Troubleshooting BGP

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Presentation Slides

- **Slides are at:**

  ftp://ftp-eng.cisco.com/pfs/seminars/

  APRICOT2005-Troubleshooting-BGP.pdf

  And on the APRICOT2005 website

- **Feel free to ask questions any time**

Assumptions

- **Presentation assumes working knowledge of BGP**

- **Please feel free to ask questions at any time!**

Agenda

- **Fundamentals of Troubleshooting**

- **Local Configuration Problems**

- **Internet Reachability Problems**

Fundamentals:
Problem Areas

- ## First step is to recognise what causes the problem

- ## Possible Problem Areas:

   ### Misconfiguration

   Configuration errors caused by bad documentation, misunderstanding of concepts, poor communication between colleagues or departments

   ### Human error

   Typos, using wrong commands, accidents, poorly planned maintenance activities

Fundamentals:
Problem Areas

- ## More Possible Problem Areas:

  ### "feature behaviour"

  #### Or – "it used to do this with Release X.Y(a) but Release X.Y(b) does that"

  ### Interoperability issues

  #### Differences in interpretation of RFC1771 and its developments

  ### Those beyond your control

  #### Upstream ISP or peers make a change which has an unforeseen impact on your network

Fundamentals:
Working on Solutions

- ## Next step is to try and fix the problem

  ### And this is not about diving into network and trying random commands on random routers, just to "see what difference this makes"

- ## Before we begin/Troubleshooting is about:

  ### Not panicking

  ### Creating a checklist

  ### Working to that checklist

  ### Starting at the bottom and working up

Fundamentals: Checklists

- **This presentation will have references in the later stages to checklists**

  They are the best way to work to a solution

  They are what many NOC staff follow when diagnosing and solving network problems

  It may seem daft to start with simple tests when the problem looks complex

  But quite often the apparently complex can be solved quite easily

Fundamentals:
Tools

- ## Familiarise yourself with the routers tools:

  ### Is logging of the BGP process enabled?

  ### Are you familiar with the BGP debug process and commands (if available)

  #### Check vendor documentation before switching on full BGP debugging – you might get fewer surprises

Agenda

- **Fundamentals**

- **Local Configuration Problems**

- **Internet Reachability Problems**

Local Configuration Problems

- **Peer Establishment**

- **Missing Routes**

- **Inconsistent Route Selection**

- **Loops and Convergence Issues**

Peer Establishment:
ACLs and Connectivity

- **Routers establish a TCP session**

  Port 179—Permit in interface packet filters

  IP connectivity (route from IGP)
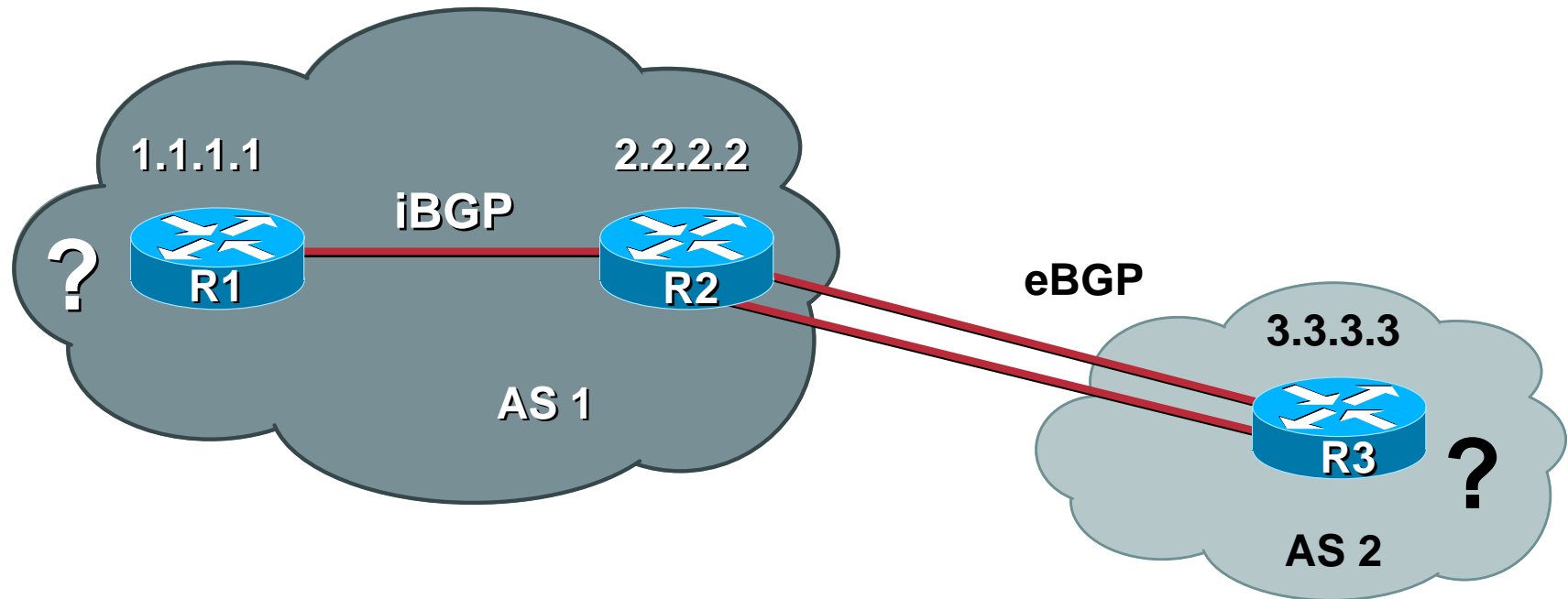
- **OPEN messages are exchanged**

  Peering addresses must match the TCP session

  Local AS configuration parameters

Peer Establishment: Common Problems

- **Sessions are not established**

    No IP reachability

    Incorrect configuration

- **Peers are flapping**

    Layer 2 problems

Peer Establishment

- **Is the Local AS configured correctly?**

- **Is the remote-as assigned correctly?**

- **Verify with your diagram or other documentation!**

Peer Establishment: iBGP Problems

- **Assume that IP connectivity has been checked**
- **Check TCP to find out what connections we are accepting**

  Check the ports (TCP/179)

  Check source/destination addresses – do they match the configuration?

- **Common problem:**

  iBGP is run between loopback interfaces on router (for stability), but the configuration is missing from the router $\Rightarrow$ iBGP fails to establish

  Remember that source address is the IP address of the outgoing interface unless otherwise specified

Peer Establishment:
eBGP Problems

- ## eBGP by and large is problem free for single point to point links

  ### Source address is that of the outbound interface

  ### Destination address is that of the outbound interface on the remote router

  #### And is directly connected (TTL is set to 1 for eBGP peers)

  ### Filters permit TCP/179 in both directions

Peer Establishment:
eBGP Problems

- **Load balancing over multiple links and/or use of eBGP multihop gives potential for so many problems**

  IP Connectivity to the remote address

  Filters somewhere in the path

  eBGP by default sets TTL to 1, so you need to change this to permit multiple hops

- **Some ISPs won't even allow their customers to use eBGP multihop due to the potential for problems**

Peer Establishment:
eBGP Problems

- ## eBGP multihop problems

  ### IP Connectivity to the remote address

  #### is a route in the local *routing* table?

  #### is a route in the remote *routing* table?

  ### Check this using ping, including the extended options that it has in most implementations

- ## Filters in the path?

  ### If this crosses multiple providers, this needs their cooperation

Peer Establishment: Passwords

- **Using passwords on iBGP and eBGP sessions**
  - **Link won't come up**
  - **Been through all the previous troubleshooting steps**
- **Common problems:**
  - **Missing password – needs to be on both ends**
  - **Cut and paste errors – don't!**
  - **Typographical errors**
  - **Capitalisation, extra characters, white space…**
- **Common solutions:**
  - **Check for symptoms/messages in the logs**
  - **Re-enter passwords from scratch – don't cut&paste**

Flapping Peer:
Common Symptoms

AS 1

AS 2

R1

R2

eBGP

Layer 2
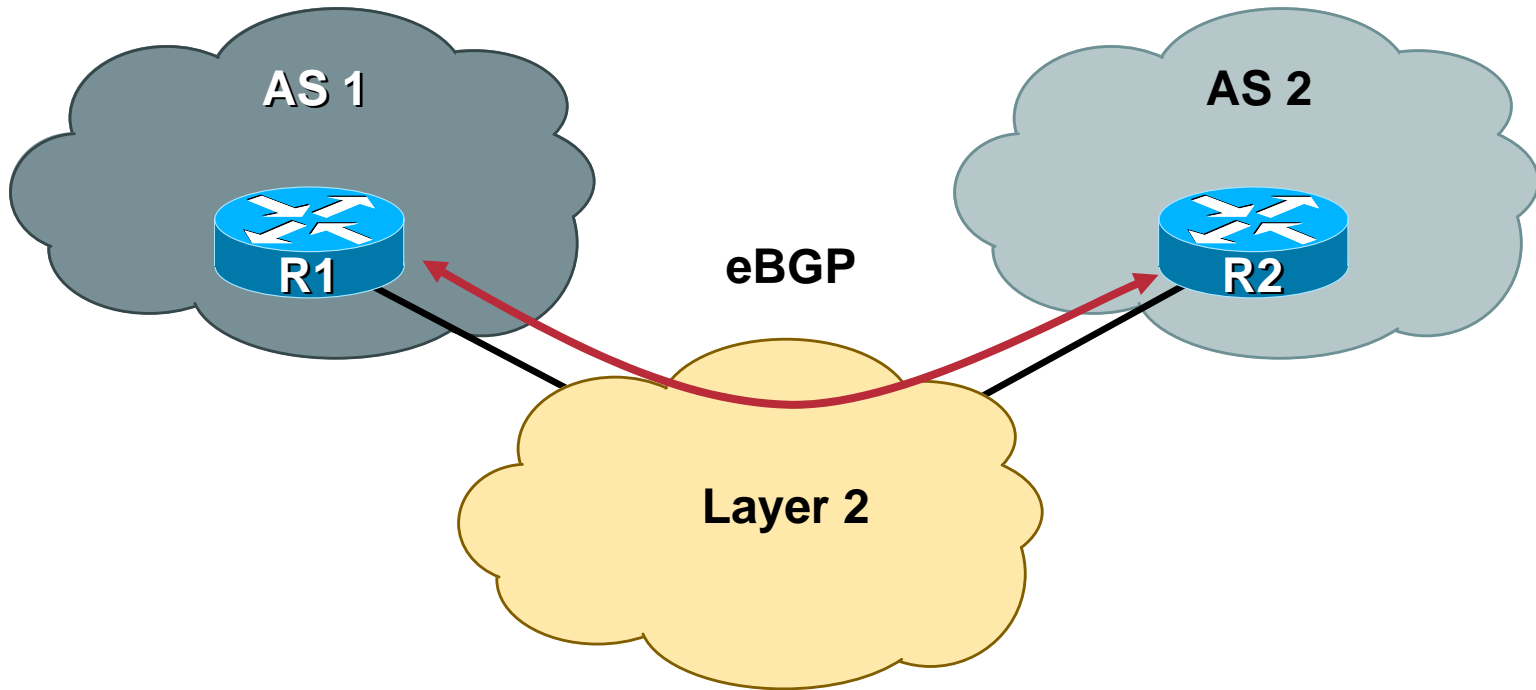
- **Symptoms – the eBGP session flaps**

- **eBGP peering establishes, then drops, re-establishes, then drops,…**

Flapping Peer:
Common Symptoms

- **Ensure logging is enabled – no logs $\rightarrow$ no clue**

- **What do the logs say?**

    Problems are usually caused because BGP keepalives are lost

    No keepalive $\Rightarrow$ local router assumes remote has gone down, so tears down the BGP session

    Then tries to re-establish the session – which succeeds

    Then tries to exchange UPDATEs – fails, keepalives get lost, session falls over again

    WHY??

Flapping Peer:
Diagnosis and Solution

- **Diagnosis**

  Keepalives get lost because they get stuck in the router's queue behind BGP update packets.

  BGP update packets are packed to the size of the MTU – keepalives and BGP OPEN packets are not packed to the size of the MTU $\Rightarrow$ Path MTU problems

  Use ping with different size packets to confirm the above – 100byte ping succeeds, 1500byte ping fails = MTU problem somewhere

- **Solution**

  Pass the problem to the L2 folks – but be helpful, try and pinpoint using ping where the problem might be in the network

Flapping Peer:
Other Common Problems

- **Remote router rebooting continually (typical with a 3-5 minute BGP peering cycle time)**

- **Remote router BGP process unstable, restarting**

- **Traffic Shaping & Rate Limiting parameters**

- **MTU incorrectly set on links, PMTU discovery disabled on router**

- **For non-ATM/FR links, instability in the L2 point-to-point circuits**

    - **Faulty MUXes, bad connectors, interoperability problems, PPP problems, satellite or radio problems, weather, etc. The list is endless – your L2 folks should know how to solve them**

    - **For you, *ping* is the tool to use**

Flapping Peer: Fixed!

AS 1

AS 2

R1

R2

eBGP

Layer 2

- - - - ➔ **Small Packets**
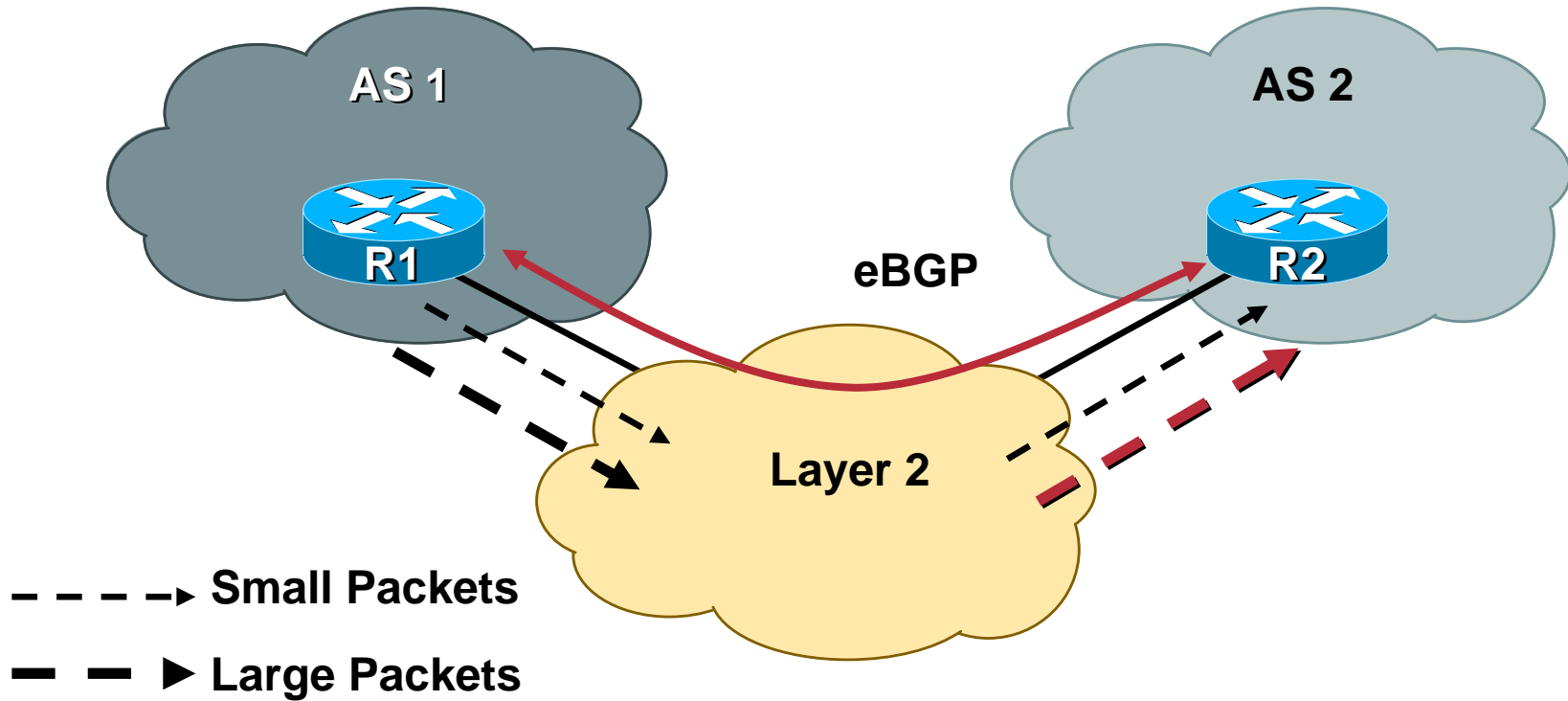
━ ━ ━ ► **Large Packets**

- **Large packets are ok now**
- **BGP session is stable!**

Local Configuration Problems

- **Peer Establishment**

- **Missing Routes**

- **Inconsistent Route Selection**

- **Loops and Convergence Issues**

Quick Review

- **Once the session has been established, UPDATEs are exchanged**

    All the locally known routes

    Only the bestpath is advertised

- **Incremental UPDATE messages are exchanged afterwards**

Quick Review

- **Bestpath received from eBGP peer**

  Advertise to all peers

- **Bestpath received from iBGP peer**

  Advertise only to eBGP peers

  A full iBGP mesh must exist

Missing Routes

- **Route Origination**

- **UPDATE Exchange**

- **Filtering**

- **iBGP mesh problems**

Missing Routes:
Route Origination

- **Common problem occurs when putting prefixes into the BGP table**

- **BGP table is NOT the RIB**

  BGP table, as with OSPF table, ISIS table, static routes, etc, is used to feed the RIB, and hence the FIB

- **To get a prefix into BGP, it must exist in another routing process too, typically:**

  Static route pointing to customer (for customer routes into your iBGP)

  Static route pointing to Null (for aggregates you want to put into your eBGP)

Missing Routes

- **Route Origination**

- **UPDATE Exchange**

- **Filtering**

- **iBGP mesh problems**

Missing Routes:
Update Exchange

- ## Ah, Route Reflectors…

    ### Such a nice solution to help scale BGP

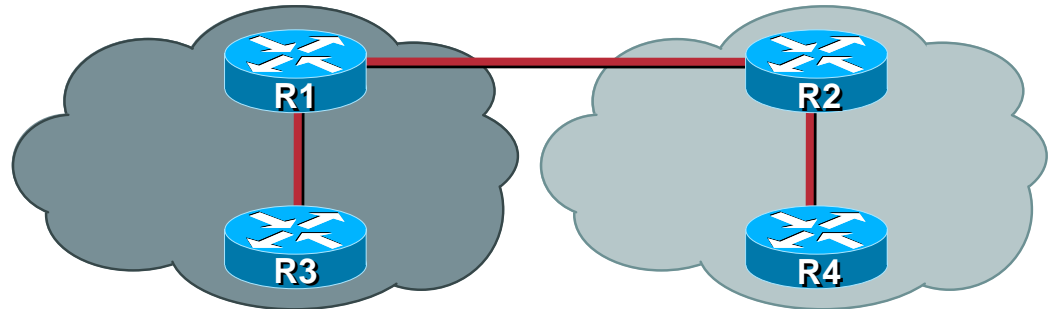   ### But why do people insist in breaking the rules all the time?!

- ## Common issues

    ### Clashing router IDs

    ### Clashing cluster IDs

Missing Routes:
Example I

- **Two RR clusters**

- **R1 is a RR for R3**

- **R2 is a RR for R4**

- **R4 is advertising 7.0.0.0/8**

- **R2 has the route but R1 and R3 do not?**

Missing Routes:
Example I

- ## R1 is not accepting the route when R2 sends it on

  ### Clashing router ID!

  If R1 sees its own router ID in the originator attribute in any received prefix, it will reject that prefix

  How a route reflector attempts to avoid routing loops

- ## Solution

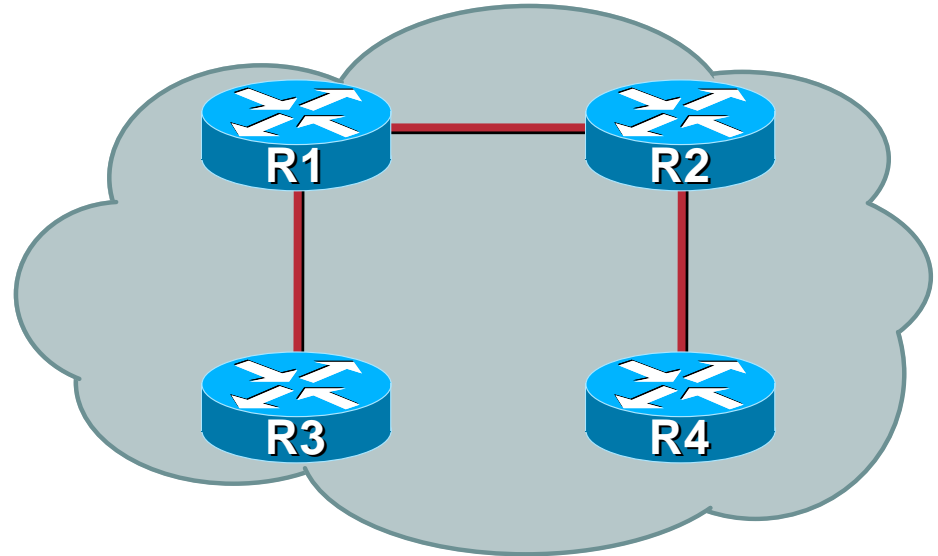 ### do NOT set the router ID by hand unless you have a very good reason to do so and have a very good plan for deployment

  ### Router-ID is usually calculated automatically by router

Missing Routes:
Example II

- **One RR cluster**

- **R1 and R2 are RRs**

- **R3 and R4 are RRCs**

- **R4 is advertising 7.0.0.0/8**

  R2 has it

  R1 and R3 do not

Missing Routes:
Example II

- ## R1 is not accepting the route when R2 sends it on

  If R1 sees its own router ID in the cluster-ID attribute in any received prefix, it will reject that prefix

  How a route reflector avoids redundant information

- ## Reason

  Early documentation claimed that RRC redundancy should be achieved by dual route reflectors in the same cluster

  This is fine and good, but then ALL clients must peer with both RRs, otherwise examples like this will occur

- ## Solution

  Use overlapping RRCs for redundancy, stick to defaults

Missing Routes

- **Route Origination**

- **UPDATE Exchange**

- **Filtering**

- **iBGP mesh problems**

Update Filtering

- **Type of filters**

  Prefix filters

  AS_PATH filters

  Community filters

  Policy/Attribute manipulation

- **Applied incoming and/or outgoing**

Update Filtering

- **If you suspect a filtering problem, become familiar with the router tools to find out what BGP filters are applied**

- **Tip: don't cut and paste!**

    Many filtering errors and diagnosis problems result from cut and paste buffer problems on the client, the connection, and even the router

Update Filtering:
Common Problems

- ## Typos in regular expressions

    Extra characters, missing characters, white space, etc

    In regular expressions every character matters, so accuracy is highly important

- ## Typos in prefix filters

    Watch the router CLI, and the filter logic – it may not be as obvious as you think, or as simple as the manual makes out

    Watch netmask confusion, and 255 profusion – easy to muddle 255 with 0 and 225!

Update Filtering:
Common Problems

- ## Communities

    Each implementation has different defaults for when communities are sent

    - Some don't send communities by default

    - Others do for iBGP and not for eBGP by default

    - Others do for all BGP peers by default

    Watch how your implementation handles communities

    - There may be implicit filtering rules

    Each ISP has different policies – never assume that because communities exist that people will use them, or pay attention to the ones you send

Missing Routes:
General Problems

- **Make and then Stick to simple policy rules:**

    Most implementations have particular rules for filtering of prefixes, AS-paths, and for manipulating BGP attributes

    Try not to mix these rules

    Rules for manipulating attributes can also be used for filtering prefixes and ASNs – can be very powerful, but can also become very confusing

Missing Routes

- **Route Origination**

- **UPDATE Exchange**

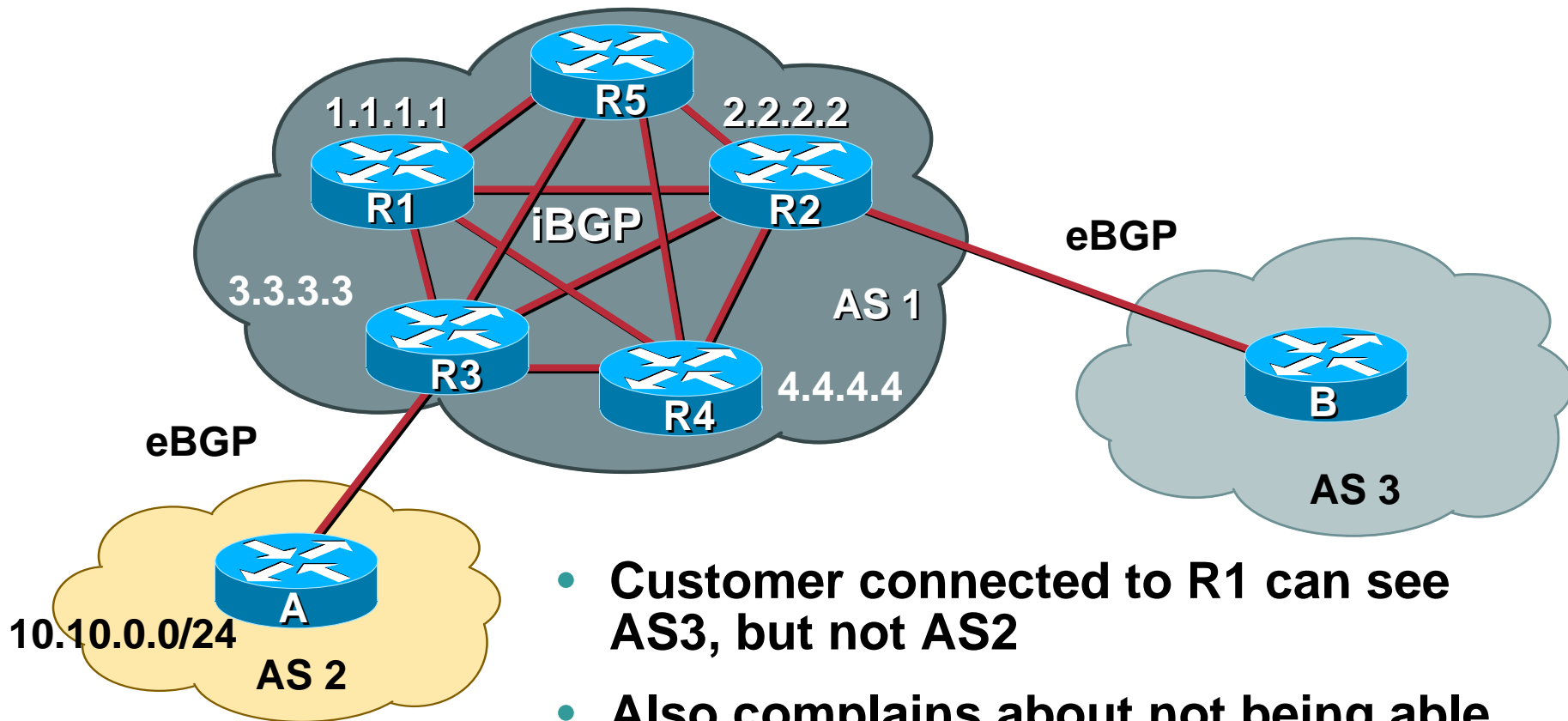- **Filtering**

- **iBGP mesh problems**

Missing Routes:
iBGP

- **Symptom: customer complains about patchy Internet access**

  Can access some, but not all, sites connected to backbone

  Can access some, but not all, of the Internet

Missing Routes: iBGP

R5

1.1.1.1

R1

2.2.2.2

R2

iBGP

eBGP

3.3.3.3

AS 1

R3

4.4.4.4

B

R4

eBGP

AS 3

A

10.10.0.0/24

AS 2

- **Customer connected to R1 can see AS3, but not AS2**

- **Also complains about not being able to see sites connected to R5**

- **No complaints from other customers**

Missing Routes:
iBGP

- ## Diagnosis: This is the classic iBGP mesh problem

    The full mesh isn't complete – how do we know this?

- ## Customer is connected to R1

    Can't see AS2 $\Rightarrow$ R3 is somehow not passing routing information about AS2 to R1

    Can't see R5 $\Rightarrow$ R5 is somehow not passing routing information about sites connected to R5

    But can see rest of the Internet $\Rightarrow$ his prefix is being announced to some places, so not an iBGP origination problem

Missing Routes:
iBGP

- **When using full mesh iBGP, check on every iBGP speaker that it has a neighbour relationship with every other iBGP speaker**

  In this example, R3 peering with R1 is down as R1 isn't seeing any of the routes connected through R3

- **Try and use configuration shorthand if available in your implementation**

  Peering between R1 and R5 was down as there was a typo in the shorthand, resulting in the incorrect configuration being used

Troubleshooting Tips

- **Use configuration shorthand both for efficiency and to avoid making policy errors within the iBGP mesh**

  - **This is especially true for full iBGP mesh networks**

  - **But be careful of not introducing typos into names of these "subroutines" – common problem**

- **Use route reflectors to avoid accidentally missing iBGP peers, especially as the mesh grows in size**

  - **But stick to the route reflector rules and the defaults in the implementation – changing defaults and ignoring BCP techniques introduces complexity and causes problems**

Local Configuration Problems

- **Peer Establishment**

- **Missing Routes**

- **Inconsistent Route Selection**

- **Loops and Convergence Issues**

Inconsistent Route Selection

- **Two common problems with route selection**

    Inconsistency

    Appearance of an incorrect decision

- **RFC 1771 defines the decision algorithm**

- **Every vendor has tweaked the algorithm**

    http://www.cisco.com/warp/public/459/25.shtml

- **Route selection problems can result from oversights by RFC 1771**

Inconsistent:
Example I

- **RFC says that MED is not always compared**

- **As a result, the ordering of the paths can effect the decision process**

- **For example, the default in Cisco IOS is to compare the prefixes in order of arrival (most recent to oldest)**

  This can result in inconsistent route selection

  Symptom is that the best path chosen after each BGP reset is different

Inconsistent: Example I

- **Inconsistent route selection may cause problems**

    Routing loops

    Convergence loops—i.e. the protocol continuously sends updates in an attempt to converge
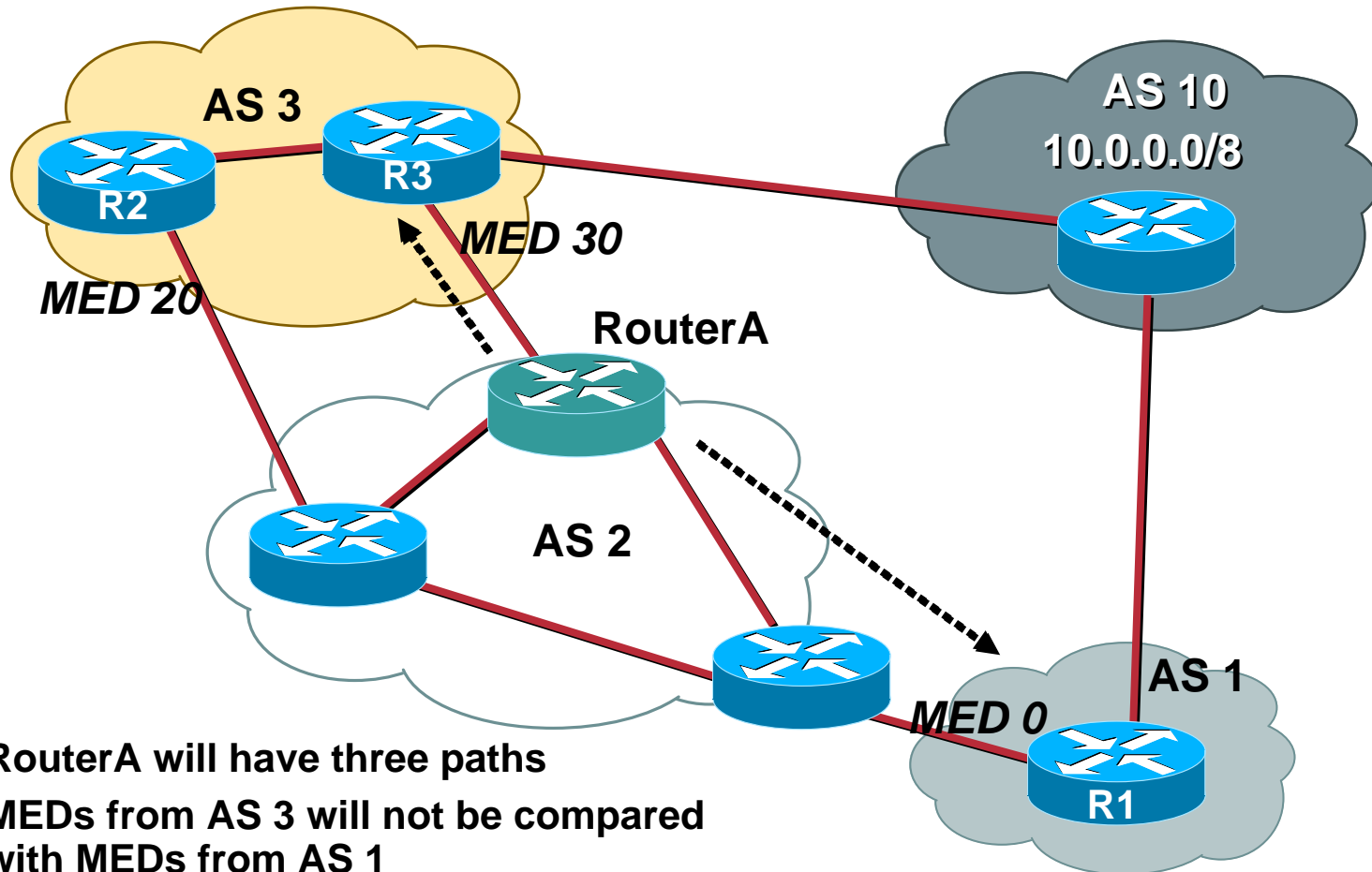
    Changes in traffic patterns

- **Difficult to catch and troubleshoot**

    In Cisco IOS, the deterministic-med configuration command is used to order paths consistently

    Enable in all the routers in the AS

    The bestpath is recalculated as soon as the command is entered

Symptom I:
Diagram

AS 3

R2

R3

MED 30

MED 20

RouterA

AS 2

AS 10
10.0.0.0/8

AS 1

MED 0

R1

- **RouterA will have three paths**
- **MEDs from AS 3 will not be compared with MEDs from AS 1**
- **RouterA will sometimes select the path from R1 as best and but may also select the path from R3 as best**

# Deterministic MED:
Operation

- **The paths are ordered by Neighbour AS**

- **The bestpath for each Neighbour AS group is selected**

- **The overall bestpath results from comparing the winners from each group**

- **The bestpath will be consistent because paths will be placed in a deterministic order**

Solution:
Diagram

AS 3

R2

R3

MED 30

MED 20

RouterA

AS 10
10.0.0.0/8

AS 2

AS 1

MED 0

R1
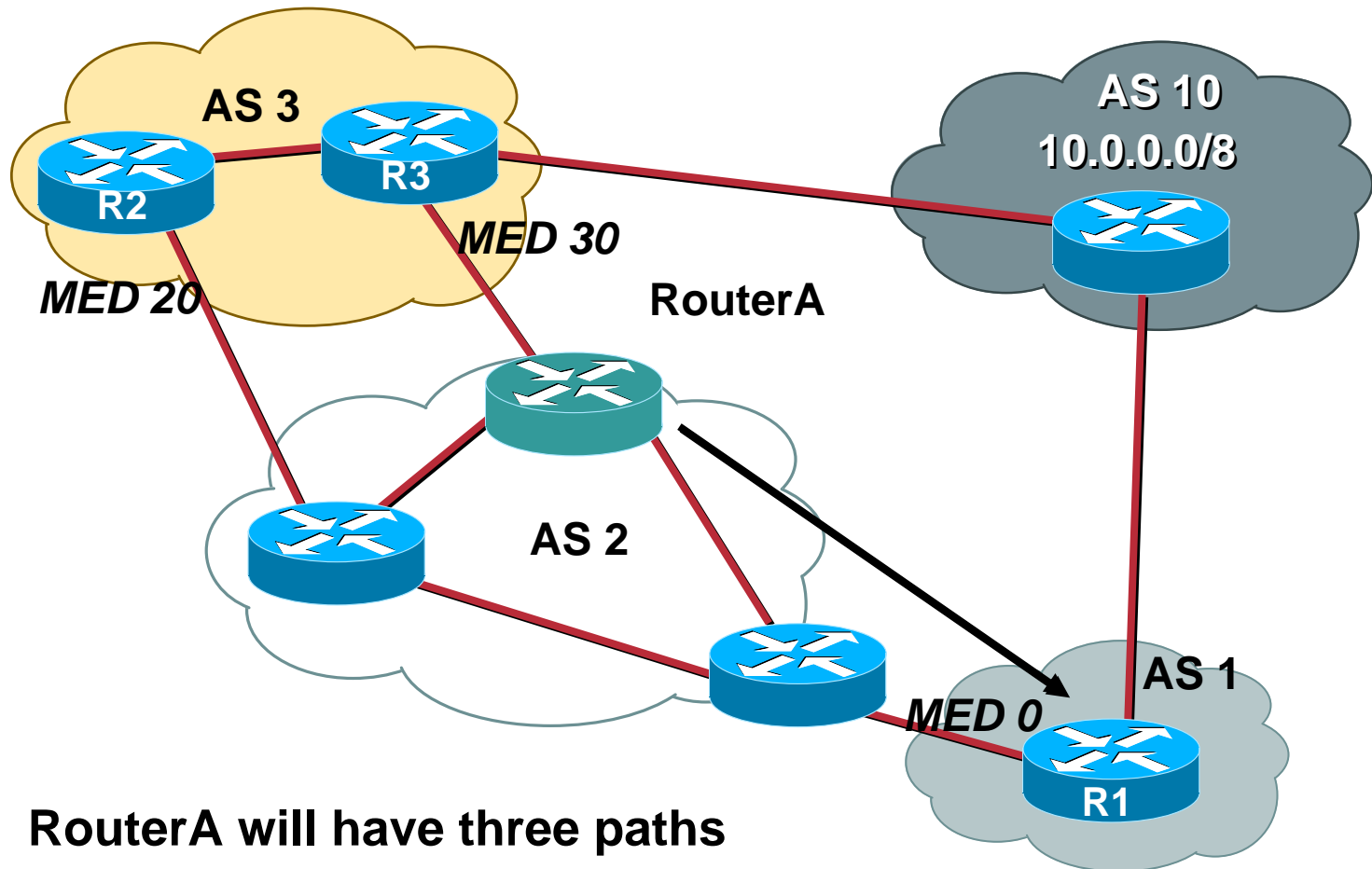
- **RouterA will have three paths**

- **RouterA will consistently select the path from R1 as best!**

Inconsistent: Example II

AS 10 — R1
AS 20 — R2
R3
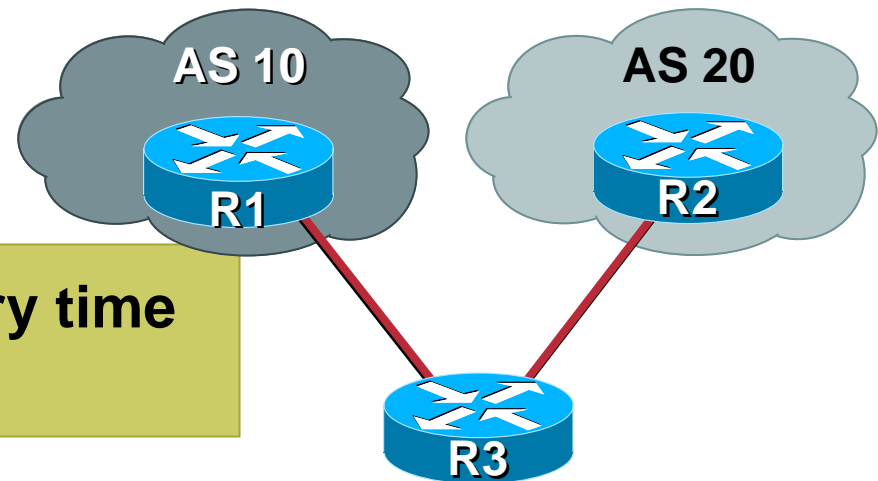
- **The bestpath changes every time the peering is reset**

- **By default, the "oldest" external is the bestpath**

  - **All other attributes are the same**

  - **Stability Enhancement in Cisco IOS**

- **The BGP sub-command "bestpath compare-router-id" will disable this enhancement**

Inconsistent:
Example III

- **Path 1 has higher localpref but path 2 is better???**

- **This appears to be incorrect…**

- **It's because Cisco IOS has "synchronization" on by default**

  …and if a prefix is not synchronized (i.e. appearing in IGP as well as BGP), its path won't be included in the bestpath process

Inconsistent Path Selection

- **Summary:**

  RFC1771 isn't prefect when it comes to path selection – years of operational experience have shown this

  Vendors and ISPs have worked to put in stability enhancements

  But these can lead to interesting problems

  And of course some defaults linger much longer than they ought to – so never assume that an out of the box default configuration will be perfect for your network
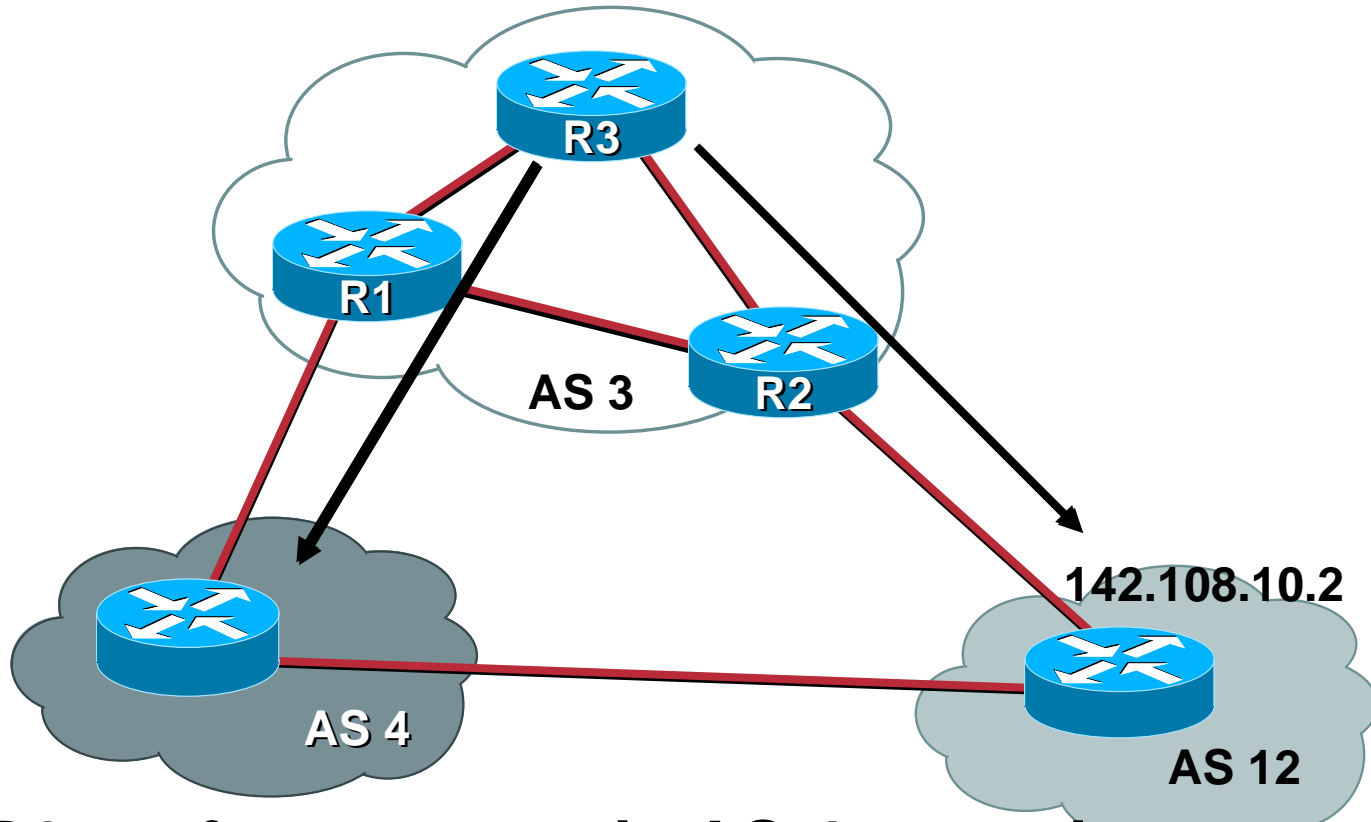
Local Configuration Problems

- **Peer Establishment**

- **Missing Routes**

- **Inconsistent Route Selection**

- **Loops and Convergence Issues**

Route Oscillation

- **One of the most common problems!**

- **Every minute routes flap in the routing table from one nexthop to another**

- **With full routes the most obvious symptom is high CPU in "BGP Router" process**

Route Oscillation: Diagram

- **R3 prefers routes via AS 4 one minute**
- **1 minute later R3 prefers routes via AS 12**
- **And 1 minute after that R3 prefers AS 4 again**

Route Oscillation: Symptom

- **Main symptom is that traffic exiting the network oscillates every minute between two exit points**

  This is almost *always* caused by the BGP NEXT_HOP being known only by BGP

  Common problem in ISP networks – but if you have never seen it before, it can be a nightmare to debug and fix

- **Other symptom is high CPU utilisation for the BGP router process**

Route Oscillation: Cause

- **BGP nexthop is known via BGP**

  This is an illegal recursive lookup

- **Scanner will notice, drop this path, and install the other path in the RIB**

- **Route to the nexthop is now valid**

- **Scanner will detect this and re-install the other path**

- **Routes will oscillate forever**

  One minute cycle in Cisco IOS as scanner runs every minute

Route Oscillation: Solution

- **Make sure that all the BGP NEXT_HOPs are known by the IGP**

  (whether OSPF/ISIS, static or connected routes)

  If NEXT_HOP is also in iBGP, ensure the iBGP distance is longer than the IGP distance

  —or—

- **Don't carry external NEXT_HOPs in your network**

  Use "next-hop-self" concept on all the edge BGP routers

- **Two simple solutions**

Troubleshooting Tips

- **High CPU utilisation in the BGP process is normally a sign of a convergence problem**

- **Find a prefix that changes every minute**

- **Troubleshoot/debug that one prefix**

Troubleshooting Tips

- **BGP routing loop?**

  First, check for IGP routing loops to the BGP NEXT_HOPs

- **BGP loops are normally caused by**

  Not following physical topology in RR environment

  Multipath with confederations

  Lack of a full iBGP mesh

- **Get the following from each router in the loop path**

  The routing table entry
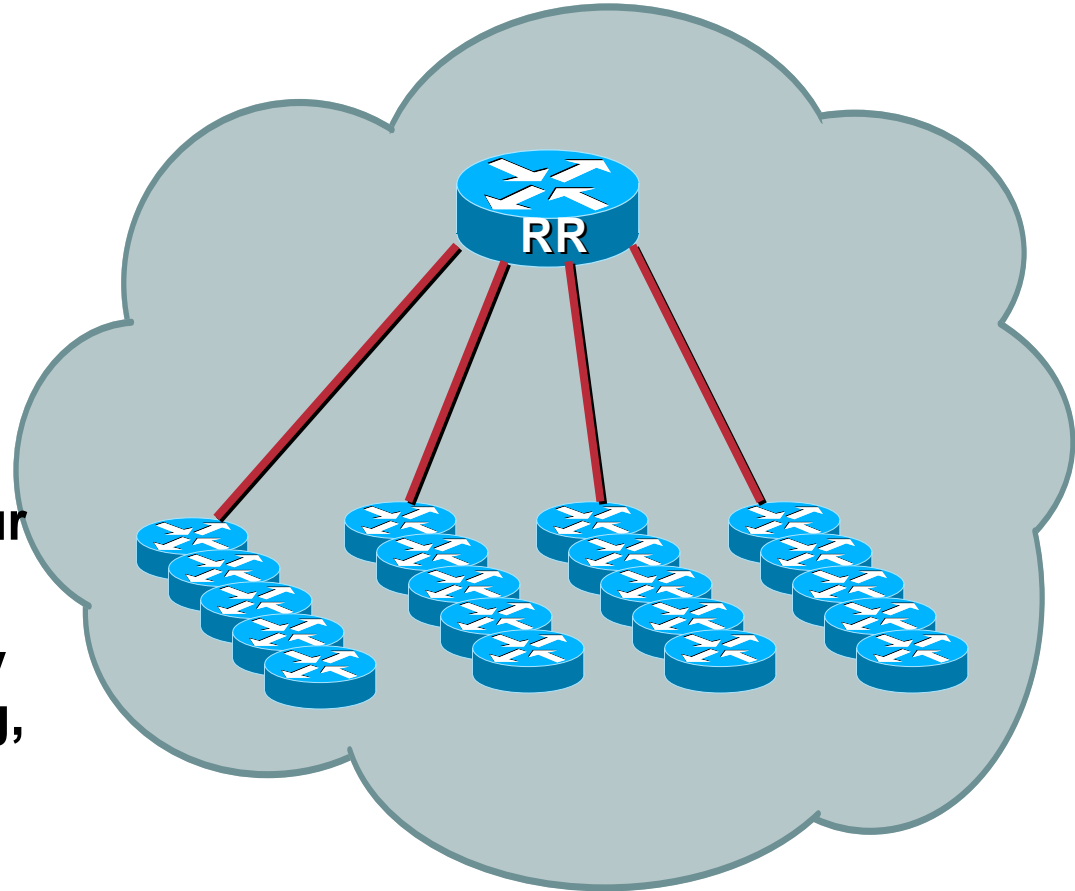
  The BGP table entry

  The route to the NEXT_HOP

Convergence Problems:
Example I

- **Route reflector with 250 route reflector clients**

- **100k routes**

- **BGP will not converge**

- **Logs show that neighbour hold times have expired**

- **The BGP router summary shows peers establishing, dropping, re-establishing**

    And it's not the MTU problem we saw earlier!

Convergence Problems: Example I

- **We are either missing hellos or our peers are not sending them**

- **Check for interface input drops**

    If the number is large, and the interface counters show recent history, then this is probably the cause of the peers going down

- **Large drops is usually due to the input queue being too small**

    Large numbers of peers can easily overflow the queue, resulting in lost hellos

- **Solution is to increase the size of the input queues to be considerably larger than the number of peers**

Convergence Problems:
Example II

- **BGP converges in 25 minutes for 250 peers and 100k routes**

  Seems like a long time

  What is TCP doing?

- **Check the MSS size**

  And enable Path MTU discovery on the router if it is not on by default

  MSS of 536 means that router needs to send almost three times the amount of packets compared with an MSS of 1460

- **Result:**

  Should see BGP converging in about half the time – which is respectable for 250 peers and 100k routes

Agenda

- **Fundamentals**

- **Local Configuration Problems**

- **Internet Reachability Problems**

Internet Reachability Problems

- **BGP Attribute Confusion**

  To Control Traffic in $\rightarrow$ Send MEDs and AS-PATH prepends on outbound announcements

  To Control Traffic out $\rightarrow$ Attach local-preference to inbound announcements

- **Troubleshooting of multihoming and transit is often hampered because the relationship between routing information flow and traffic flow is forgotten**

Internet Reachability Problems

- ## BGP Path Selection Process

  Each vendor has "tweaked" the path selection process

  Know it, learn it, for your router equipment – saves time later

- ## MED confusion

  Default MED on Cisco IOS is ZERO – it may not be this on your router, or your peer's router

Internet Reachability Problems

- **Community confusion**

    set community does just that – it overwrites any other community set on the prefix

    Use **additive** keyword to add community to existing list

    Use Internet format for community (AS:xx) not the 32-bit IETF format

    Cisco IOS never sends community by default

    Other implementations may send community by default for iBGP and/or eBGP

    Never assume that your neighbouring AS will honour your **no-export** community – ask first!

Internet Reachability Problems

- ## AS-PATH prepends

  20 prepends won't lessen the priority of your path any more than 10 prepends will – check it out at a Looking Glass

  - The Internet is on average only 5 ASes deep, maximum AS prepend most ISPs have to use is around this too

 - Know you BGP path selection algorithm

  Some ISPs use bgp maxas-path 15 to drop prefixes with ridiculously long AS-paths

Internet Reachability Problems

- **Private ASes should not ever appear in the Internet**

- **Cisco IOS remove-private-AS command does not remove every instance of a private AS**

  - **e.g. won't remove private AS appearing in the middle of a path surrounded by public ASNs**

  - **www.cisco.com/warp/public/459/32.html**

- **Apparent non-removal of private-ASNs may not be a bug, but a configuration error somewhere else**

Troubleshooting Connectivity – Example I
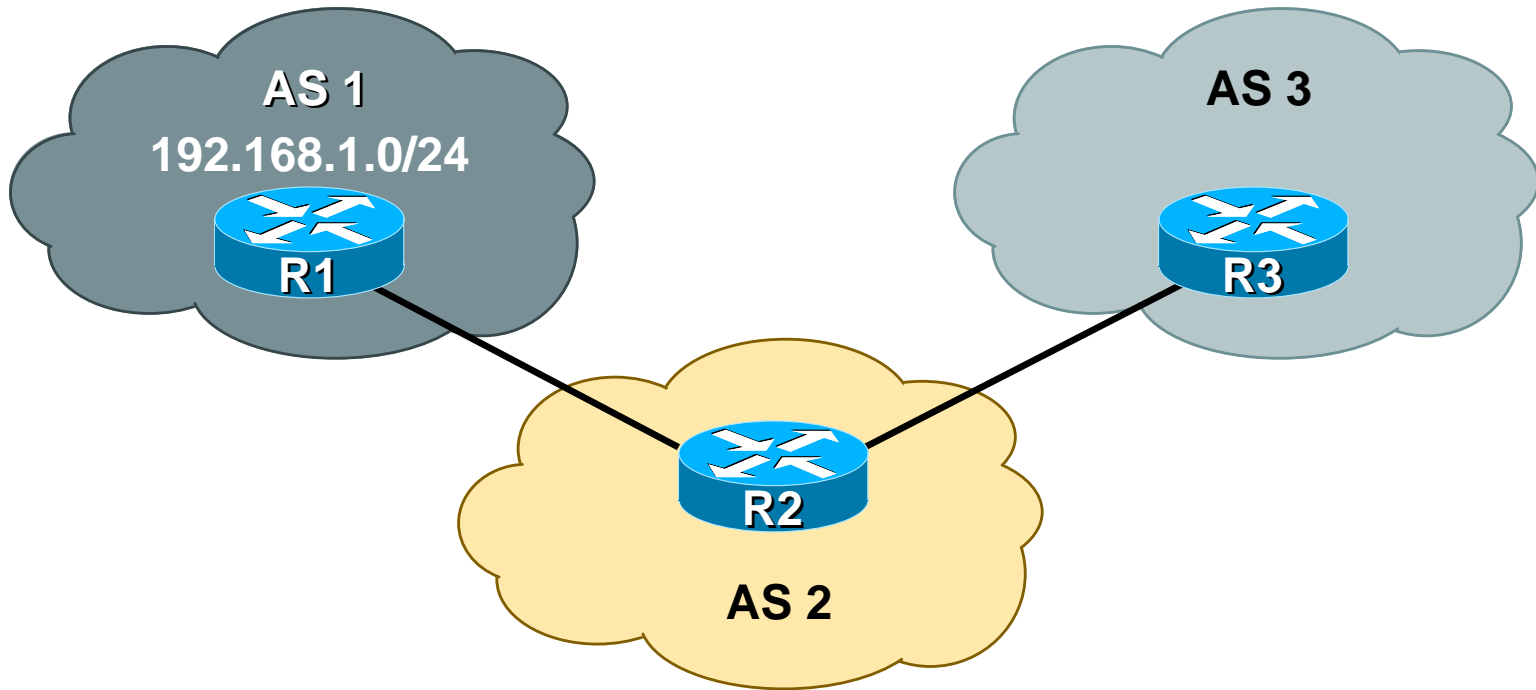
- **Symptom: AS1 announces 192.168.1.0/24 to AS2 but AS3 cannot see the network**

Troubleshooting Connectivity – Example I

- ## Checklist:

  ### AS1 announces, but does AS2 see it?

  We are checking eBGP filters on R1 and R2. Remember that R2 access will require cooperation and assistance from your peer

  ### Does AS2 see it over entire network?

  We are checking iBGP across AS2's network (unneeded step in this case, but usually the next consideration). Quite often iBGP is misconfigured, lack of full mesh, problems with RRs, etc.

Troubleshooting Connectivity – Example I

- ## Checklist:

  ### Does AS2 send it to AS3?

  We are checking eBGP configuration on R2. There may be a configuration error with as-path filters, or prefix-lists, or communities such that only local prefixes get out

  ### Does AS3 see all of AS2's originated prefixes?

  We are checking eBGP configuration on R3. Maybe AS3 does not know to expect prefixes from AS1 in the peering with AS2, or maybe it has similar errors in as-path or prefix or community filters

Troubleshooting Connectivity – Example I

- **Troubleshooting connectivity beyond immediate peers is much harder**

    Relies on your peer to assist you – they have the relationship with their BGP peers, not you

    Quite often connectivity problems are due to the private business relationship between the two neighbouring ASNs

Troubleshooting Connectivity – Example II
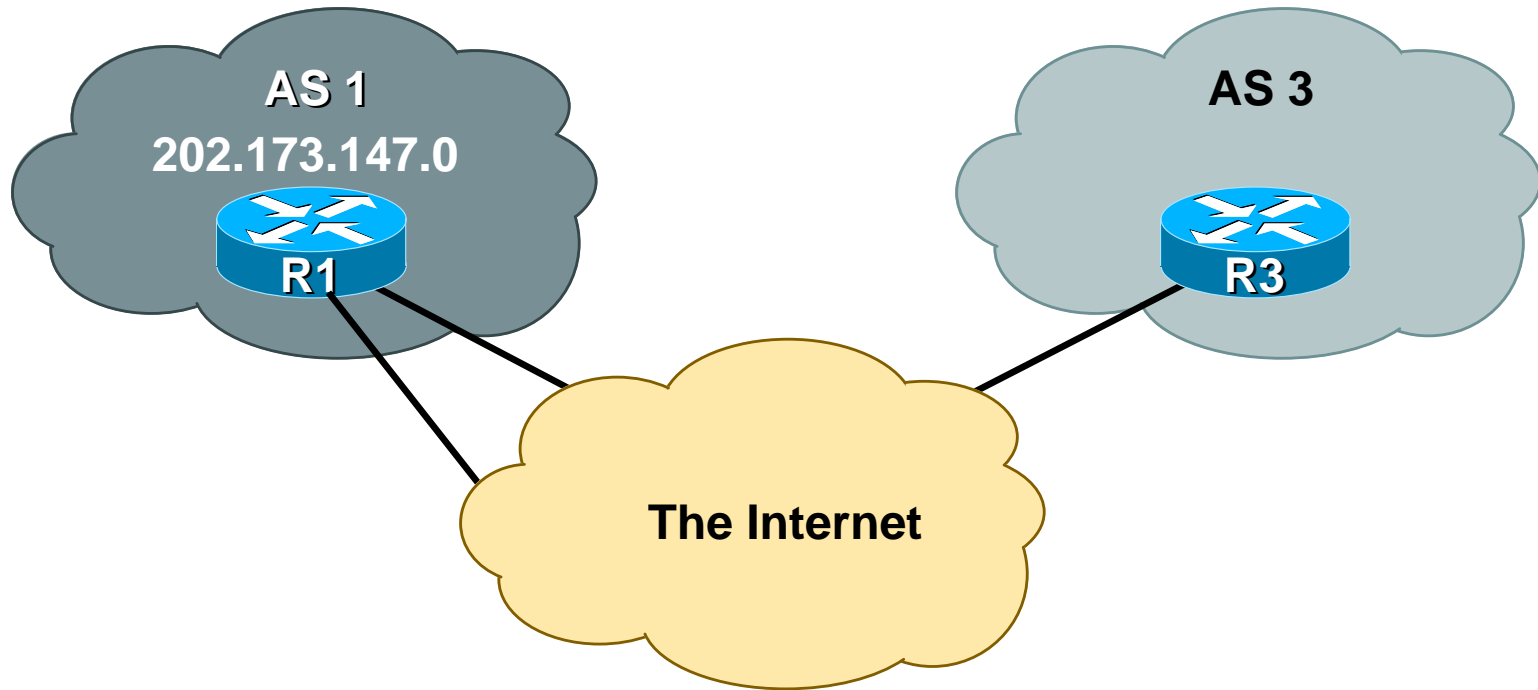
- **Symptom: AS1 announces 202.173.147.0/24 to its upstreams but AS3 cannot see the network**

Troubleshooting Connectivity – Example II

- ## Checklist:

AS1 announces, but do its upstreams see it?

We are checking eBGP filters on R1 and upstreams. Remember that upstreams will need to be able to help you with this

Is the prefix visible anywhere on the Internet?

We are checking if the upstreams are announcing the network to anywhere on the Internet. See next slides on how to do this.

Troubleshooting Connectivity – Example II

- **Help is at hand – the Looking Glass**

- **Many networks around the globe run Looking Glasses**

  These let you see the BGP table and often run simple ping or traceroutes from their sites

  www.traceroute.org for IPv4

  www.traceroute6.org for IPv6

- **Next slides have some examples of a typical looking glass in action**

Routing Information Service

RIPE NCC Homepage -> RIS

RIS - Looking Glass

RRC Box: RRC00, Amsterdam

RRC00, Amsterdam
RRC01, LINX
RRC02, SFINX
RRC03, AMS-IX
RRC04, CIXP
RRC05, VIX
RRC06, NSPIXP2
RRC07, Netnod
RRC10, MIX
RRC11, NYIIX
RRC12, DE-CIX
RRC14, PAIX

Query:
- show ip
- ● show ip
- show bg
- show ip
- show ipv
- show ipv
- show ipv
- show version
- traceroute
- ping

Argument: [____] Execute

Multi-Router Looking Glass
Written by: John Fraizer - EnterZone, Inc

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RIS - Looking Glass

- **RIS Home Page**
- **Tools**
- **Statistics**
- **RIS Raw Data**
- **Documentation**
- **Presentations**
- **Miscellaneous**
- **News**
- **Contact Us**
- **Disclaimer**

RRC Box: RRC01, LINX ▼

Query:
- ⦿ show ip bgp
- ◯ show ip bgp summary
- ◯ show bgp neighbors
- ◯ show ip bgp regexp
- ◯ show ipv6 bgp
- ◯ show ipv6 bgp summary
- ◯ show ipv6 bgp regexp
- ◯ show version
- ◯ traceroute
- ◯ ping

Argument: 202.173.147.0   [Execute]

```
BGP routing table entry for 202.173.144.0/21
Paths: (4 available, best #3, table Default-IP-Routing-Table)
  Not advertised to any peer
  13237 1668 4648 2764 9543
    195.66.224.99 from 195.66.224.99 (82.197.136.1)
      Origin IGP, localpref 100, valid, external
      Community: 1668:31000 13237:44088 13237:46881
      Last update: Fri Jan 14 01:48:12 2005

  286 209 1239 4648 2764 9543
    195.66.224.54 from 195.66.224.54 (134.222.86.174)
      Origin IGP, localpref 100, valid, external
      Last update: Wed Jan  5 13:52:52 2005

  5511 10026 4648 2764 9543
    195.66.224.83 from 195.66.224.83 (193.251.245.1)
      Origin IGP, localpref 100, valid, external, best
      Last update: Mon Jan 17 02:15:07 2005

  8342 702 701 1239 4648 2764 9543
    195.66.224.90 from 195.66.224.90 (195.161.1.152)
      Origin IGP, localpref 100, valid, external
      Last update: Wed Dec 29 00:13:04 2004
```

Multi-Router Looking Glass

Troubleshooting Connectivity – Example II

- ## Hmmm….

- ## Looking Glass can see 202.173.144.0/21

    ### This includes 202.173.147.0/24

    ### So the problem must be with AS3, or AS3's upstream

- ## A traceroute confirms the connectivity

- **Tools**
- **Statistics**
- **RIS Raw Data**
- **Documentation**
- **Presentations**
- **Miscellaneous**
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- **Contact Us**
- **Disclaimer**

RRC Box: RRC01, LINX

Query:
- ○ show ip bgp
- ○ show ip bgp summary
- ○ show bgp neighbors
- ○ show ip bgp regexp
- ○ show ipv6 bgp
- ○ show ipv6 bgp summary
- ○ show ipv6 bgp regexp
- ○ show version
- ⦿ traceroute
- ○ ping

Argument: 202.173.147.216 [Execute]

Traceroute from **RRC01** to **202.173.147.216**.

```
traceroute to 202.173.147.216 (202.173.147.216), 30 hops max, 38 byte packets
 1  collector.linx.net (195.66.225.254)  0.752 ms  0.487 ms  0.567 ms
 2  fa2-1-112.transit1.thn.linx.net (195.66.248.226)  0.641 ms  0.778 ms  0.745 ms
 3  demon-transit.thn.linx.net (195.66.248.26)  0.654 ms  0.643 ms  0.518 ms
 4  tele-border-2-g1-0-0.router.demon.net (194.70.98.182)  0.981 ms  1.082 ms  1.212 ms
 5  sl-gw22-lon-2-2.sprintlink.net (213.206.156.49)  0.945 ms  1.105 ms  0.946 ms
 6  sl-bb21-lon-9-0.sprintlink.net (213.206.128.98)  1.117 ms  0.933 ms  1.030 ms
 7  sl-bb21-tuk-10-0.sprintlink.net (144.232.19.69)  73.652 ms  73.803 ms  73.570 ms
 8  sl-bb20-tuk-15-0.sprintlink.net (144.232.20.132)  82.147 ms  81.515 ms  73.878 ms
 9  sl-bb21-rly-14-0.sprintlink.net (144.232.20.115)  81.549 ms  81.799 ms  81.536 ms
10  sl-bb22-rly-13-0.sprintlink.net (144.232.7.254)  81.302 ms  81.898 ms  81.816 ms
11  sl-bb22-sj-10-0.sprintlink.net (144.232.20.186)  143.283 ms  143.680 ms  143.041 ms
12  144.232.20.47 (144.232.20.47)  164.658 ms  148.663 ms  148.483 ms
13  sl-newzeal-1-0.sprintlink.net (144.223.243.18)  151.380 ms  151.648 ms  151.394 ms
14  p5-1.sjbr1.global-gateway.net.nz (202.37.245.229)  306.191 ms  307.392 ms  305.750 ms
15  p1-5.sybr3.global-gateway.net.nz (202.37.247.81)  306.225 ms  306.216 ms  306.239 ms
16  con2.sybr3.global-gateway.net.nz (202.37.246.242)  306.370 ms  307.952 ms  306.693 ms
17  so-3-0-3.crel.syd.connect.com.au (202.10.4.11)  308.144 ms  306.429 ms  307.282 ms
18  so-3-0-2.crel.hay.connect.com.au (202.10.0.63)  306.027 ms  306.267 ms  307.442 ms
19  so-1-1-0.crel.for.connect.com.au (202.10.0.34)  322.587 ms  327.149 ms  325.830 ms
20  so-0-0-1.dst2.bri.connect.com.au (202.10.0.102)  331.707 ms  322.102 ms  322.023 ms
21  gigabitethernet0-1.cor2.bri.connect.com.au (203.63.11.82)  322.028 ms  323.343 ms  323.508 ms
22  DWES131845-8.gw.connect.com.au (210.8.13.61)  325.219 ms  323.865 ms  323.619 ms
23  gi0-1.bri-lns1.qld.westnet.com.au (202.173.144.82)  323.118 ms  323.777 ms  323.458 ms
24  dsl-202-173-147-216.qld.westnet.com.au (202.173.147.216)  337.079 ms  337.940 ms *
```

Troubleshooting Connectivity – Example II

- **Help is at hand – RouteViews**

- **The RouteViews router has BGP feeds from around 60 peers**

  www.routeviews.org explains the project

  Gives access to a real router, and allows any provider to find out how their prefixes are seen in various parts of the Internet

  Complements the Looking Glass facilities

- **Anyway, back to our problem…**

Troubleshooting Connectivity – Example II

- ## Checklist:

  ### Does AS3's upstream send it to AS3?

  We are checking eBGP configuration on AS3's upstream. There may be a configuration error with as-path filters, or prefix-lists, or communities such that only local prefixes get out. This needs AS3's assistance.

  ### Does AS3 see any of AS1's originated prefixes?

  We are checking eBGP configuration on R3. Maybe AS3 does not know to expect the prefix from AS1 in the peering with its upstream, or maybe it has some errors in as-path or prefix or community filters

Troubleshooting Connectivity – Example II

- **Troubleshooting across the Internet is harder**

  But tools are available

- **Looking Glasses, offering traceroute, ping and BGP status are available all over the globe**

  Most connectivity problems seem to be found at the edge of the network, rarely in the transit core

  Problems with the transit core are usually intermittent and short term in nature

Troubleshooting Connectivity – Example III

The Internet

AS 2

AS 3

R2

R3

R1

AS 1
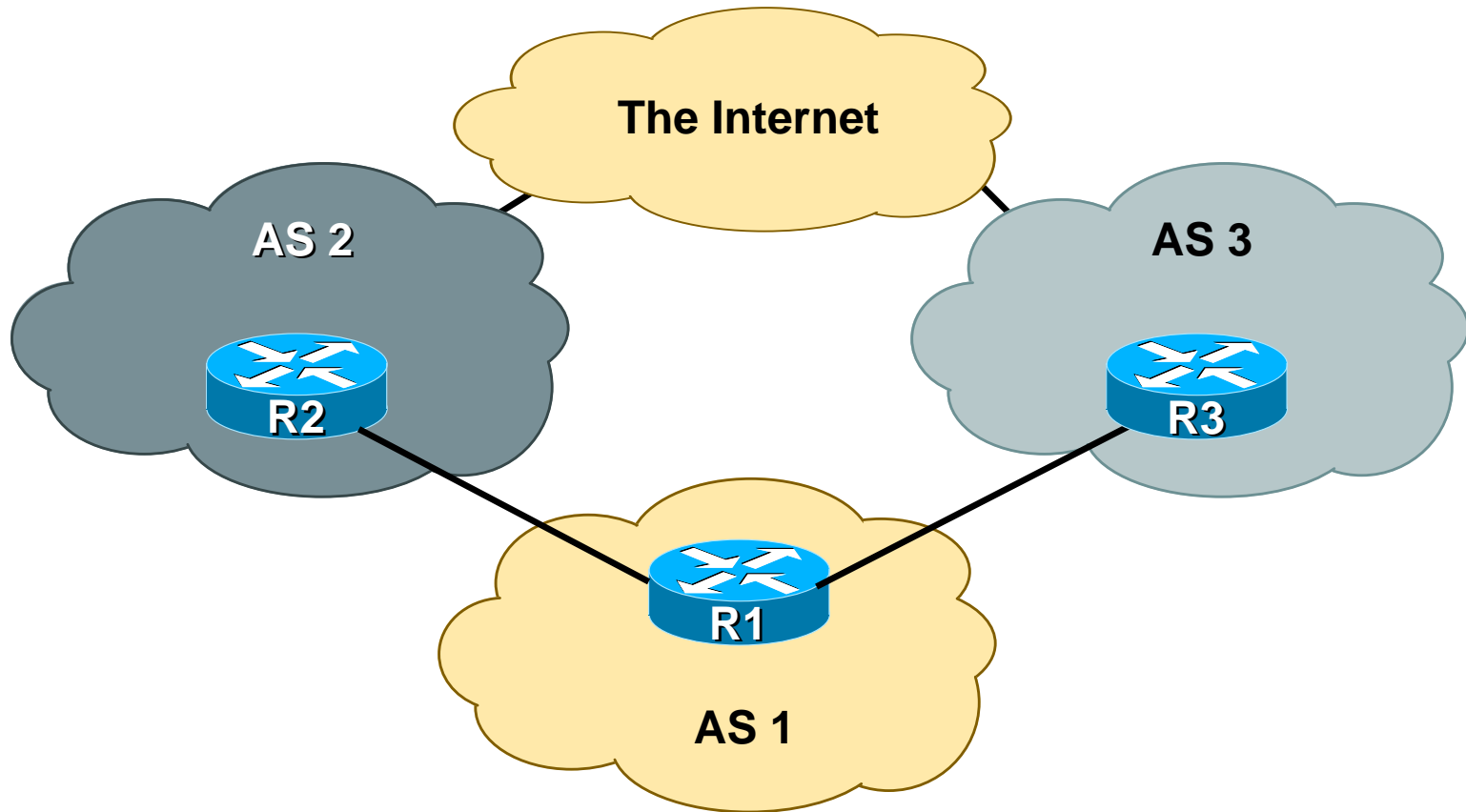
- **Symptom: AS1 is trying to loadshare between its upstreams, but has trouble getting traffic through the AS2 link**

Troubleshooting Connectivity – Example III

- ## Checklist:

    What does "trouble" mean?

- ## Is outbound traffic loadsharing okay?

    Can usually fix this with selectively rejecting prefixes, and using local preference

    Generally easy to fix, local problem, simple application of policy

- ## Is inbound traffic loadsharing okay?

    Errummm, bigger problem if not

    Need to do some troubleshooting if configuration with communities, AS-PATH prepends, MEDs and selective leaking of subprefixes don't seem to help

Troubleshooting Connectivity – Example III

- ## Checklist:

  ### AS1 announces, but does AS2 see it?

  We are checking eBGP filters on R1 and R2. Remember that R2 access will require cooperation and assistance from your peer

  ### Does AS2 see it over entire network?

  We are checking iBGP across AS2's network. Quite often iBGP is misconfigured, lack of full mesh, problems with RRs, etc.

Troubleshooting Connectivity – Example III

- ## Checklist:

  ### Does AS2 send it to its upstream?

  We are checking eBGP configuration on R2. There may be a configuration error with as-path filters, or prefix-lists, or communities such that only local prefixes get out

  ### Does the Internet see all of AS2's originated prefixes?

  We are checking eBGP configuration on other Internet routers. This means using looking glasses. And trying to find one as close to AS2 as possible.

Troubleshooting Connectivity – Example III

- **Checklist:**

    Repeat all of the above for AS3

- **Stopping here and resorting to a huge prepend towards AS3 won't solve the problem**

- **There are many common problems – listed on next slide**

    And tools to help decipher the problem

Troubleshooting Connectivity – Example III

- ## No inbound traffic from AS2

  AS2 is not seeing AS1's prefix, or is blocking it in inbound filters

- ## A trickle of inbound traffic

  Switch on NetFlow (if the router has it) and check the origin of the traffic

  If it is just from AS2's network blocks, then is AS2 announcing the prefix to its upstreams?

  If they claim they are, ask them to ask their upstream for their BGP table – or use a Looking Glass to check

Troubleshooting Connectivity – Example III

- **A light flow of traffic from AS2, but 50% less than from AS3**

    Looking Glass comes to the rescue

    LG will let you see what AS2, or AS2's upstreams are announcing

    AS1 may choose this as primary path, but AS2 relationship with their upstream may decide otherwise

    NetFlow comes to the rescue

    Allows AS1 to see what the origins are, and with the LG, helps AS1 to find where the prefix filtering culprit might be

Troubleshooting Connectivity – Example IV
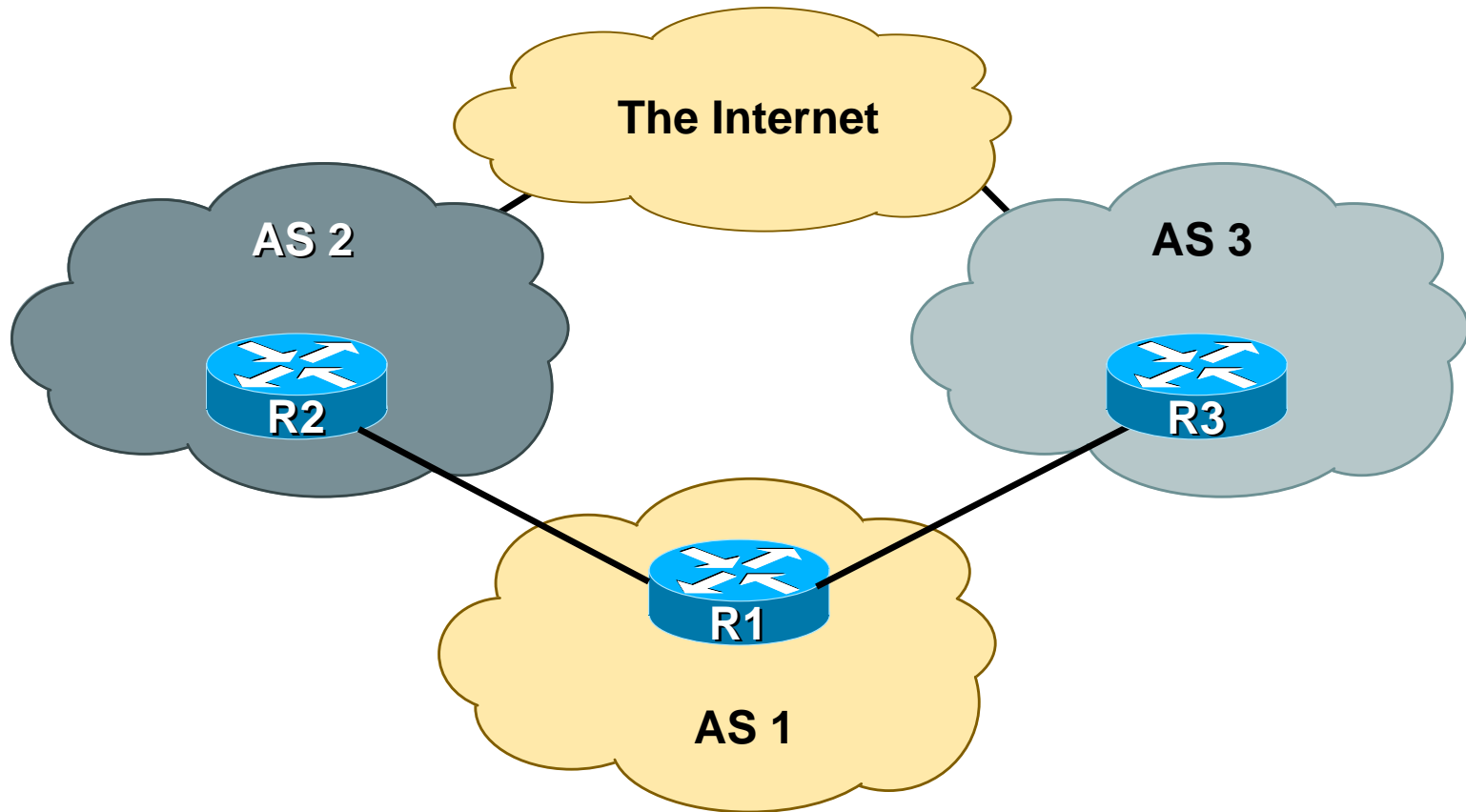
- **Symptom: AS1 is loadsharing between its upstreams, but the traffic load swings randomly between AS2 and AS3**

Troubleshooting Connectivity – Example IV

- ## Checklist:

Assume AS1 has done everything in this tutorial so far

All the configurations look fine, the Looking Glass outputs look fine, life is wonderful… Apart from those annoying traffic swings every hour or so

L2 problem? Route Flap Damping?
Since BGP is configured fine, and the net has been stable for so long, can only be an L2 problem, or Route Flap Damping side-effect

Troubleshooting Connectivity – Example IV

- **L2 – upstream somewhere has poor connectivity between themselves and the rest of the Internet**

  Only real solution is to impress upon upstream that this isn't good enough, and get them to fix it

  Or change upstreams

Troubleshooting Connectivity – Example IV

- ## Route Flap Damping

    Many ISPs implement route flap damping

    Many ISPs simply use the vendor defaults

    Vendor defaults are generally far too severe

    There is even now some real concern that the "more lenient" RIPE-229 values are too severe

    www.cs.berkeley.edu/~zmao/Papers/sig02.pdf

- ## Again Looking Glasses come to the operator's assistance

Query Results:

```
sl-bb20-sj>sh ip bgp flap
 % NOTE: This command will be deprecated soon. Please use 'show ip bgp dampening [dampened-paths|flap-statistics]'
 BGP table version is 87689246, local router ID is 144.228.241.64
 Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
 Origin codes: i - IGP, e - EGP, ? - incomplete


    Network          From           Flaps Duration Reuse      Path
 h 12.44.243.0/24    144.232.9.2    1     00:13:12            701 26144
 h 12.104.113.0/24   144.232.9.2    1     00:45:12            701 27358 27358 27358 27358 27358
 h 12.104.114.0/24   144.232.9.2    1     00:45:12            701 27358 27358 27358 27358 27358
 h 12.108.254.0/24   144.232.9.2    1     00:26:32            701 6389 6197 26829
 h 15.130.192.0/20   144.232.9.2    1     00:52:38            701 1273 1889
 h 15.195.176.0/20   144.232.9.2    1     00:52:28            701 1273 1889
 h 15.197.192.0/18   144.232.9.2    1     00:52:28            701 1273 1889
 h 15.198.0.0/17     144.232.9.2    1     00:52:38            701 1273 1889
 h 15.203.128.0/18   144.232.9.2    1     00:52:38            701 1273 1889
 h 15.204.96.0/19    144.232.9.2    1     00:52:28            701 1273 1889
 h 15.204.128.0/17   144.232.9.2    1     00:52:28            701 1273 1889
 h 16.0.0.0/12       144.232.9.2    1     00:52:28            701 1273 1889 1889
 h 16.6.0.0/15       144.232.9.2    1     00:52:38            701 1273 1889
 h 16.8.0.0/15       144.232.9.2    1     00:52:38            701 1273 1889
 h 16.14.0.0/15      144.232.9.2    1     00:52:38            701 1273 1889
 * 59.81.0.0/18      144.232.9.2    20    05:01:05            701 9800 17773
 * 59.81.64.0/18     144.232.9.2    20    05:01:05            701 9800 17773
 * 59.81.128.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 * 59.81.192.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 * 59.82.0.0/18      144.232.9.2    20    05:01:05            701 9800 17773
 * 59.82.64.0/18     144.232.9.2    20    05:01:05            701 9800 17773
 * 59.82.128.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 * 59.82.192.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 * 59.83.0.0/18      144.232.9.2    20    05:01:05            701 9800 17773
 * 59.83.64.0/18     144.232.9.2    20    05:01:05            701 9800 17773
 * 59.83.128.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 * 59.83.192.0/18    144.232.9.2    20    05:01:05            701 9800 17773
 *> 61.1.176.0/20    144.232.9.2    1     00:33:24            701 22351 4755 9829
 *> 61.1.192.0/19    144.232.9.2    1     00:33:24            701 22351 4755 9829
 *> 61.2.208.0/20    144.232.9.2    1     00:33:24            701 22351 4755 9829
 *> 61.3.224.0/20    144.232.9.2    1     00:33:24            701 22351 4755 9829
 * 62.24.32.0/22     144.232.9.2    2     00:33:45            701 22351
 * 62.24.36.0/24     144.232.9.2    2     00:33:45            701 22351
```

Troubleshooting Connectivity – Example IV

- **Most Looking Glasses allow the operators to check the flap or damped status of their announcements**

    - **Many oscillating connectivity issues are usually caused by L2 problems**

    - **Route flap damping will cause connectivity to persist via alternative paths even though primary paths have been restored**

    - **Quite often, the exponential back off of the flap damping timer will give rise to bizarre routing**

        - **Common symptom is that bizarre routing will often clear away by itself**

Troubleshooting Summary

- **Most troubleshooting is about:**

- **Experience**

  Recognising the common problems

- **Not panicking**

- **Logical approach**

  Check configuration first

  Check locally first before blaming the peer

  Troubleshoot layer 1, then layer 2, then layer 3, etc

Troubleshooting Summary

- **Most troubleshooting is about:**

- **Using the available tools**

  The debugging tools on the router hardware

  Internet Looking Glasses

  Colleagues and their knowledge

  Public mailing lists where appropriate

Closing Comments

- **Presentation has covered the most common troubleshooting techniques used by ISPs today**

- **Once these have been mastered, more complex or arcane problems are easier to solve**

- **Feedback and input for future improvements is encouraged and very welcome**

Troubleshooting BGP

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