AS Numbers - Again

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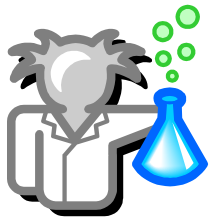

Current Status

- 65,536 2-byte AS Numbers
  - 1,042 Reserved Numbers
  - 32,102 AS numbers visible in BGP
  - 15,053 not advertised in BGP

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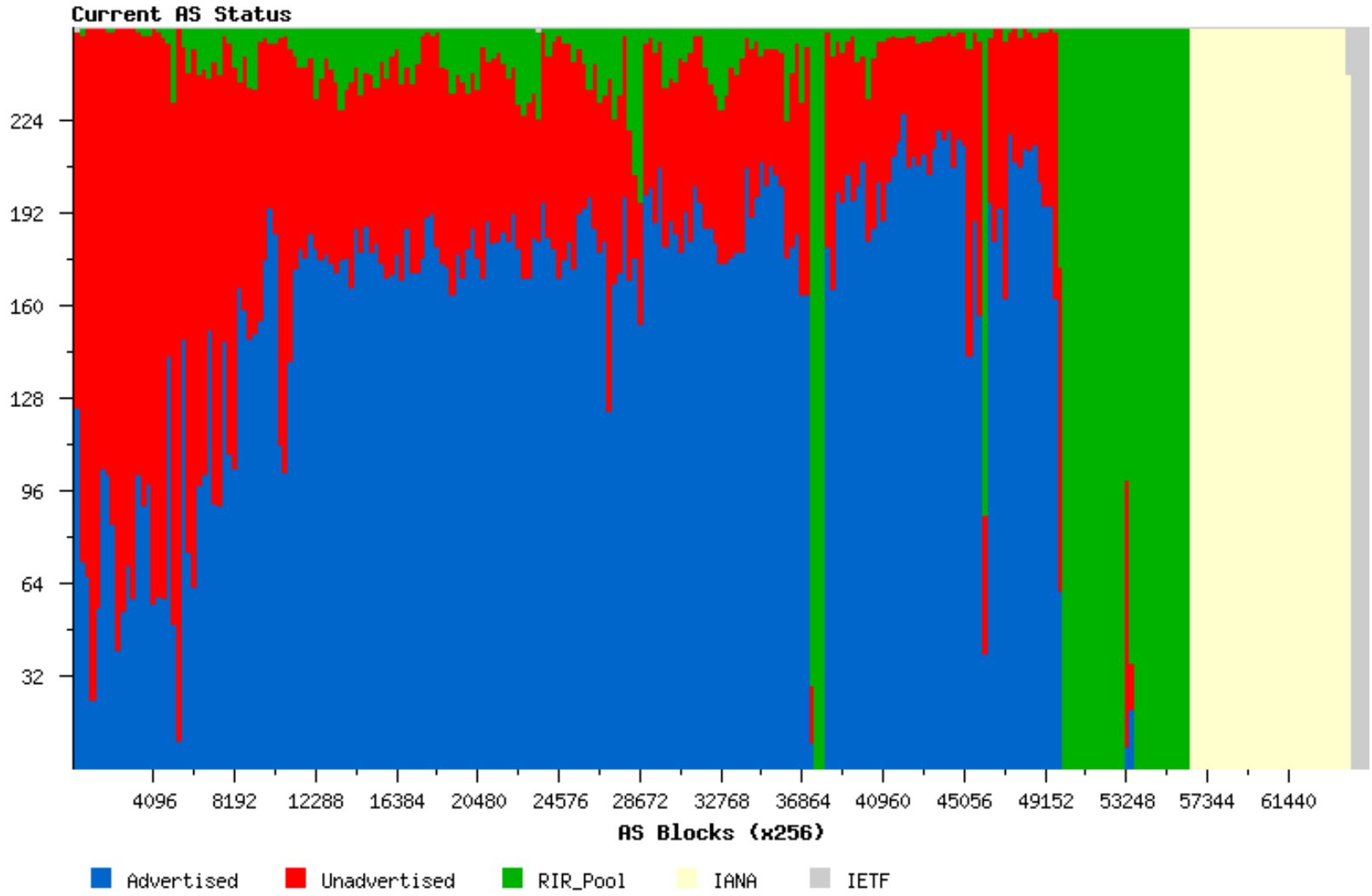
  - 8,176 AS numbers left with IANA
  - 9,163 AS numbers in the RIR pools

AS Number Map



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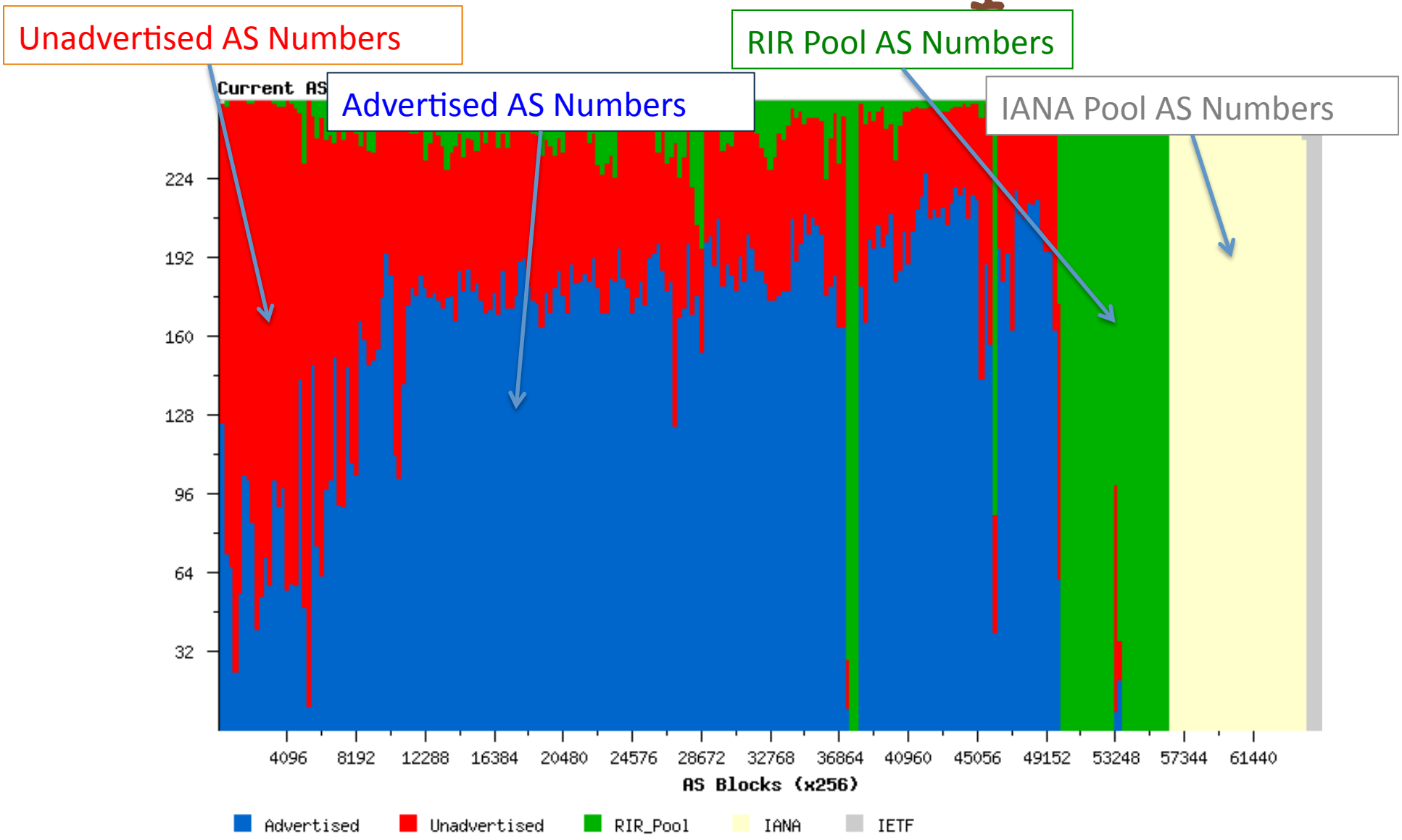
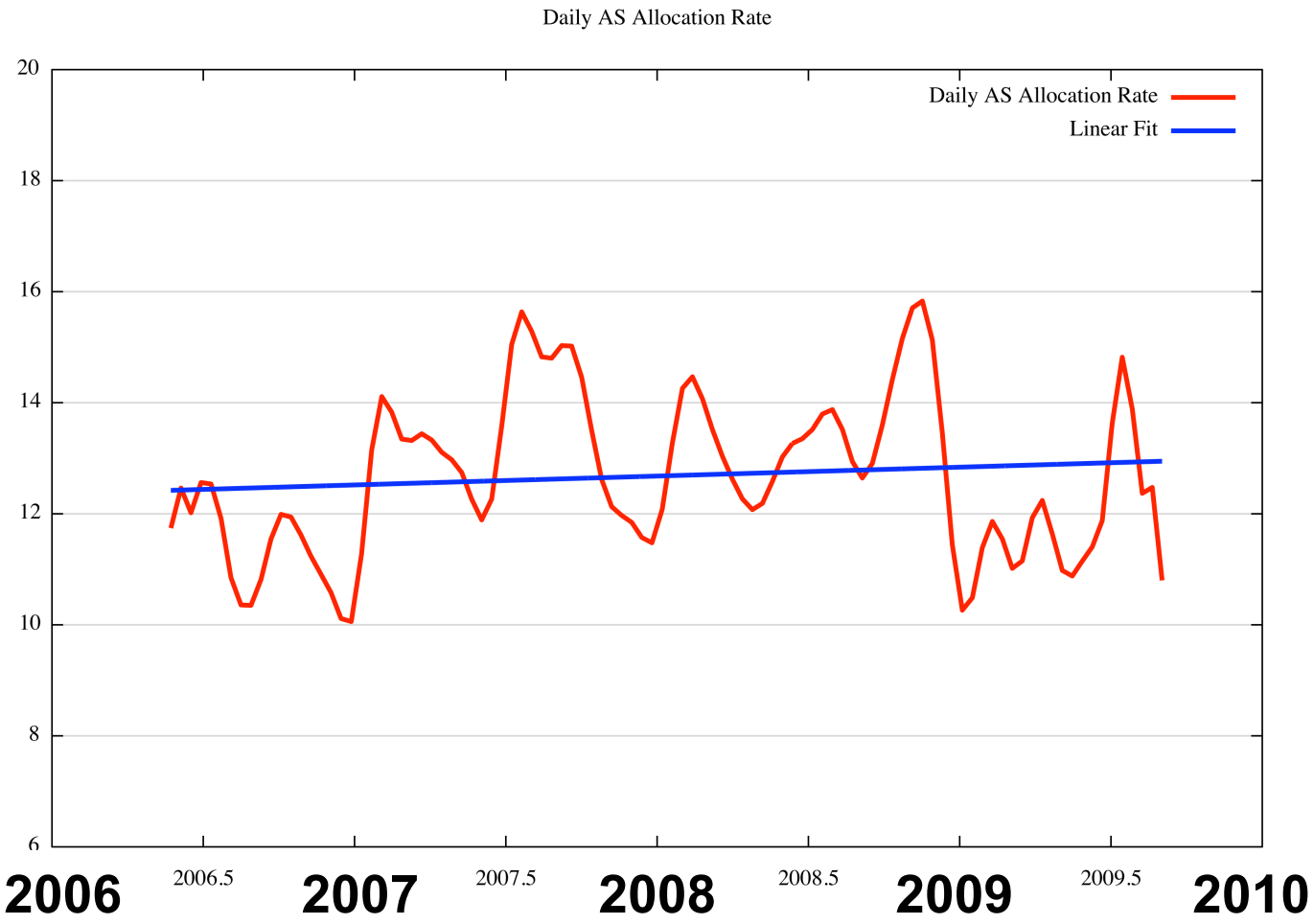


AS Allocation Rate



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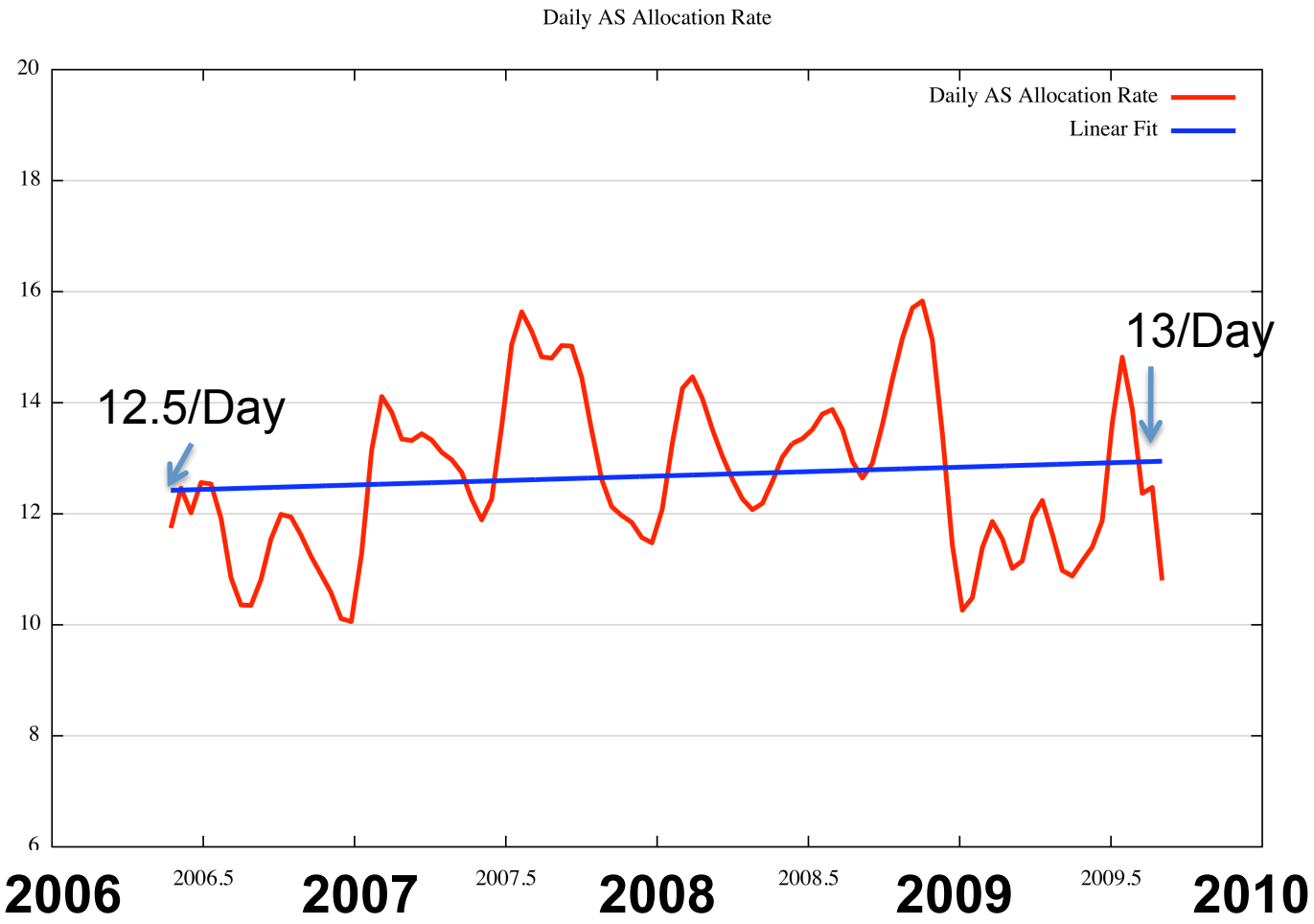
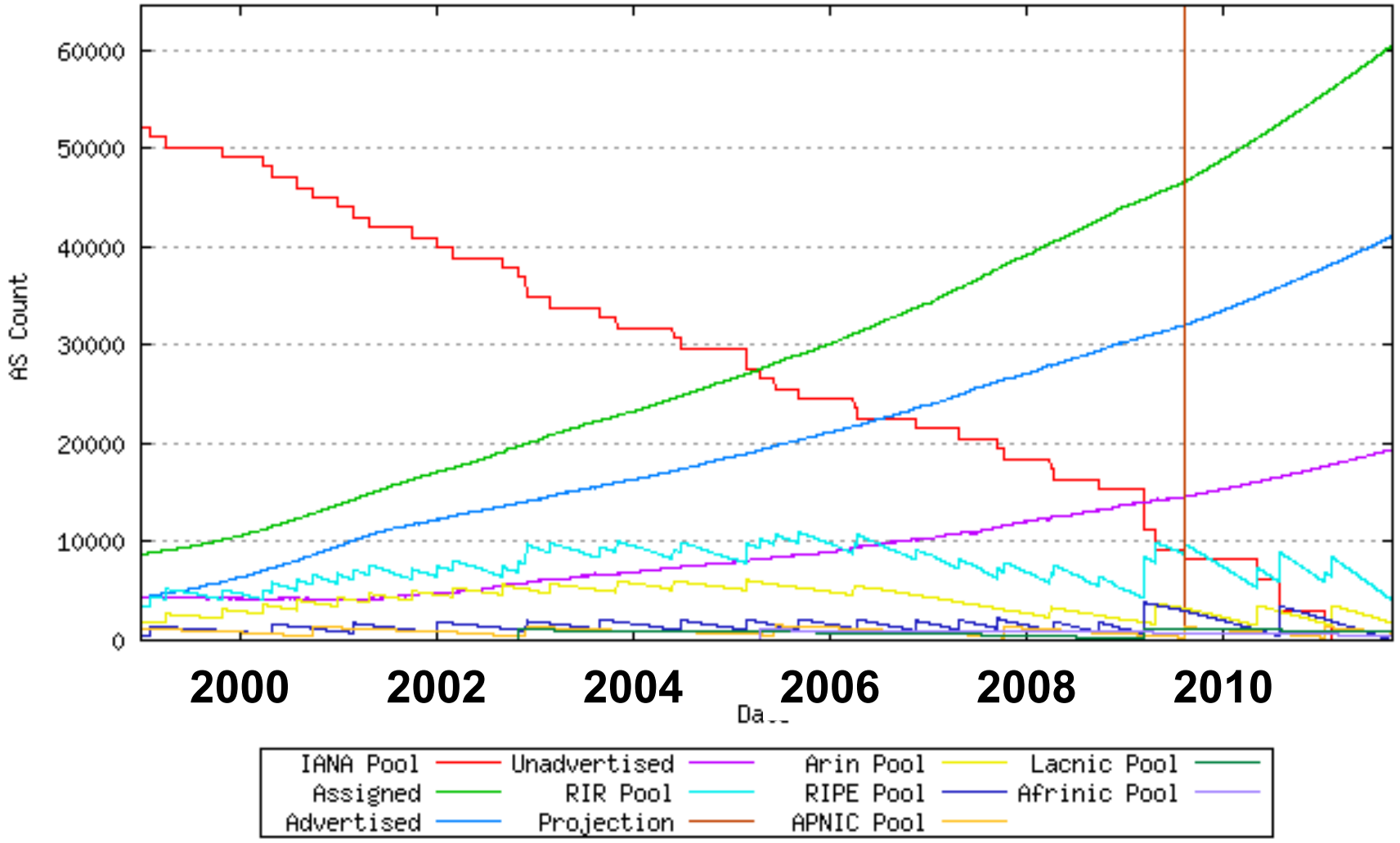


How long have we got?



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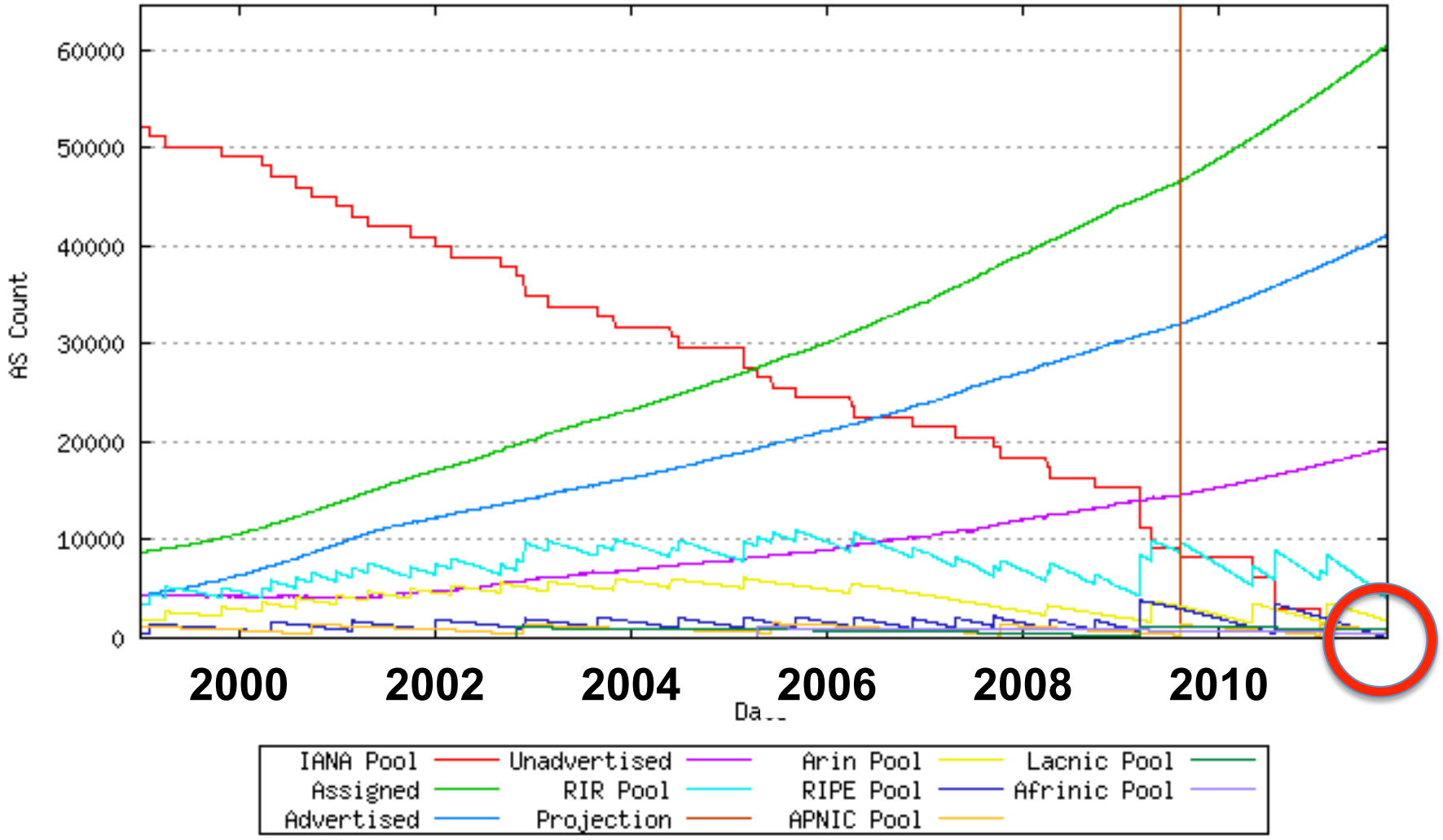

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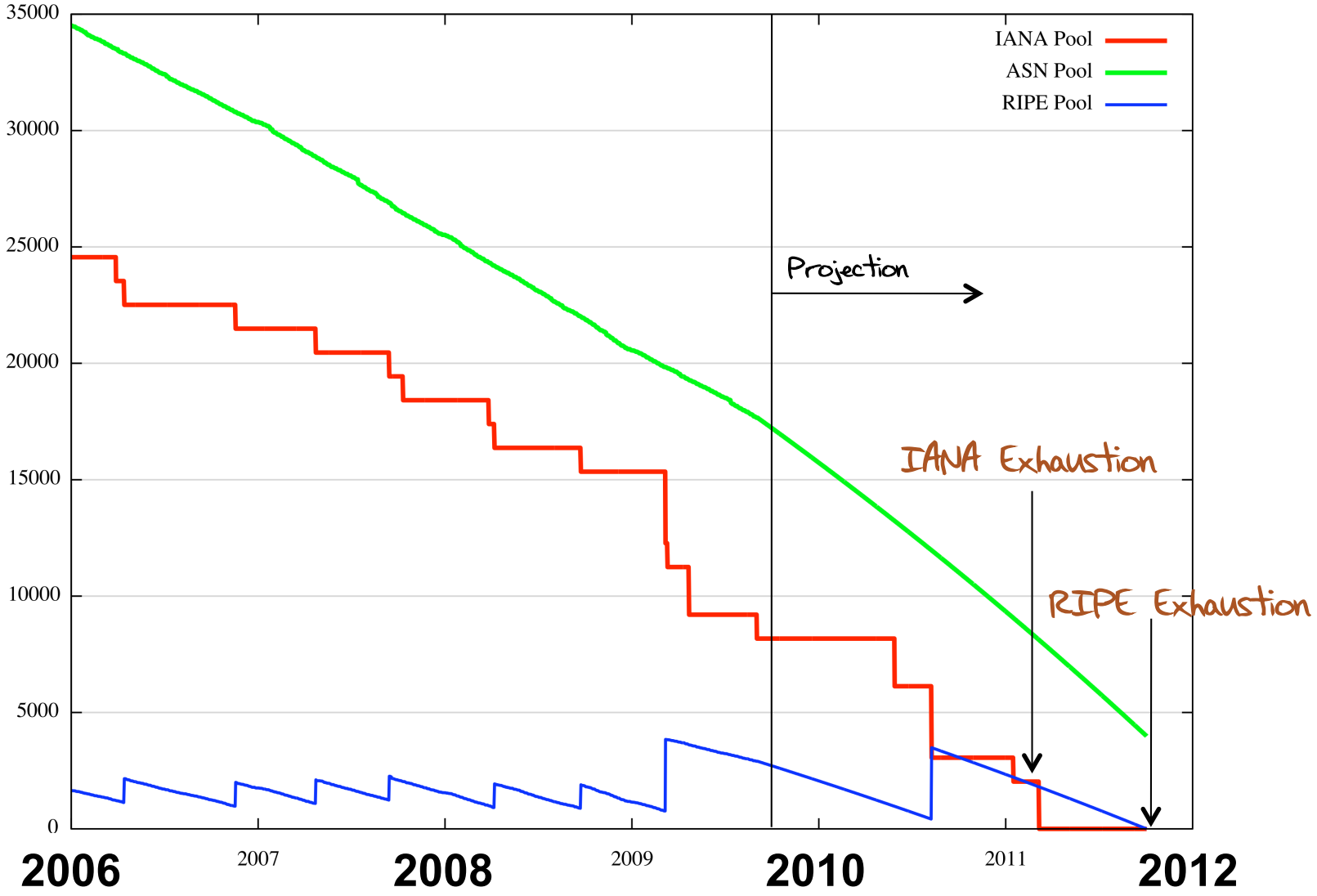
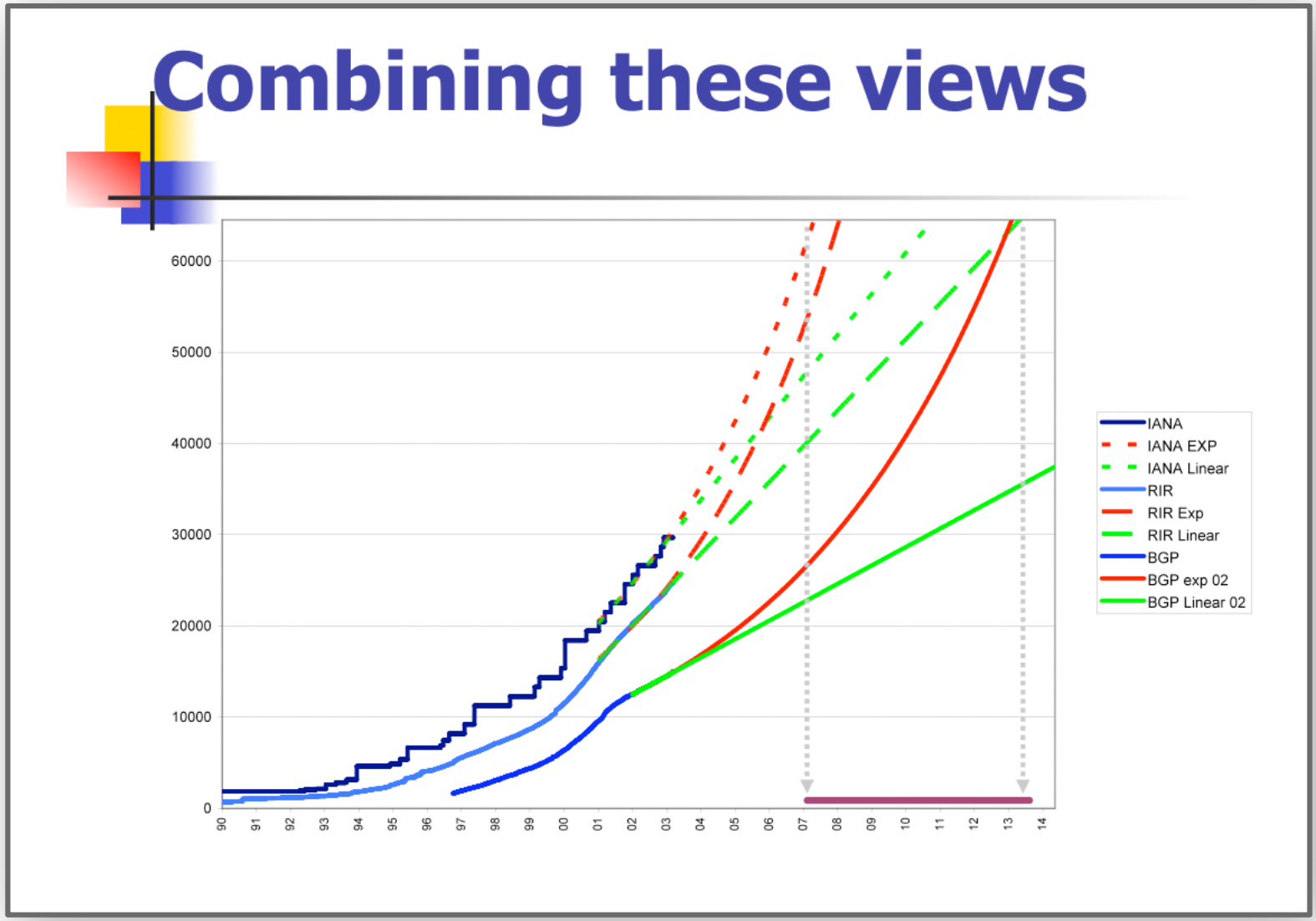


How long have we got?

- IANA will allocate its last 16-bit AS number block in **March 2011**
- RIPE will exhaust its 16-bit AS Number pool in **October 2011**

This is not exactly news!



AS Number Exhaustion – March 2003

2003 Projection

Current AS Forecast

- The available AS number pool will exhaust in the timeframe of 2009-2011 if current AS use trends continue

2009

- no significant reclamation in old AS number space
- No coordinated effort to increase utilization density of AS numbers

2011

- reclamation and increased deployment efficiency

The Agenda for AS Transition

Developed in 2004 as a 4 step process:

1. IETF to complete BGP Standards to support transition mechanisms to 32-bit AS numbers

   ~2 years

2. RIRs to start making 32-bit AS numbers available

   ~½ year

3. Vendors to provide 32-bit AS number capable BGP implementations

   ~1 year

4. BGP networks to commence deployment

   - ready for deployment by 2008!

1. IETF Standards Activity

- 4-Byte AS Specification
  - Initial draft prepared in Feb 2001
    - Change BGP Attribute Definitions to extend AS components from 16 to 32 bits
    - Change BGP OPEN message to include capability negotiation for peer 4 byte support
    - Carry 32-bit AS path across 16-bit AS domains using new opaque transitive attribute (AS4_PATH)
    - Transition mechanism via translation and tunneling that allows piecemeal introduction of 4-byte AS numbers into the Internet
  - Specification ready for publication in late 2005
- IANA 32 bit AS number registry created in November 2006
- RFC 4893 published in May 2007

The Agenda for AS Transition

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   RFC 4893 - May 2007
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4. BGP networks to commence deployment

2. RIR ASN Allocation Policy

- Globally coordinated policy proposal 2005 / 2006
- Intended to avoid surprises and disappointment during the run-out of the 16-bit AS number space
- State clear milestones for vendors, ISPs and network admins for 32-bit ASN uptake
- Phased transition to the 32-bit AS number pool:
  - Jan 2007 – 32 bit ASNs available upon request
  - Jan 2009 – 32 bit ASNs available by default
  - Jan 2010 – transition projected to be complete

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RFC 4893 – May 2007

32 bit AS Policy -2006

3. Vendor Support in BGP

Name	Version	Notation
Alcatel-Lucent SR OS	7.0	asplain
Arbor Peakflow SP	5.5	asplain
BIRD	1.0.12	asplain
Brocade (Foundry) IronWare	4.0.00 for the NetIron MLX and XMR, 2.8.00 for the BigIron RX	asdot, asdot+, asplain
Cisco IOS	12.0(32)S12, 12.0(32)SY8, 12.2(33)SXI1, 12.4(24)T	asdot (asplain planned for future)
Cisco IOS XE	2.3	asplain (asdot optional)
Cisco IOS XR	3.4(1)	asdot (asplain planned for 3.9)
Cisco NX-OS	4.0(1)	asdot (asplain planned for 4.1(3))
ExtremeXOS	Need Information	Need Information
Juniper JUNOS	9.1R1	asplain (asdot optional)
Juniper JUNOSe	4.1.0	asplain
Force10 FTOS	7.7.1.0	asplain (asdot, asdot+ optional)
OpenBGPD	4.2, patches for 3.9 and 4.0	asdot
Quagga	0.99.10, patches for 0.99.6 and other versions	asplain
Redback SEOS	2.0	ascolon (asplain planned for end of 2009)

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

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RFC 4893 - May 2007

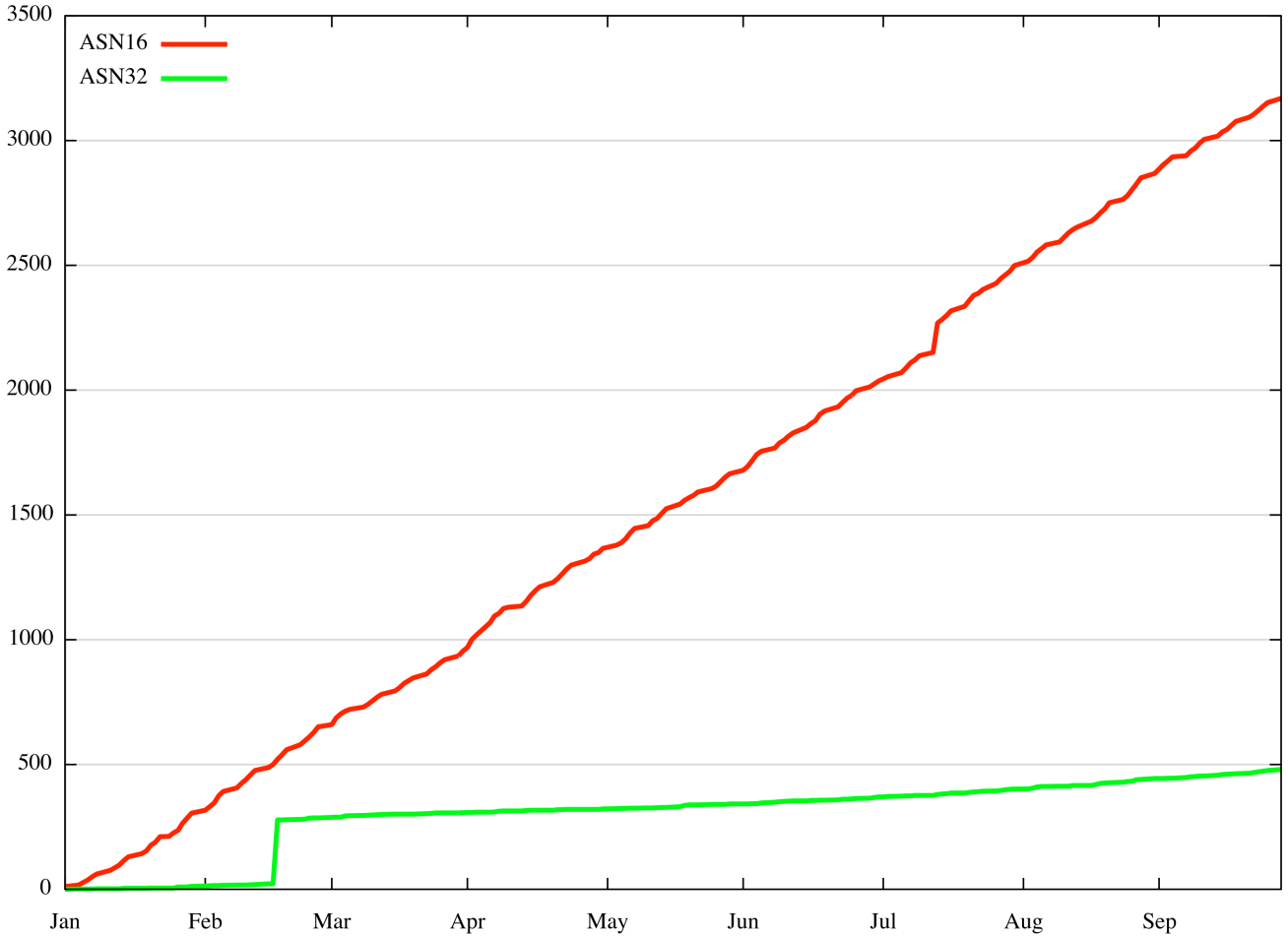
32 bit AS Policy - 2006

Currently gathering pace:
2009-2010

32-bit ASN Deployment

- In 2009 the RIRs allocated 3,649 ASNs up to the 30th September
  - 3,169 were 16-bit ASNs
  - 480 were 32 bit ASNs

RIR ASN Allocations for 2009



32-bit ASN Deployment

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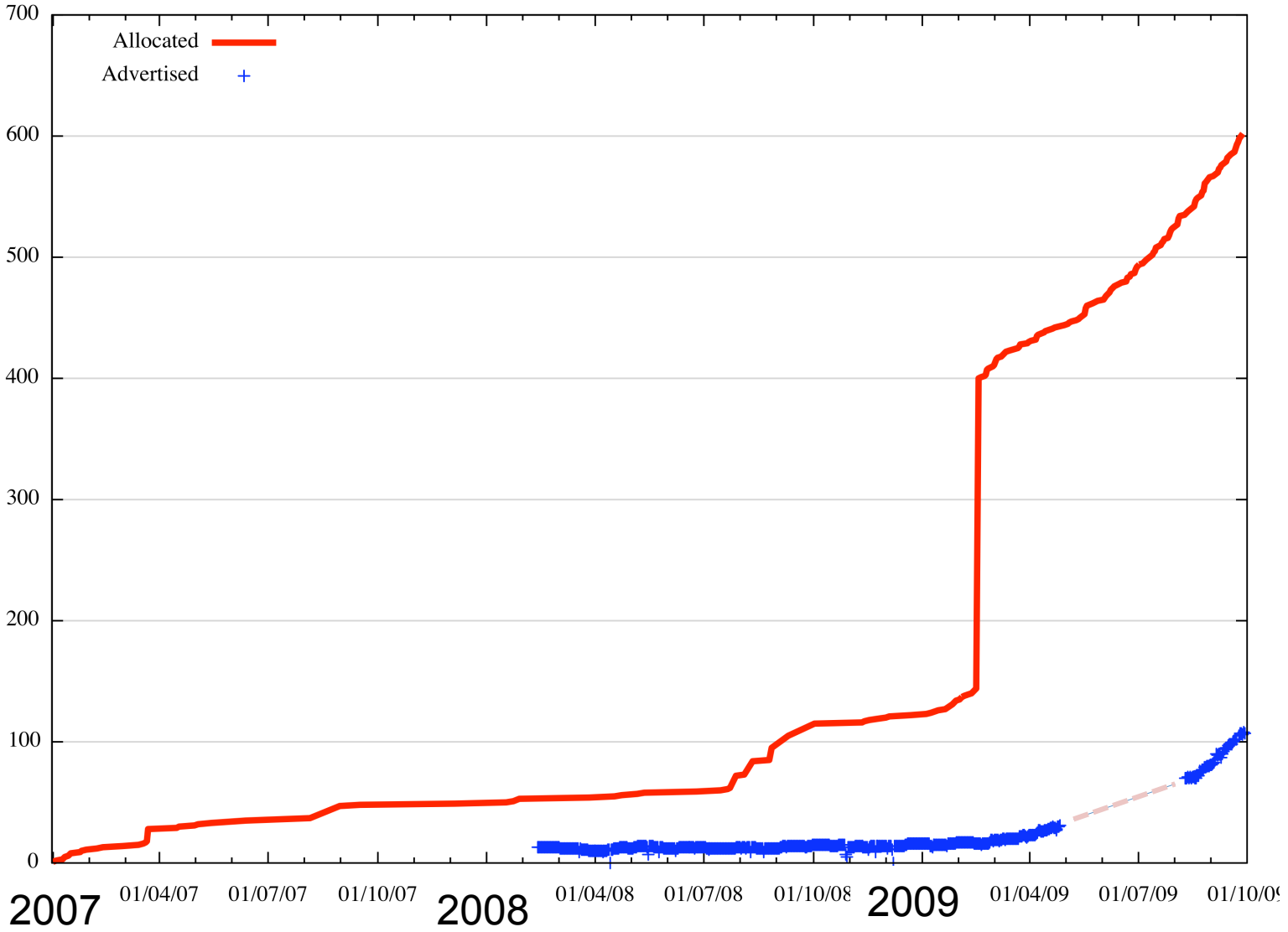
- Allocation status as of September 2009:
  - Advertised: 107
  - Unadvertised: 492

32-bit ASes in BGP



The Agenda for Transition

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32 bit AS policy - 2006

Currently gathering pace 2009 – 2010

Lagging – badly!

How can we assist with 4-byte AS deployment?

- Information and education
  - Keep the community informed
  - Address some common misunderstandings about 4 byte AS numbers
- Supply chain pressure
  - Add 4 byte AS support to your “mandatory to support” in your next BGP purchase

Common Questions

1. *Someone out there is using 4 byte AS numbers. Do I have to upgrade my BGP to support 4-byte AS numbers in order to reach the prefixes that they are announcing?*

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Common Questions

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   - BGP uses a translation approach to mapping 4-byte AS numbers into a 2-byte AS number
   - The 4 byte BGP speaker does all the translation work, so the existing BGP world will not need to upgrade to "see" these additional networks that lie within 4-byte ASNs in the routing space
   - All that you will see is:
     - AS 23456 appearing in many AS paths
     - A very minor increase in memory use by BGP - associated with the storage of the additional AS4_PATH attribute
       - which contains the 4-byte AS path
       - but its an opaque transitive attribute to you, so you don't care about its contents

Common Questions

2. *My customers / peers/ upstreams are using 4-byte AS numbers. Do I have to upgrade my BGP to support 4-byte AS numbers?*

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You need to do **nothing**!

- The new 4-byte BGP speaker figures out its talking to your old 2-byte BGP speaker and the 4-byte BGP speaker does **all** the work
  - it translates all instances of 4 byte AS numbers in the AS Path and Aggregator attributes to 23456 and stores the original 4-byte AS Path and Aggregator in new opaque transitive attributes (tunneling) before sending you the update
  - and restores the 4-byte information in any updates it received from you from the tunneled attribute information

Common Questions

2. *My customers / peers/ upstreams are using 4-byte AS numbers. Do I have to upgrade my BGP to support 4-byte AS numbers?*

   – **But** you should've checked out your operational support system by now to make sure it can cope:
     - because you will need to support multiple peers / customers / upstreams who will have 4-byte AS numbers
     - and you will want to differentiate between them
     - but your routers' BGP configs will be peering with AS 23456 for each instance
     - so your support system better be able to work this all out and not get confused!

Common Questions

3. *Can I use communities for 4-byte ASNs?*

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NO – not quite yet

Common Questions

3. Can I use communities for 4-byte ASNs?

- NO, because there is only a 2 byte field for the ASN in the conventional BGP community
- You need to use a BGP extended community to define a set of communities for 4-byte origin and target AS values
  - This is specified in draft-ietf-l3vpn-as4octet-ext-community
    - not yet an RFC - currently in IESG review
- Ask your vendor when they are/will be supporting BGP extended communities with 4-byte ASNs

Common Questions

4. *If I upgrade BGP, will BGP crash?*

Common Questions

4. *If I upgrade BGP, will BGP crash?*

MAYBE!

Common Questions

4. *If I upgrade BGP, will BGP crash?*

   - Some Cisco implementations of BGP with 4-byte ASN support get unhappy when the number of elements in the AS path gets to over 1,000
   - The maxas-limit setting is your friend

Common Questions

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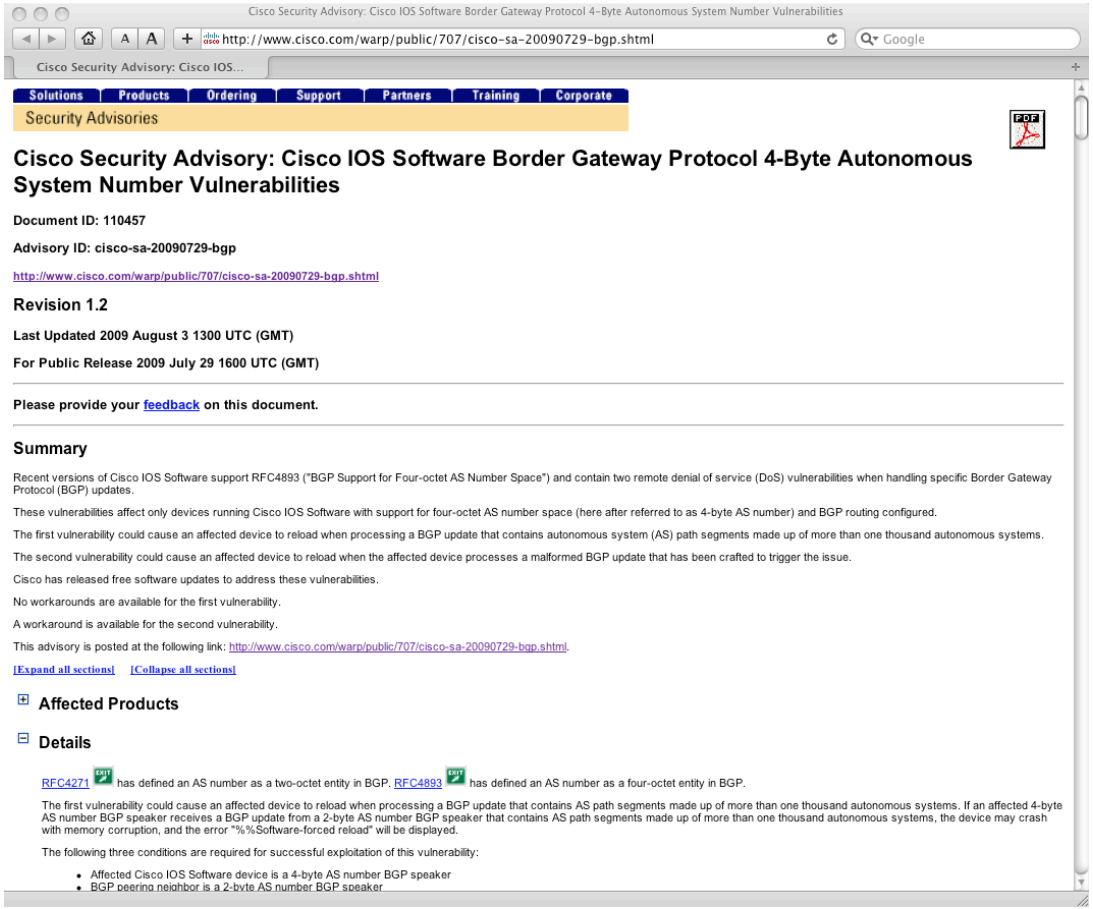

Common Questions

4. If I upgrade BGP, will BGP crash?

Also, there is the issue of the "standard" method for handling invalid components in the the AS4_PATH attribute

- AS Confederation path segments are declared invalid in the AS4_PATH attribute (RFC4893)
- If an optional attribute in an UPDATE is recognised then it must be checked, and if it is detected as invalid then a NOTIFICATION message must be sent and the BGP session is closed (RFC4271)
- A literal implementation of 4-byte AS BGP will be triggered to repeatedly tear down the local BGP session if AS Confederation elements are added into the AS PATH by a 4-byte AS BGP speaker, and then immediately propagated to a 2-byte AS BGP peer

Common Questions

4. If I upgrade BGP, will BGP crash?

The "safest" option is for the 4-byte BGP speaker to remove the offending element and reconstruct the AS Path as best it can, and log the error

- Which appears to be what many BGP implementations now do
- And this consideration of "soft handling" of update errors applies to any BGP update, not only those with the AS4_PATH attribute, such as the use of AS0 in an AS Path
- The IETF is working on refining the BGP specification to treat such BGP update attribute errors with some circumspection, rather than a rather brutal "just drop the session" response!

Common Questions

5. *I see AS 23456 in a 4-byte AS path – Is the Internet about the crash and die?*

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Calm down!

Common Questions

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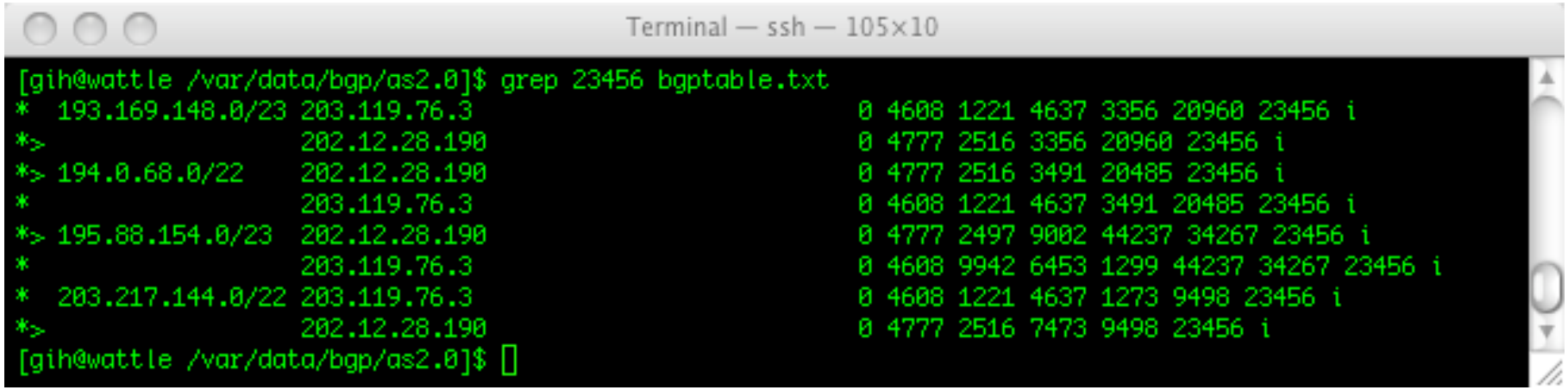

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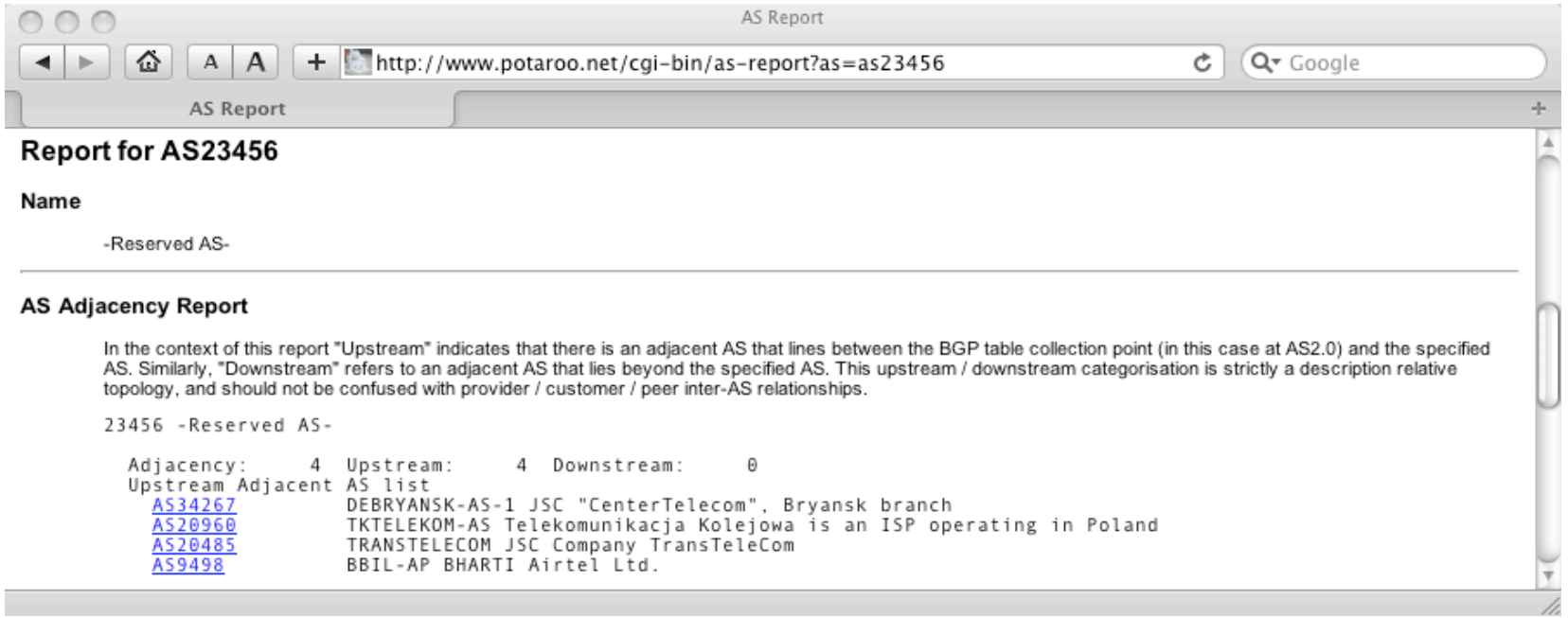

Common Questions

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- The AS Path is used for loop detection and path metric
- Even when AS23456 appears in the AS path, routing loops cannot form in BGP
  - but such "hybrid" loops may take a few more AS hops to detect and kill

Common Questions

6. Are there AS Bogons in the 4-byte space?

Common Questions

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Yes!

Common Questions

6. *Are there AS Bogons in the 4-byte space?*

- Advertised 4-byte ASNs: 70

- Advertised Bogons: 4

  196636 advertised by AS 29608 – WAN2MANY

  262657 advertised by AS 12956 - Telefonica

  393392 advertised by AS 12874 - Fastweb

  2076901376 advertised by AS 43314 – DIANET

32-bit ASN Resources

- **IETF Specifications**

  RFC4893 – the 4-byte AS specification

  draft-ietf-idr-rfc4893bis – working document that adds some further clarity and error handling to the specification

- **Documentation**

  Exploring AS Numbers – Internet Protocol Journal, Vol 9, No 1

  (http://www.cisco.com/web/about/ac123/ac147/archived_issues/ipj_9-1/autonomous_system_numbers.html)

- **Reports and Resources**

  The AS Reports

  http://www.potaroo.net/tools/asn16/

  http://www.potaroo.net/tools/asn32/

  ISP Resource Wiki for ASNs

  http://as4.cluepon.net

Thank You