Agenda

- What does it mean?
- What’s the motivation for AS4
- How it works
  - Backwards compatible mode
  - “Native” AS4 mode
- AS_CONFED_SEQ in AS4_PATH
What does it mean

- Historically, AS numbers have been 2 byte numbers - 0 to 65,535
- 4 byte ASNs are 4 byte numbers - 0 to 4,294,967,295
What's the motivation?

Thank you Geoff Huston
(P.S, The red lines are the scary ones)

Today
No new Networks
Early 2011
## How to display AS4

These ASN belong to Afrinic

<table>
<thead>
<tr>
<th>Name</th>
<th>16 bit (as2905)</th>
<th>32 bit (as327676)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>asplain</td>
<td>2905</td>
<td>327676</td>
<td>Use this one RFC5396</td>
</tr>
<tr>
<td>asdot+</td>
<td>0.2905</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>asdot</td>
<td>2905</td>
<td>5.1</td>
<td>Quite popular, easy to read, RIRs use it today</td>
</tr>
<tr>
<td>ascolon</td>
<td>0:2905</td>
<td>5:1</td>
<td>Redback</td>
</tr>
</tbody>
</table>
RIR Timescale

ASN were 16 bit.

Then RFC4893 happened
- 32 bit ASN optional

32 bit ASN by default
16 bit ASN on request
No distinction between 16 and 32
Unallocated 16 bit
ASN LOCKED

Old Days 2009 2010
What’s the change about?

Someone’s going to be AS65536 - which won’t fit here
AS4 BGP Open Packet

(It’s the same)

My proper ASN lives in a capability value, inside here

AS_TRANS

Magic Number

AS23456
ASN16 to ASN32

- RFC4893 implements a new capability ("I speak ASN32") and carries the 32 bit ASN as a capability value.

- AS4_PATH is a new optional, transitive attribute in UPDATE which carries 32-bit portion of the AS_PATH.

- AS 23456 reserved for ASN32<-->ASN16 sessions (AS_TRANS)

- Both implementations co-exist, ASN32 originated prefixes in table today.
The new attributes, **AS4_PATH** and **AS4Agregarator** SHOULD NOT be carried in the UPDATE messages between NEW BGP peers. A NEW BGP speaker that receives the **AS4_PATH** and **AS4Agregarator** path attributes in an UPDATE message from a NEW BGP speaker SHOULD discard these path attributes and continue processing the UPDATE message.
Compatibility mode

AS222222
Originates 1.0.0.0/8

AS333333
1.0.0.0/8
AS_PATH 333333 222222

peers with AS23456

AS444444
1.0.0.0/8
AS_PATH 444444 333333 222222

AS50000
AS_PATH 50000 23456 23456
AS4_PATH 333333 222222 (optional, transitive)

AS50001
ASN32 UPGRADED
AS_PATH 50001 50000 23456 23456
AS4_PATH 50001 50000 333333 222222
(rfc4893, 4.2.3 mandates padding)

4.2.2. Generating Updates

When communicating with an OLD BGP speaker, a NEW speaker MUST send the AS path information in the AS_PATH attribute encoded with 2-octet AS numbers. The NEW speaker MUST also send the AS path information in the AS4_PATH attribute (encoded with 4-octet AS numbers), except for the case where the entire AS path information is composed of 2-octet AS numbers only. In this case, the NEW speaker SHOULD NOT send the AS4_PATH attribute.
Danger of comp’ mode

- Everything you have needs upgrading if you make route-map/policy based on ASN

- You could have many sessions to 23456 - all different networks

- Best Path Selection algorithm will get tricked

- NetFlow sees 32 bit world as one ASN
Support is coming

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcatel-Lucent SR OS</td>
<td>$\geq 7.0$</td>
<td>asplain</td>
</tr>
<tr>
<td>BIRD</td>
<td>$\geq 1.0.12$</td>
<td>asplain</td>
</tr>
<tr>
<td>Brocade (Foundry) IronWare</td>
<td>$\geq 4.0.00$ for the NetIron MLX and XMR, $\geq 2.8.00$ for the BigIron RX</td>
<td>asdot, asdot+, asplain</td>
</tr>
<tr>
<td>Cisco IOS</td>
<td>$\geq 12.4(24)T$, $\geq 12.0(32)S12$</td>
<td>asplain (asdot optional)</td>
</tr>
<tr>
<td>Cisco IOS XR</td>
<td>$\geq 3.4(1)$</td>
<td>asdot (asplain planned for 3.9)</td>
</tr>
<tr>
<td>Cisco NX-OS</td>
<td>$\geq 4.0(1)$</td>
<td>asdot (asplain planned for 4.1(3))</td>
</tr>
<tr>
<td>ExtremeXOS</td>
<td>Need Information</td>
<td>Need Information</td>
</tr>
<tr>
<td>Juniper JUNOS</td>
<td>$\geq 9.1R1$</td>
<td>asplain (asdot optional)</td>
</tr>
<tr>
<td>Juniper JUNOSe</td>
<td>$\geq 4.1.0$</td>
<td>asplain</td>
</tr>
<tr>
<td>Force10 FTOS</td>
<td>$\geq 7.7.1.0$</td>
<td>asdot (asdot+, asplain optional)</td>
</tr>
<tr>
<td>OpenBGPD</td>
<td>$\geq 4.2$, patches for 3.9 and 4.0</td>
<td>asdot</td>
</tr>
<tr>
<td>Quagga</td>
<td>$\geq 0.99.10$, patches for 0.99.6 and other versions</td>
<td>asplain</td>
</tr>
<tr>
<td>Redback SEOS</td>
<td>$\geq 2.0$</td>
<td>ascolon (asplain planned for end of 2009)</td>
</tr>
</tbody>
</table>

http://as4.cluepon.net/index.php/Software_Support
Communities

• Usual (new-)format is 16bits:16bits - first half usually your ASN

• New type of community proposed, “four-octet AS specific extended community” - 32bits:16bits.

• Only Quagga implements to date. (Early draft status)
AS_CONFED_SEQ in AS4_PATH - the bug

- Thanks also Rob Shakir (GX) and Jonathan Oddy (Hostway), without whom this research would be incomplete.
- December 10\textsuperscript{th} 2008
- AS196629 originated 91.207.218.0/23
- AS\_PATH: xx xx 35320 23456 (13 bytes)
- AS4\_PATH: (65044 65057) 196629 (7 bytes)
- Confederation ASN in AS4\_PATH is illegal
What happened?

• “To prevent the possible propagation of confederation path segments outside of a confederation, the path segment types AS_CONFED_SEQUENCE and AS_CONFED_SET [RFC3065] are declared invalid for the AS4_PATH attribute.”

• BGP Speakers we managed, which supported AS4, literally translated the RFC and tore down the session.

• The speakers kept flapping the sessions with their transits (where they were learning the route)

• Disconnection from the internet
  • http://www.merit.edu/mail.archives/nanog/msg14345.html
How did it leak?

• Junos introduced AS4 in 9.1R1.
• An AS with a mixed <9.1 and >9.1 network, using confederations in as4_path, updates with “dirty” transitive values can leak through egress routers running <9.1.
• If you use Junos and confeds, run >9.1R1 everywhere.
Cisco IOS behaviour

- Installed 12.0(32)S12 on c7200vxr and singled homed it to AS15653.

*Jan 16 11:29:58.531: %BGP-5-ADJCHANGE: neighbor 193.239.32.2 Up

*Jan 16 11:30:02.595: %BGP-6-ASPATH: Invalid AS path (65044 65048 65062)
3.21 23456 received from 193.239.32.2: Confederation found in AS4_PATH
*Jan 16 11:30:02.595: %BGP-5-ADJCHANGE: neighbor 193.239.32.2 Down BGP Notification sent
*Jan 16 11:30:02.595: %BGP-3-NOTIFICATION: sent to neighbor 193.239.32.2
3/1 (update malformed) 27 bytes E0111803 030000FE 140000FE 180000FE 26 FFFF FFFF FFFF FFFF FFFF FFFF FFFF 0050 0200 0000 3540 0101 0240 020C 0205 3D25 2114 89F8 5BA0 5BA0 4003 04C1 EF20 02E0 1118 0303 0000 FE14 0000 FE18 0000 FE26 0202 0003 0015 0000 5BA0 175B CFDA

Track bug CSCsx10140
Note:

• AS4 / ASN32 is not inherently “bad”, in fact we need it to support the growth of the internet.

• We don’t want you to go away with the message, “do not upgrade”, we want you to take the message “follow progress of this issue, and upgrade when safe”.

• Safety comes when the standard is fixed - being discussed on idr@ietf list (recommendation is to ignore ‘diseased’ updates)
Conclusion

• AS4 matters, you probably want to upgrade whether you have a 32 bit as number or not

• Upgrade your tools, train your NOC

• Lab the upgrade and track progress of AS_CONFED bugs for your software
Any Questions?

Any Answers?