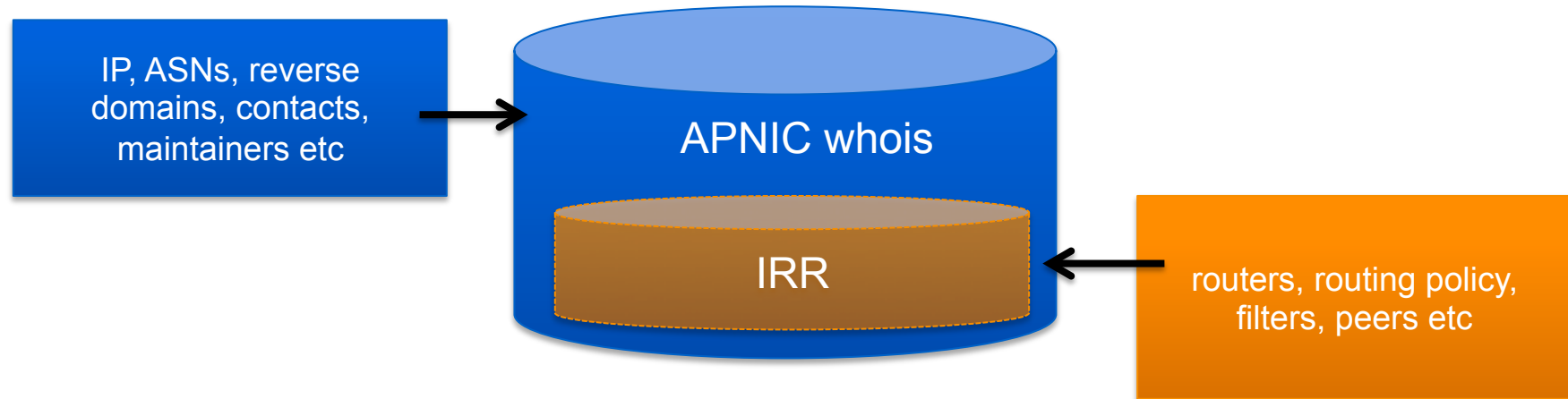
```
whois -h whois.radb.net '!iAS-APNICTRAINING'
```

[returns members of AS-APNICTRAINING as-set object]

- For details please check
  - [https://www.apnic.net/apnic-info/whois\\_search/using-whois/searching/query-options](https://www.apnic.net/apnic-info/whois_search/using-whois/searching/query-options)
  - <http://www.radb.net/support/query2.php>

# Whois & IRR Database

- APNIC whois database also works as IRR database
- Integrated APNIC whois database & Internet Routing Registry



Internet Resources & Routing Information

# RPSL

- Routing Policy Specification Language
- RPSL is object oriented
  - These objects are registered in the Internet Routing Registry (IRR)
  - route, autonomous system, router, contact and set objects
- RIPE-81 was the first language deployed in the Internet for specifying routing policies
  - It was later replaced by RIPE-181
  - RPSL is a replacement for the RIPE-181 or RFC-1786
  - RPSL addresses RIPE-181's limitations

# What is RPSL

- Describes things interesting to routing policy
  - Prefixes
  - AS Numbers
  - Relationships between BGP peers
  - Management responsibility
- For more about RPSL
  - RFC-1786: RIPE-181
  - RFC-2622: Routing Policy Specification Language
  - RFC-2650: Using RPSL in Practice
  - RFC-2726: PGP Authentication for RIPE Database Updates
  - RFC-2725: Routing Policy System Security
  - RFC-2769: Routing Policy System Replication
  - RFC-4012: Routing Policy System Replication next generation

# RPSL Objects

- RPSL objects are similar to RIPE-181 objects
- Objects
  - set of attributes
- Attributes
  - mandatory or optional
  - values: single, list, multiple
- Class “key”
  - set of attributes
  - usually one attribute has the same name as the object’s class
  - uniquely identify each object
- Class “key” = primary key
  - must be specified first

# RPSL Attributes

- Case insensitive
- Value of an attribute has a type
  - <object-name>
  - <as-number>
  - <ipv4-address>
  - <ipv6-address>
  - <address-prefix>
  - etc
- Complete list of attributes and types in RFC 2622
  - <https://www.rfc-editor.org/rfc/rfc2622.txt>

# APNIC Database Objects and Routing Registry Objects

OBJECT	PURPOSE
person	Technical or administrative contacts responsible for an object
role	Technical or administrative contacts represented by a role, performed by one or more people
Inetnum / inet6num	Allocation or assignment of IPv4 / IPv6 address space
aut-num	Registered holder of an AS number and corresponding routing policy
route / route6	Single IPv4/IPv6 route injected into the Internet routing mesh
mntner	Authorized agent to make changes to an object
as-set	Collect together Autonomous Systems with shared properties
route-set	Defines a set of routes prefixes
filter-set	Defines a set of routes that are matched by a filter expression

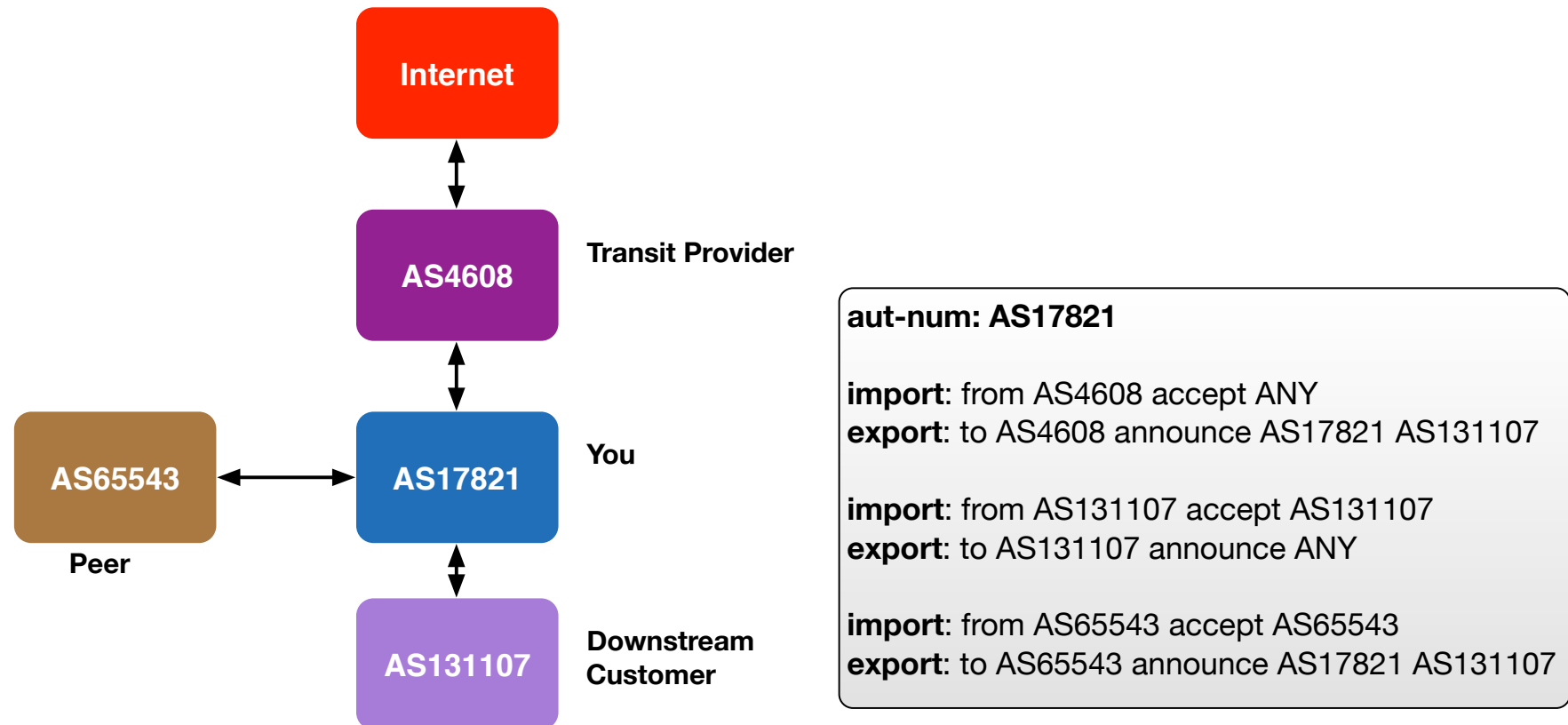


# Import and Export Attributes

- You can document your routing policy in your aut-num object in the APNIC Database:
  - Import lines describe what routes you accept from a neighbor and what you do with them
  - Export lines describe which routes you announce to your neighbor

```
aut-num:      AS17821
as-name:      APNIC-TRAINING-Lab-AS-AP
descr:        Two-byte AS number for APNIC Training Lab
country:      AU
import:        from AS45192 action pref=200; accept ANY
import:        from AS4608 action pref=100; accept ANY
export:        to AS45192 announce AS17821
export:        to AS4608 announce AS17821
default:      to AS45192 action pref=50; networks ANY
admin-c:      AT480-AP
tech-c:       AT480-AP
mnt-by:       MAINT-AU-APNICTRAINING
mnt-routes:   MAINT-AU-APNICTRAINING
changed:      hm-changed@apnic.net 20080424
changed:      hm-changed@apnic.net 20100818
changed:      hm-changed@apnic.net 20100819
mnt-irt:      IRT-APNICTRAINING-AU
changed:      hm-changed@apnic.net 20110701
source:       APNIC
```

# Routing Policy Scenarios



# RPSL Tools

- IRRToolSet (written in C++)
  - <https://github.com/irrtoolset/irrtoolset>
- Rpsltool (perl, using Template::Toolkit)
  - <http://www.linux.it/~md/software>
- IRR Power Tools (PHP)
  - <http://sourceforge.net/projects/irrpt/>
- BGPQ3 (C)
  - <http://snar.spb.ru/prog/bgpq3/>

# Use of IRRToolSet

- Use IRRToolSet to generate filters based on information stored in our routing registry
  - Avoid filter errors (typos)
  - Filters consistent with documented policy (need to get policy correct though)
  - Engineers don't need to understand filter rules (it just works :-)
- Some providers have own tools.

# IRRToolSet : Installation

- Dependency (Debian / Ubuntu)

```
# apt-get install build-essential libtool subversion bison  
flex libreadline-dev autoconf automake
```

- Installation

```
# wget  
ftp://ftp.isc.org/isc/IRRToolSet/IRRToolSet-5.0.1/  
irrtoolset-5.0.1.tar.gz  
# tar -zxvf irrtoolset-5.0.1.tar.gz  
# cd irrtoolset-5.0.1  
# ./configure  
# make  
# make install
```

For details : <https://github.com/irrtoolset/irrtoolset>

# RtConfig CLI Options

- Defaults to using RADB
  - -h whois.ra.net / whois.radb.net
  - -p 43
  - Default protocol irrd
- For other RIR use protocol bird
  - -protocol bird/ripe
- Defaults to “cisco” style output
  - -config cisco / -config junos
- -s <list of IRR sources>
  - -s APNIC,RADB,RIPE

# RtConfig Syntax

- import / export pair for each link; syntax

```
@RtConfig [import/export] <yourASN> <yourRouterIP>  
<neighbourASN> <neighbourRouterIP>
```

- Takes other command also

```
@RtConfig configureRouter <inet-rtr-name>  
@RtConfig static2bgp <ASN-1> <rtr-1>  
@RtConfig access_list filter <filter>
```

- And many more. But best thing to look

```
man rtconfig
```

# IRRToolSet Cisco Example

```
bash-3.2$ rtconfig -protocol bird -config cisco -h whois.apnic.net
```

```
rtconfig> @RtConfig import AS17821 2406:6400:10::1 AS65001 2406:6400:10::2
!  
no ipv6 access-list ipv6-500  
ipv6 access-list ipv6-500 permit 2406:6400:8000::/48 any  
ipv6 access-list ipv6-500 deny any any  
!  
no ip as-path access-list 500  
ip as-path access-list 500 permit ^(_65001)+$
```

**<output truncated>**

```
router bgp 17821  
!  
neighbor 2406:6400:10::2 remote-as 65001  
address-family ipv4  
  no neighbor 2406:6400:10::2 activate  
address-family ipv6 unicast  
  neighbor 2406:6400:10::2 activate  
  neighbor 2406:6400:10::2 route-map AS65001-IN in  
exit
```



# IRRToolSet JunOS Example

```
bash-3.2$ rtconfig -protocol bird -config junos -h whois.apnic.net
```

```
rtconfig> @RtConfig import AS17821 2406:6400:10::1 AS65001 2406:6400:10::2
policy-options {
    community community-1 members [17821:65001];
    as-path as-path-1 "( 65001)+";
```

**<output truncated>**

```
protocols {
    bgp {
        group peer-2406:6400:10::2 {
            type external;
            peer-as 65001;
            neighbor 2406:6400:10::2 {
                import policy_65001_1 ;
                family inet6 {
                    unicast;
                }
            }
        }
    }
}
```

# Getting the Complete Picture

- Automation relies on the IRR being complete
  - Not all resources are registered in an IRR
  - Not all information is correct
- Small mistakes can have a big impact
  - Check your output before using it
- Be prepared to make manual overrides
  - Help others by documenting your policy

# RPSL in Summary

1. Define Routing Policy

2. Create IRR Object/Objects

3. Run RtConfig to generate config

4. Push config to router/routers



## Questions

- Please remember to fill out the feedback form
  - `<survey-link>`
- Slide handouts will be available after completing the survey

# APNIC Helpdesk Chat

## Helpdesk

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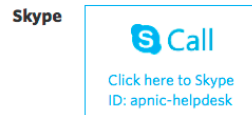
APNIC Helpdesk provides assistance to all on matters related to APNIC Services, such as membership and IP address enquiries.

APNIC Helpdesk offers (through prior arrangement) multi-language phone support for the following: Bahasa Indonesia, Bahasa Malaysia, Bengali, Cantonese, English, Filipino (Tagalog), Hindi, Japanese, Malay, Mandarin, Sinhalese, Tamil and Telugu.

You may also find our [FAQs](#) helpful with your enquiries.

## Contact details

**Helpdesk hours** 09:00 to 21:00 (UTC +10)  
Monday - Friday  
(closed for some [public holidays](#))



**Email** [helpdesk@apnic.net](mailto:helpdesk@apnic.net)

**Phone** +61 7 3858 3188

**VoIP** [helpdesk@voip.apnic.net](mailto:helpdesk@voip.apnic.net)

**Fax** + 61 7 3858 3199

## Service Updates

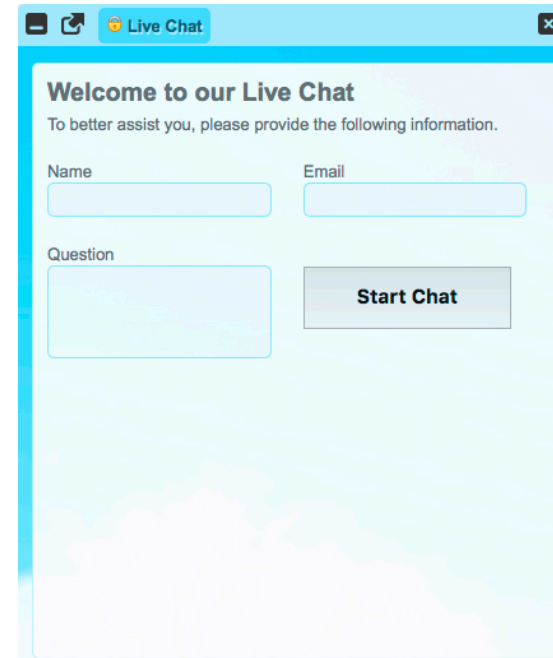
### Service announcement: 10 February 2016

Service disruption: APNIC services were disrupted on Wednesday, 10 February 2016

[More announcements](#)

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A screenshot of a web browser window titled "Live Chat". The window has a blue header bar with a close button (X) on the right. The main content area has a light blue background with a faint world map. It contains a "Welcome to our Live Chat" message, followed by a prompt "To better assist you, please provide the following information." Below this are two input fields: "Name" and "Email". Under the "Name" field is a "Question" label and a larger text input area. To the right of the question input area is a grey button labeled "Start Chat".

# APNIC



# Thank You!

END OF SESSION

