RPSL 101

Introduction to Routing Policy Specification Language

APAN/TransPAC/NLANR/Internet2 Techs Workshop

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Who am I?

Network Architect for Tier 1 ISP in Australia

Designed and built Connect's RPSL based system to manage our routing policy and configure routers

Member of the RPS working group at IETF

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Agenda

- Routing Policy
  - What is Routing Policy?
  - Why define one?
- RPSL
  - What is RPSL?
  - Benefits of using RPSL
  - How to use RPSL.
- Questions anytime!

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What is Routing Policy

- Public description of the relationship between external BGP peers
- Can also describe internal BGP peer relationship
- Usually registered with an Internet Routing Registry (IRR)
  - RADB
  - RIPE
  - CW

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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

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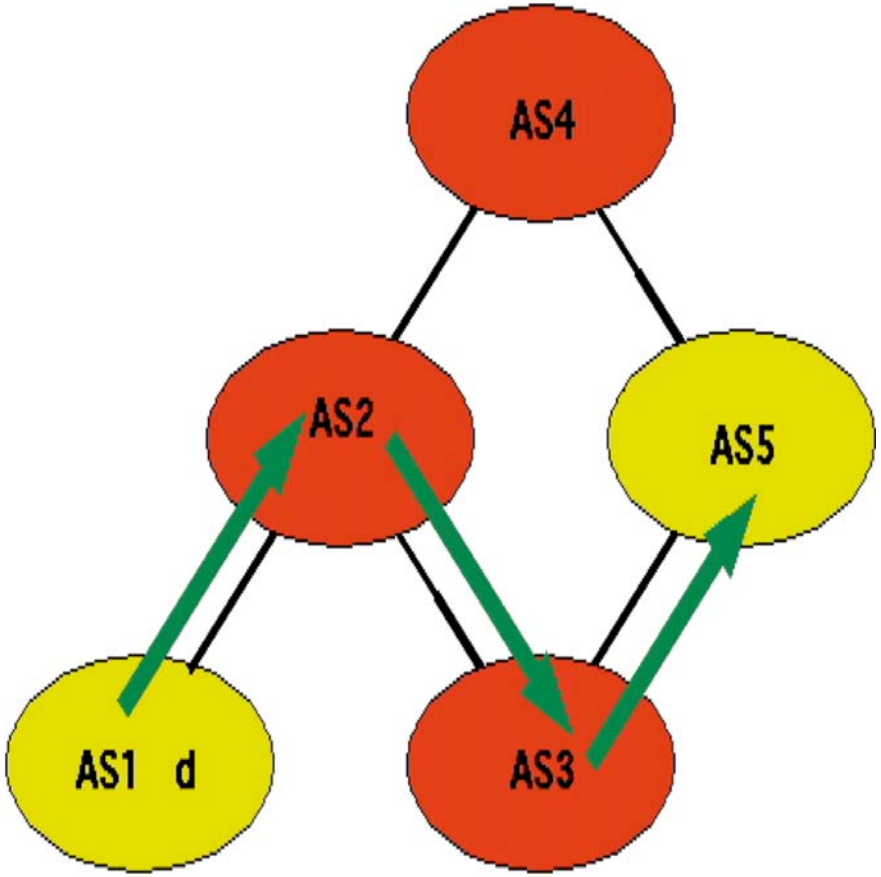
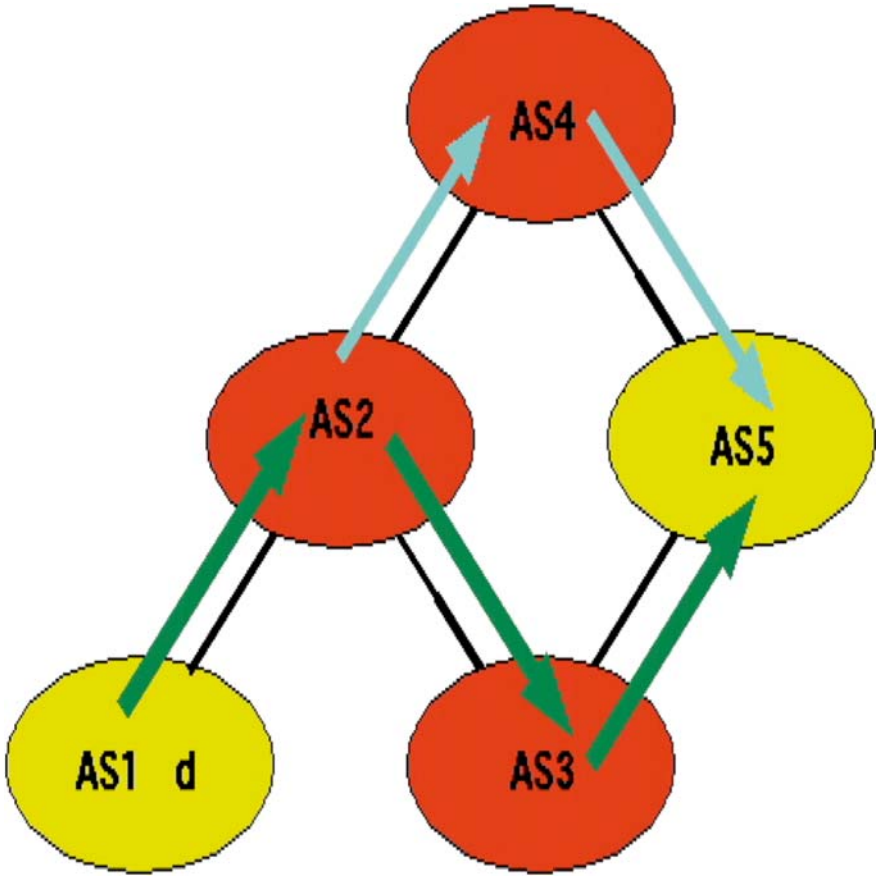
Routing Policy Example



- AS1 originates prefix “d”
- AS1 exports “d” to AS2, AS2 imports
- AS2 exports “d” to AS3, AS3 imports
- AS3 exports “d” to AS5, AS5 imports

Routing Policy Example (cont)



- AS5 also imports “d” from AS4
- Which route does it prefer?
  - Does it matter?
  - Consider case where
    - AS3 = Commercial Internet
    - AS4 = Internet2

  Should you prefer transit via Internet2?

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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

What is RPSL?

- Object oriented language
- Development of RIPE 181
- Structured whois objects
- Describes things interesting to routing policy
  - Routes
  - AS Numbers
  - Relationships between BGP peers
  - Management responsibility

FOR MORE INFO...

RFC 2622 - “Routing Policy Specification Language (RPSL)”

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Person, Role & Maintainer Objects

- Maintainer objects used for authentication
- Person and role objects are for contact info

```
mntner:      [mandatory]  [single]    [primary/look-up key]
descr:       [mandatory]  [multiple]
admin-c:     [mandatory]  [multiple]  [inverse key]
tech-c:      [optional]   [multiple]  [inverse key]
upd-to:      [mandatory]  [multiple]  [inverse key]
mnt-nfy:     [optional]   [multiple]  [inverse key]
auth:        [mandatory]  [multiple]
remarks:     [optional]   [multiple]
notify:      [optional]   [multiple]  [inverse key]
mnt-by:      [mandatory]  [multiple]  [inverse key]
changed:     [mandatory]  [multiple]
source:      [mandatory]  [single]
```

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Maintainer Object Example

```
mntner:         MAINT-AS2764
descr:          Maintainer for AS 2764
admin-c:        MP151
upd-to:         routing@connect.com.au
mnt-nfy:        routing@connect.com.au
auth:           PGPKEY-81E92D91
auth:           PGPKEY-562C2749
auth:           PGPKEY-8C1EEB21
mnt-by:         MAINT-AS2764
changed:        mrp@connect.com.au 20000725
source:         RADB
```

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Route Object

- Use CIDR length format
- Specifies origin AS for a route
- Can indicate membership of a route set

```
route:          [mandatory]  [single]    [primary/look-up key]
descr:          [mandatory]  [multiple]
origin:         [mandatory]  [single]    [primary/inverse key]
withdrawn:      [optional]   [single]
member-of:      [optional]   [single]    [inverse key]
inject:         [optional]   [multiple]
components:     [optional]   [single]
aggr-bndry:     [optional]   [single]    [inverse key]
aggr-mtd:       [optional]   [single]
export-comps:   [optional]   [single]
holes:          [optional]   [single]
remarks:        [optional]   [multiple]
cross-nfy:      [optional]   [multiple]  [inverse key]
cross-mnt:      [optional]   [multiple]  [inverse key]
notify:         [optional]   [multiple]  [inverse key]
mnt-by:         [mandatory]  [multiple]  [inverse key]
changed:        [mandatory]  [multiple]
source:         [mandatory]  [single]
```

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Route Object Example

```
route:          203.63.0.0/16
descr:          connect.com.au pty ltd
origin:         AS2764
notify:         routing@connect.com.au
mnt-by:         MAINT-AS2764
changed:        mrp@connect.com.au 19971027
source:         RADB
```

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AS Set

- Collect together Autonomous Systems with shared properties
- Can be used in policy in place of AS
- RPSL has hierarchical names

```
as-set:       [mandatory]  [single]    [primary/look-up key]
descr:        [mandatory]  [multiple]
members:      [optional]   [single]
mbrs-by-ref:  [optional]   [single]
remarks:      [optional]   [multiple]
tech-c:       [mandatory]  [multiple]  [inverse key]
admin-c:      [mandatory]  [multiple]  [inverse key]
notify:       [optional]   [multiple]  [inverse key]
mnt-by:       [mandatory]  [multiple]  [inverse key]
changed:      [mandatory]  [multiple]
source:       [mandatory]  [single]
```

AS Set Object Example

```
as-set:          AS2764:AS-CUSTOMERS:AS3409
descr:           connect.com.au AS set
members:         AS7632, AS9324
remarks:         Autonomous systems that transit through AS3409
admin-c:         CC89
tech-c:          MP151
mnt-by:          MAINT-AS2764
changed:         mrp@connect.com.au 20001214
source:          RADB
```

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Route Set

- Collects routes together with similar properties

```
route-set:    [mandatory]  [single]    [primary/look-up key]
descr:        [mandatory]  [multiple]
members:      [optional]   [single]
mbrs-by-ref:  [optional]   [single]
remarks:      [optional]   [multiple]
tech-c:       [mandatory]  [multiple]  [inverse key]
admin-c:      [mandatory]  [multiple]  [inverse key]
notify:       [optional]   [multiple]  [inverse key]
mnt-by:       [mandatory]  [multiple]  [inverse key]
changed:      [mandatory]  [multiple]
source:       [mandatory]  [single]
```

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Route Set Object Example

```
route-set:      AS2764:RS-PROVIDER
descr:          Connect's provider blocks
members:        202.21.8.0/21, 203.8.176.0/21, 203.63.0.0/16,
210.8.0.0/15, 210.10.0.0/16
admin-c:        CC89
tech-c:         MP151
notify:         routing@connect.com.au
mnt-by:         MAINT-AS2764
changed:        mrp@connect.com.au 20000604
source:         RADB
```

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Autonomous System Object

- Routing Policy Description object
- Most important components are
  - import
  - export
- These define the incoming and outgoing routing announcement relationships

Autonomous System Object (cont)

aut-num:	[mandatory]	[single]	[primary/look-up key]
as-name:	[mandatory]	[single]	
descr:	[mandatory]	[multiple]	
member-of:	[optional]	[single]	[inverse key]
import:	[optional]	[multiple]	[inverse key]
export:	[optional]	[multiple]	[inverse key]
default:	[optional]	[multiple]	[inverse key]
admin-c:	[mandatory]	[multiple]	[inverse key]
tech-c:	[mandatory]	[multiple]	[inverse key]
remarks:	[optional]	[multiple]	
cross-nfy:	[optional]	[multiple]	[inverse key]
cross-mnt:	[optional]	[multiple]	[inverse key]
notify:	[optional]	[multiple]	[inverse key]
mnt-by:	[mandatory]	[multiple]	[inverse key]
changed:	[mandatory]	[multiple]	
source:	[mandatory]	[single]	

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Simple “Documentation” Policy

- The simplest policy is strict customer/provider relationship
  - Customer accepts everything the provider sends
  - Customer sends its routes to provider

```
aut-num:      AS2
as-name:      EXAMPLE-NET
descr:        RPSL Example
import:       from AS1 accept ANY
export:       to AS1 announce AS2
admin-c:      MANAGEMENT
tech-c:       OPERATIONS
mnt-by:       MAINT-AS2
changed:      noc@example.net 20010101
source:       TEST
```

Why use (RPSL) Policy?

- Consistent configuration between BGP peers (peers & customers)
- Expertise encoded in the tools that generate the policy rather than engineer configuring peering session
- Automatic, manageable solution for filter generation

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Use of RPSL

- Use RtConfig v4 (part of RAToolSet from ISI) 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 their own code but RtConfig possibly only freely available code

RtConfig

- Version 4.0 supports RPSL
- Generates cisco configurations
- Contributed support for Bay's BCC, Juniper's Junos and Gated/RSd
- Creates route and AS path filters.
- Can also create ingress/egress filters (cisco only)

Using RtConfig for static route importation into BGP

- We use policy to filter static routes into BGP
  - Allows for martian filtering
  - Tagging routes with special communities
  - Other filtering, such as filter host routes

```
import:          protocol STATIC into BGP4
                 from AS2170
                 action community.append(2170:1);
                 accept AS2170
```

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RtConfig commands for static import

```
RtConfig> @RtConfig set cisco_map_name = "STATIC-EXPORT"
RtConfig> @RtConfig static2bgp AS2170 0.0.0.0
!
no access-list 100
access-list 100 permit ip 203.17.185.0   0.0.0.0   255.255.255.0   0.0.0.0
access-list 100 permit ip 205.191.168.0   0.0.0.0   255.255.255.0   0.0.0.0
access-list 100 permit ip 210.8.207.176   0.0.0.0   255.255.255.240   0.0.0.0
access-list 100 deny ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
!
no route-map STATIC-EXPORT
!
route-map STATIC-EXPORT permit 1
 match ip address 100
 set community  2170:1 additive
!
router bgp 2170
 redistribute static route-map STATIC-EXPORT
```

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Customer Import Policy

```
import: {
     from AS-ANY
          action med=0;
          accept ANY AND NOT { 0.0.0.0/0 };
     } refine {
     from AS-ANY
          action community.append(2764:65408); pref=25;
          accept community.contains(2764:3) AND NOT AS2764:RS-PROVIDER^-;
     from AS-ANY
          action community.append(2764:65408); pref=15;
          accept community.contains(2764:4) AND NOT AS2764:RS-PROVIDER^-;
     from AS-ANY
          action community.append(2764:65408); pref=5;
          accept community.contains(2764:5);
     from AS-ANY
          action community.append(2764:65408); pref=0;
          accept ANY;
     } refine {
     from AS2764:AS-CUSTOMERS
          accept PeerAS AND <^PeerAS+$>;
     from AS2764:AS-TRANSIT
          accept AS2764:AS-CUSTOMERS:PeerAS AND <^PeerAS+ AS2764:AS-CUSTOMERS:PeerAS+$>;
     }
```

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RtConfig Configuration Template

```
@RtConfig set cisco_map_first_no = 10
@RtConfig set cisco_map_increment_by = 10
@RtConfig set cisco_prefix_acl_no = 130
@RtConfig set cisco_aspath_acl_no = 130
@RtConfig set cisco_pktfilter_acl_no = 130
@RtConfig set cisco_community_acl_no = 30
@RtConfig set cisco_max_preference = 100
!
router bgp 2764
neighbor 203.63.122.193 remote-as 9313
neighbor 203.63.122.193 description On The Net
@RtConfig set cisco_map_name = "AS9313-EXPORT"
@RtConfig export AS2764 203.63.80.230 AS9313 203.63.122.193
@RtConfig set cisco_map_name = "AS9313-IMPORT"
@RtConfig import AS2764 203.63.80.230 AS9313 203.63.122.193
!
end
```

cisco Configuration

```
! access-list 135 – customer routes
!
no ip as-path access-list  130
ip as-path access-list 130 permit ^(_9313)+$
!
no route-map AS9313-IMPORT
!
no ip community-list 32
ip community-list 32 permit 2764:3
!
route-map AS9313-IMPORT permit 20
 match as-path 130
 match community 32
 match ip address 135
 set local-preference 75
!
no ip community-list 33
ip community-list 33 permit 2764:4
!
route-map AS9313-IMPORT permit 30
 match as-path 130
 match community 33
 match ip address 135
 set local-preference 85
```

```
no ip community-list 34
ip community-list 34 permit 2764:5
!
route-map AS9313-IMPORT permit 40
 match as-path 130
 match community 34
 match ip address 135
 set local-preference 95
!
route-map AS9313-IMPORT permit 50
 match as-path 130
 match ip address 135
 set local-preference 100
!
router bgp 2764
neighbor 203.63.122.193 route-map AS9313-IMPORT in
!
end
```

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Problems?

- Policy can easily get very complex and result in even more complex router configuration
- Line limit on cisco AS path filters (need to be careful when using as-sets)
- Avoid making rules too complex, rather tha using “OR” within single rule use multiple rules
- ISI/Qwest whois server doesn’t cope with the RPSL v2 community format

References

- RPSL - RFC 2622
  - ftp://munnari.oz.au/rfc/rfc2622.Z
- Using RPSL in Practice - RFC 2650
  - ftp://munnari.oz.au/rfc/rfc2650.Z
- RAToolSet
  - ftp://ftp.isi.edu/ra/RAToolSet
- RPSL Training Page
  - http://www.isi.edu/ra/rps/training
- RADB
  - http://www.merit.edu/radb

Contact Details

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e-mail:         mrp@connect.com.au
nic-hdl:        MP151
changed:        mrp@connect.com.au 19980316
source:         RADB
```

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