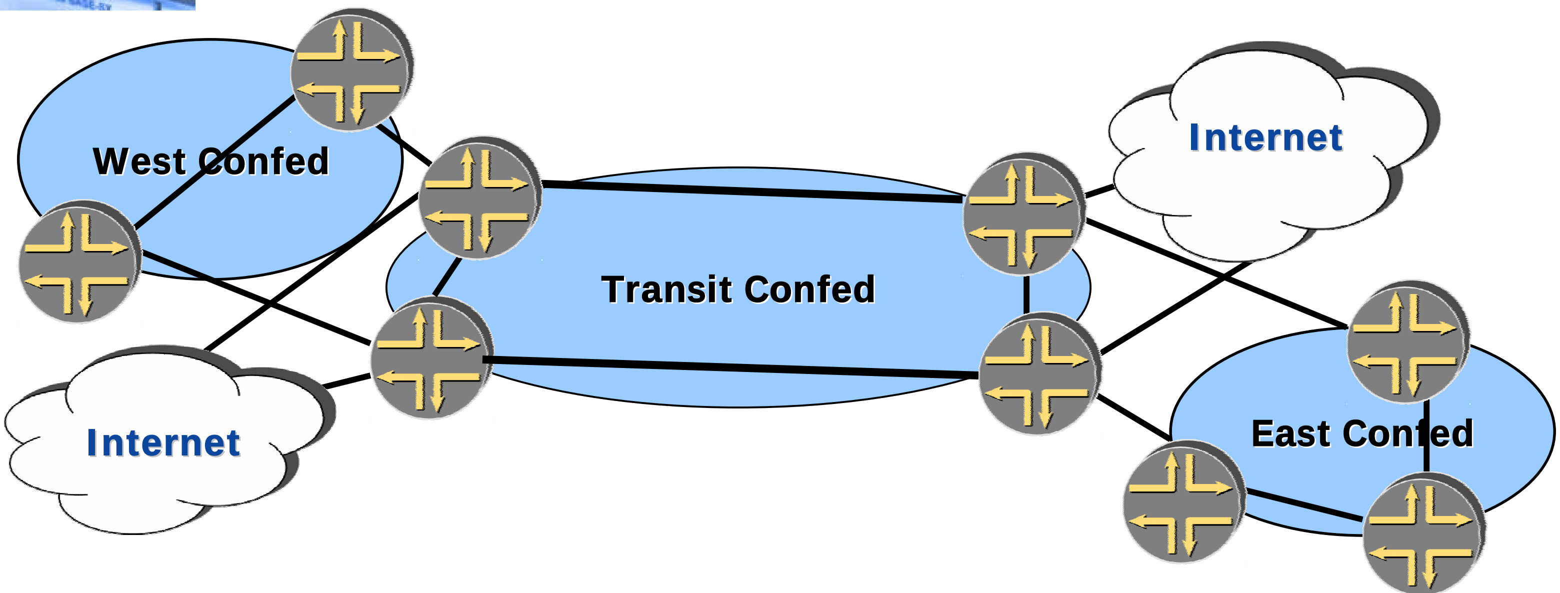
BGP Network Design
RIPE 49

Pedro Roque Marques
roque@juniper.net

Introduction

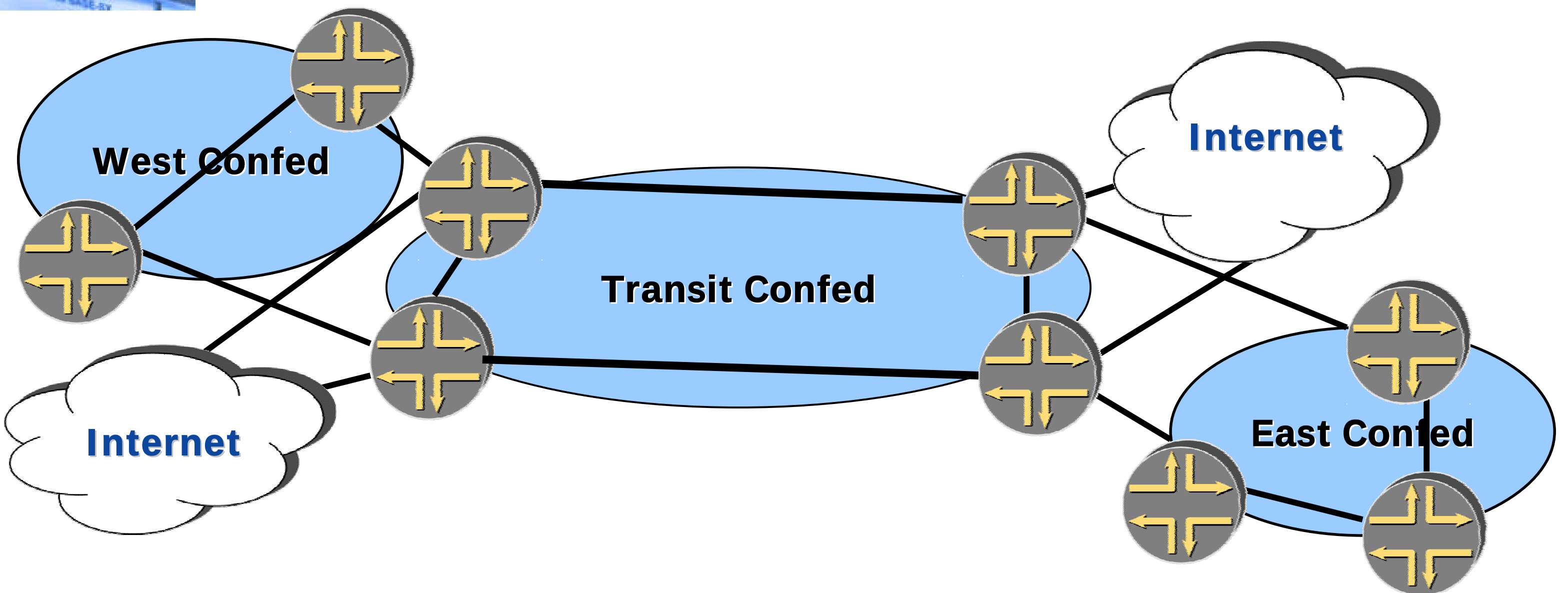
- Personal view as a person on the equipment vendor side.
- BGP design decisions.
- Frequent discussion topics:
  - How much hierarchy ?
  - Where to place route reflectors.
  - Implications of MEDs and damping.
  - Next-hop self.
  - Advertising multiple paths in BGP.

An example



- 10 locations; 2 core routers each.
- Route reflection from core to access.
- Goal: keep traffic away from E-W links.

What is wrong with this picture ?



- IGP metrics control which exit point gets selected.
- Top level of hierarchy unnecessary to meet requirement.
- Adds significant amount of complexity.

What does BGP do well ?

- Database transfer of external routing information (bulk).
  - Designed for networks with 100s of iBGP mesh peeers, millions of paths.
  - With rudimentary policy selection.
- It is not an IGP. Doesn't care which internal links are up or down; doesn't need to follow link topology.
  - Using BGP for internal traffic eng. is generally a bad idea.

Confederations <-> Reflection

- "You're right! No need to use confederations. We will use 2 levels of route reflection instead".
- Same beast by a different name.
- Confederations are equivalent to Reflection w/ no-client-to-client (as per spec).
- Difference: boundary on the link, or on the system.

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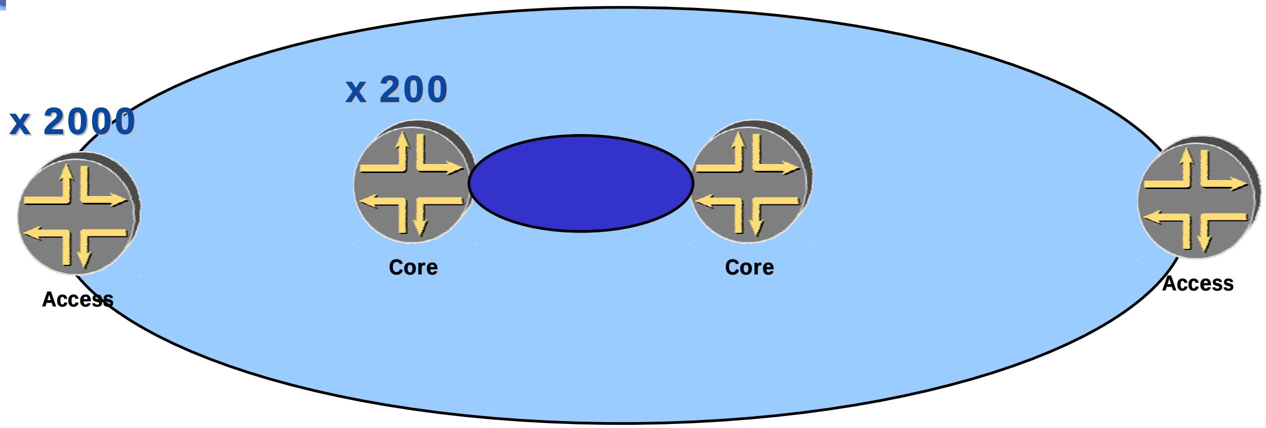
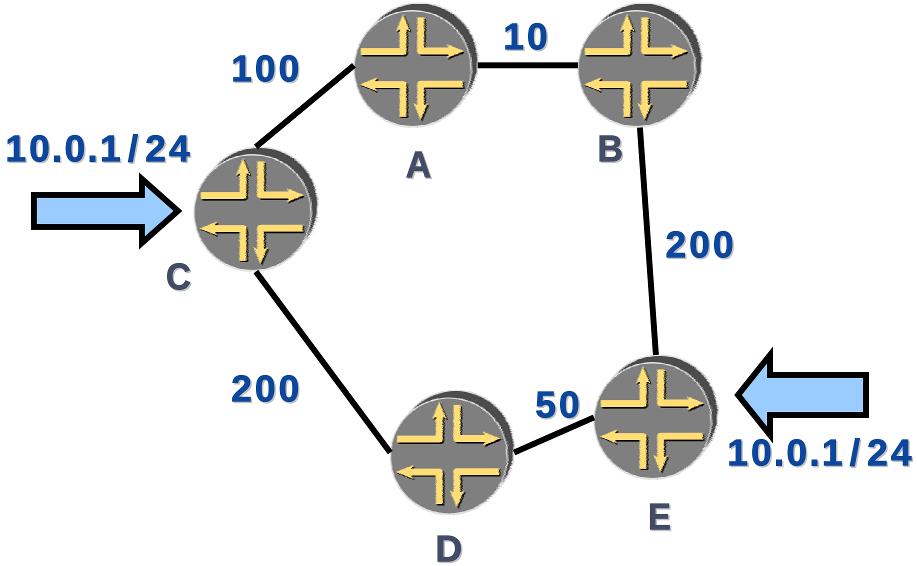
Route Reflection



- Goal: Reduce routing information.
- Otherwise you can end up with 2k copies of the routing table.
- Non-goals: configuration management; scaling # TCP sessions.

Information hiding

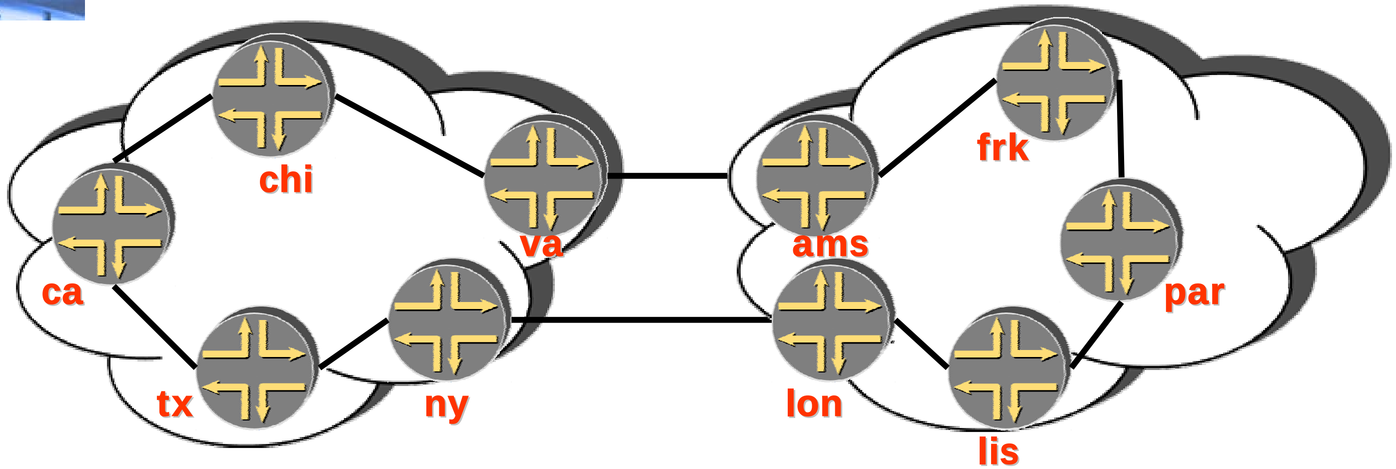


- Assume {a, b} reflectors for {c, d, e}
- Without client-reflection: only c is used as exit point from d.
- Beyond the cluster: lost path to e.

Configuration management

- In practice, many use RR as a configuration management tool.
- It is the wrong tool for the job: “side effects” of path selection are not usually understood.
- Solutions ?
  - Automated scripts / provisioning system;
  - draft-raszuk-idr-ibgp-auto-mesh-00.txt;

Information hiding



- Confed per continent or top level RRs on both sides of the pond.
- Vs all major locations on top level mesh.

Trade-offs

Confed per continent	Large top level mesh
1 path per inter-continent link.	1 off-continent path per city (worse case).
Less info for choosing exit point.	More ability to do intra-domain TE.
Convergence depends on 2 RR hops.	Choice of remote exit point via IGP metric.
Ability to do policy.	No policy.

How RRs achieve efficiency

- Statement: BGP can do 100s of iBGP mesh peers or rr-clients.
- Under what conditions is this true ?
- BGP efficiency depends on peer-groups.
  - Select which routes should be advertised once per group;
  - Format updates once per group;
  - Copy the update to N sockets;
- Means BGP is as efficient w/ 1 peer or 100 per group (minus TCP processing).

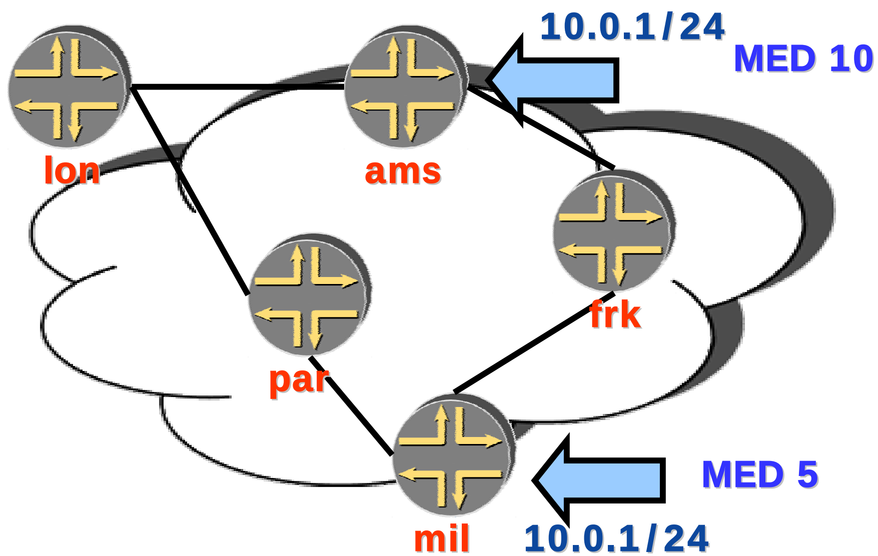
Caveat

- We left flow-control out of the previous equation (which is per peer).
- Revise: work is done per set of peers in the group which have approx. same flow-control state.
  - Implementation dependent: select updates to send once per group (or sub-group). JunOS only formats messages per sub-group.
- Particularly for an RR (sending full routes) the Round Trip Time distribution to clients does matter.

Recommendations

- **Keep It Simple.**
  - **Engineering: find the lowest cost solution that satisfies the problem.**
- **Avoid loosing information in the core.**
  - **Keep your multiple city to city choices available.**
- **Avoid centralization.**
  - **Distribution improves resiliency and performance.**

Cold-potato

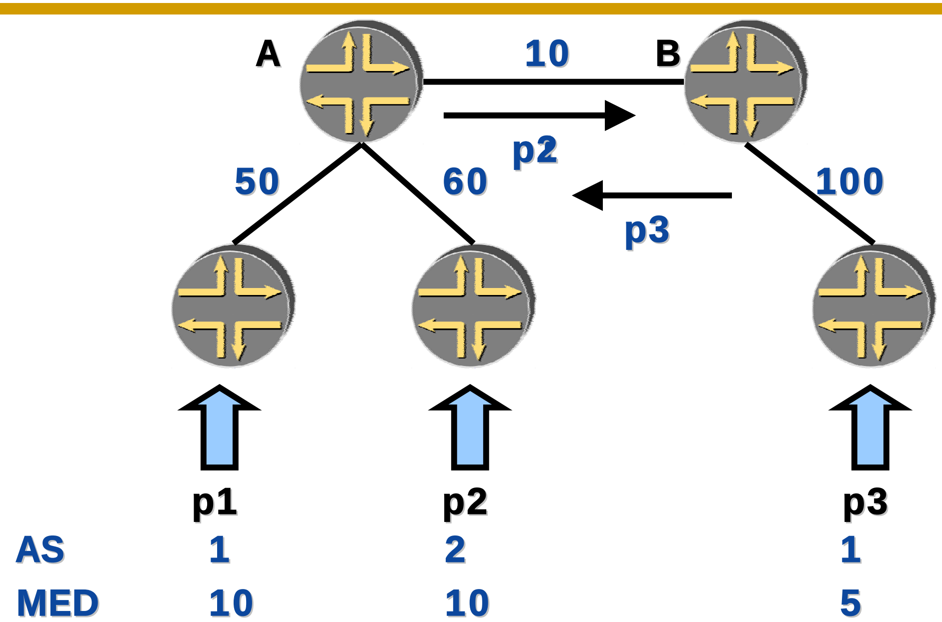


- Customer pays ISP to transport incoming traffic to selected location.
- From London POV: w/o MED 2 available paths; w/ MED only one.

Implications of cold-potato

- AMS router prefers MIL; and refrains from advertising its own path.
- Less information; only best overall path is known.
- Convergence: withdrawal of MIL path will cause AMS to advertise its alternate; LON will probably see MIL -> unreach -> AMS.
- JunOS has hidden knob to force advertisement of "best-external" route.

Cold-potato (continued).



- Likely-hood of MED oscillation problems: proportional to the number of hierarchies in the network.
- Simplest case:
  - In A: p1 < p2; p2 < p3 < p1
  - In B: p2 < p3; p3 < p1

To “next-hop self”

… Or not to “next-hop self”.

- Advantages of external next-hop addresses:
  - Metric of external link can be used to influence decision.
  - Convergence in terms of IGP propagation.
    - Assumes efficient detection of resolution changes by remote peer.
- Disadvantages:
  - Need to configure external link as passive in IGP.

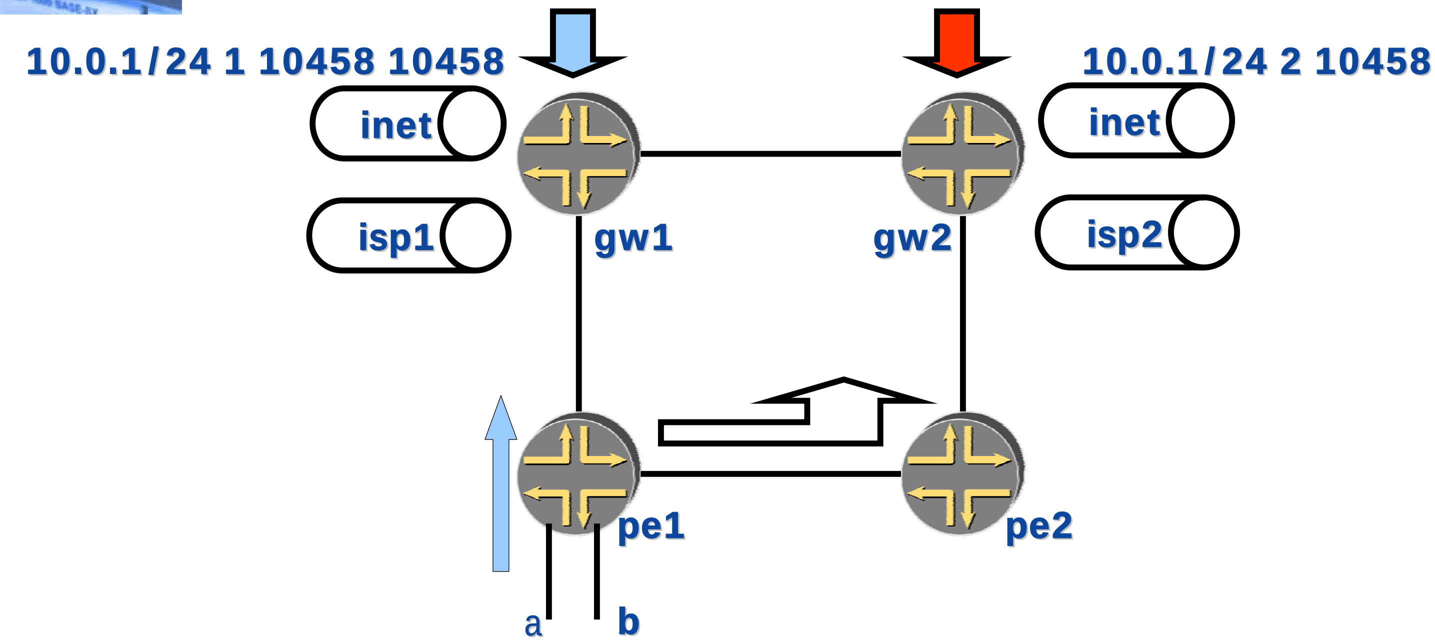
Damping

- Goal: eliminate noise generated by flapping tail circuit.
- Problem: it cannot distinguish between that case and changes caused by transit ASes (example: MED change).
- Current implementations create more problems than it solves.
- If you must: crank up suppress; low half-life so that only continuous flapping prefixes are suppressed.

Routing Views

- "Can BGP advertise more than one path ?"
- RFC 2547
  - Route Distinguisher qualifies IP prefix.
  - Route Target community used to control which routes are imported into which forwarding tables.
- JunOS
  - Input firewall filter can specify which routing-instance to use for forwarding lookup.
- Use of tunneling (mpls, ip) in the core.

Upstream selection



- **Policy: customer Ca uses upstream 1; other customers use best of all internet routes.**

Configuration – gw1

```
[edit routing-options]
rib-groups rg-isp1 {
  import-rib [inet.0 isp1.inet.0];
  /* optional import-policy */
}
[edit protocols bgp group isp1]
family inet unicast rib-group rg-isp1;
[edit routing-instances isp1]
instance-type vrf;
vrf-target target:10458:1; /* identify table */
```

Configuration – pe1

```
[edit routing-instances isp1]
instance-type vrf;
vrf-target target:10458:1; /* identify table */
[edit interfaces so-0/0/1.0 family inet]
filter input fbf;
[edit firewall filter fbf]
term a {
    from /* some criteria */
    then routing-instance isp1;
}
```

Limitations

- # entries in forwarding tables.
- Can selectively discard forwarding table state.
- No forwarding entries needed for diagnostic applications.
- Scaling of BGP: depends mostly on the number of events processed rather than number of total entries.

Recent JunOS BGP behavior changes

- **6.3**
  - **Incoming interface check on EBGP sessions.**
  - **Policy `from aggregate-contributor`.**
- **7.0**
  - **No EBGP poison reverse to neighbor-as.**
  - **`policy next-hop [discard | reject]`.**
  - **TCP path mtu discovery (knob).**

Thank You

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