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

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

• You can search from APNIC website also

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

```bash
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

```bash
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
  – 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
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-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

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

**Internet**

**AS4608**

**AS17821**

**AS131107**

**AS65543**

**You**

**Downstream Customer**

**Transit Provider**

**Peer**

---

**aut-num: AS17821**

**import:** from AS4608 accept ANY

**export:** to AS4608 announce AS17821 AS131107

**import:** from AS131107 accept AS131107

**export:** to AS131107 announce ANY

**import:** from AS65543 accept AS65543

**export:** to AS65543 announce AS17821 AS131107
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)
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

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

• Takes other command also

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

• And many more. But best thing to look

```plaintext
man rtconfig
```
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

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)

Chat
APNIC Live Chat
Online

Skype
Call
Click here to Skype
ID: apnic-helpdesk

Email
helpdesk@apnic.net

Phone
+61 7 3858 3188

VoIP
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

Subscribe to APNIC Service Announcements

Learn more about system maintenance
Thank You!
END OF SESSION