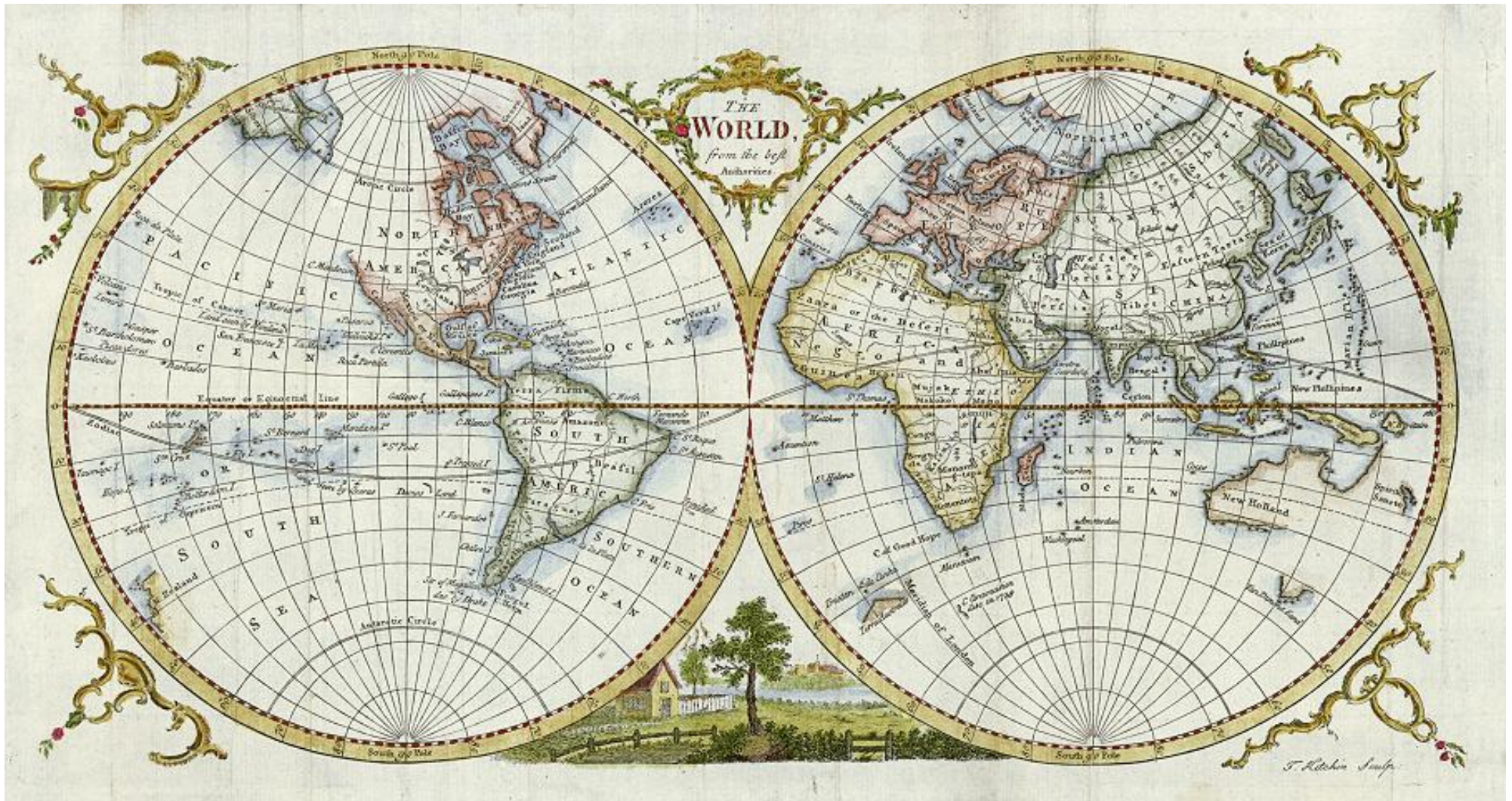
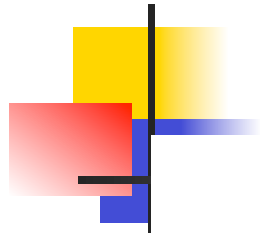


# New World BGP



Geoff Huston  
January 2010  
APNIC

# 16-bit AS Number Map



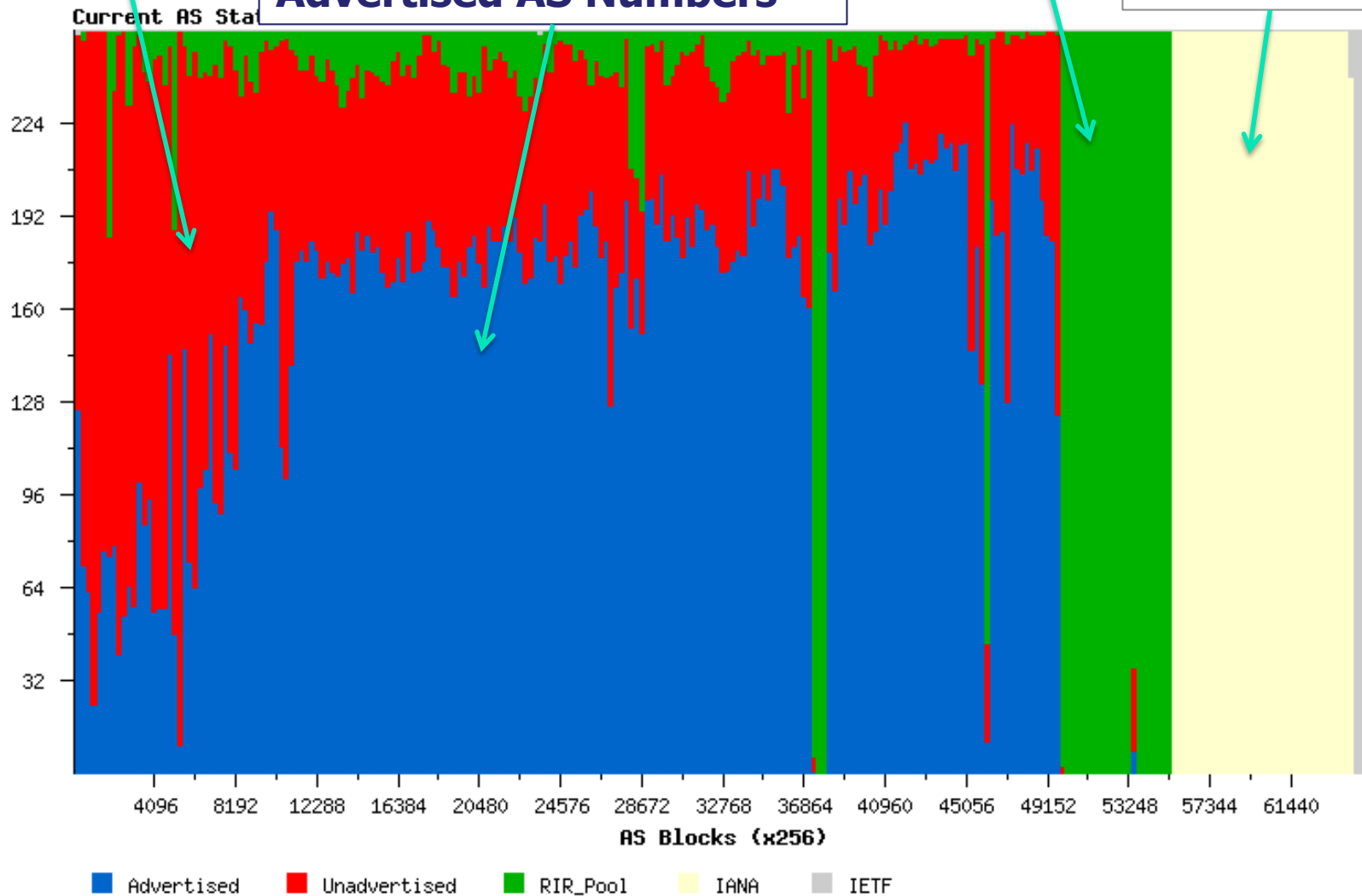
# 16-bit AS Number Map

Unadvertised AS Numbers

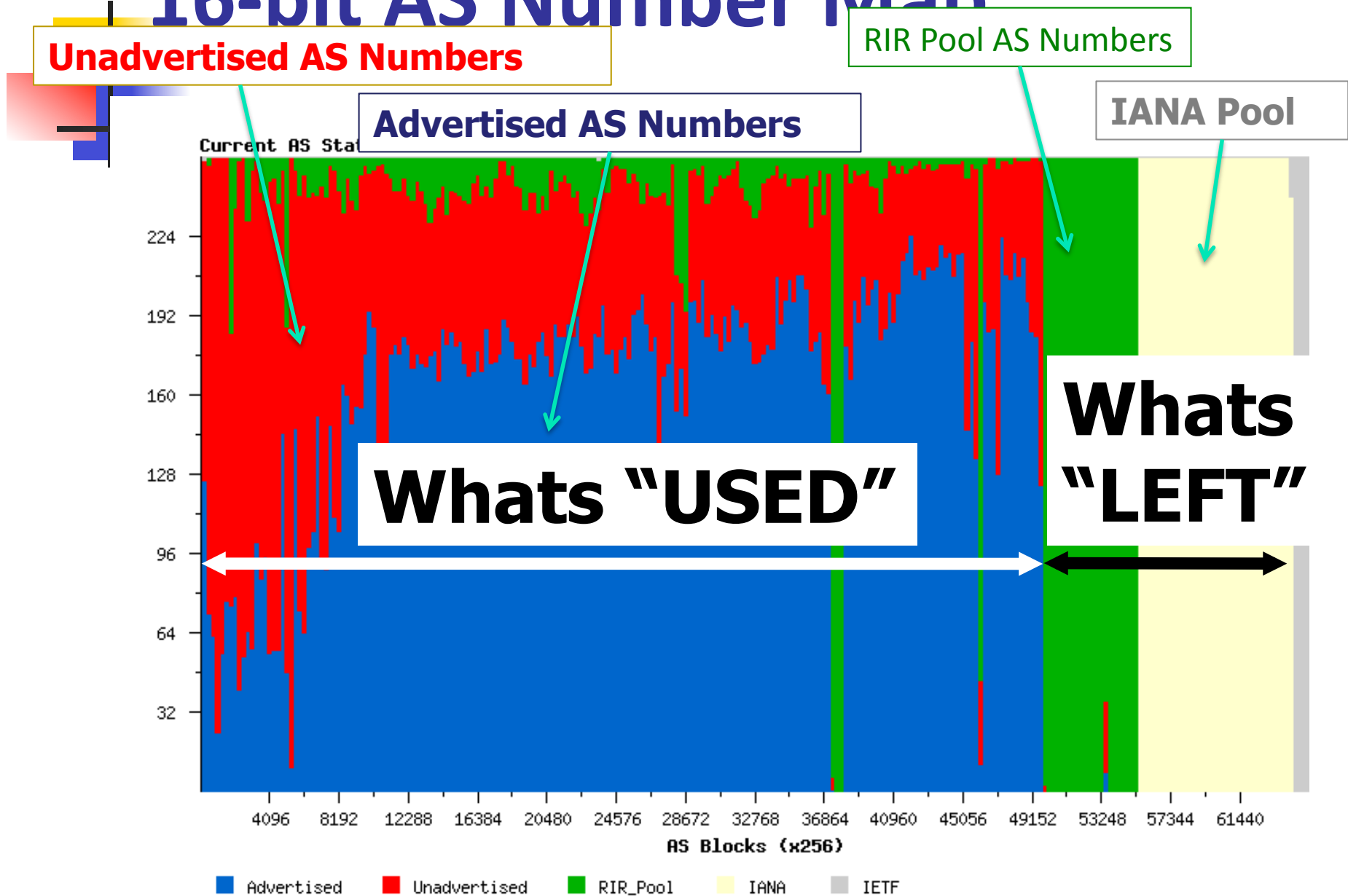
RIR Pool AS Numbers

Advertised AS Numbers

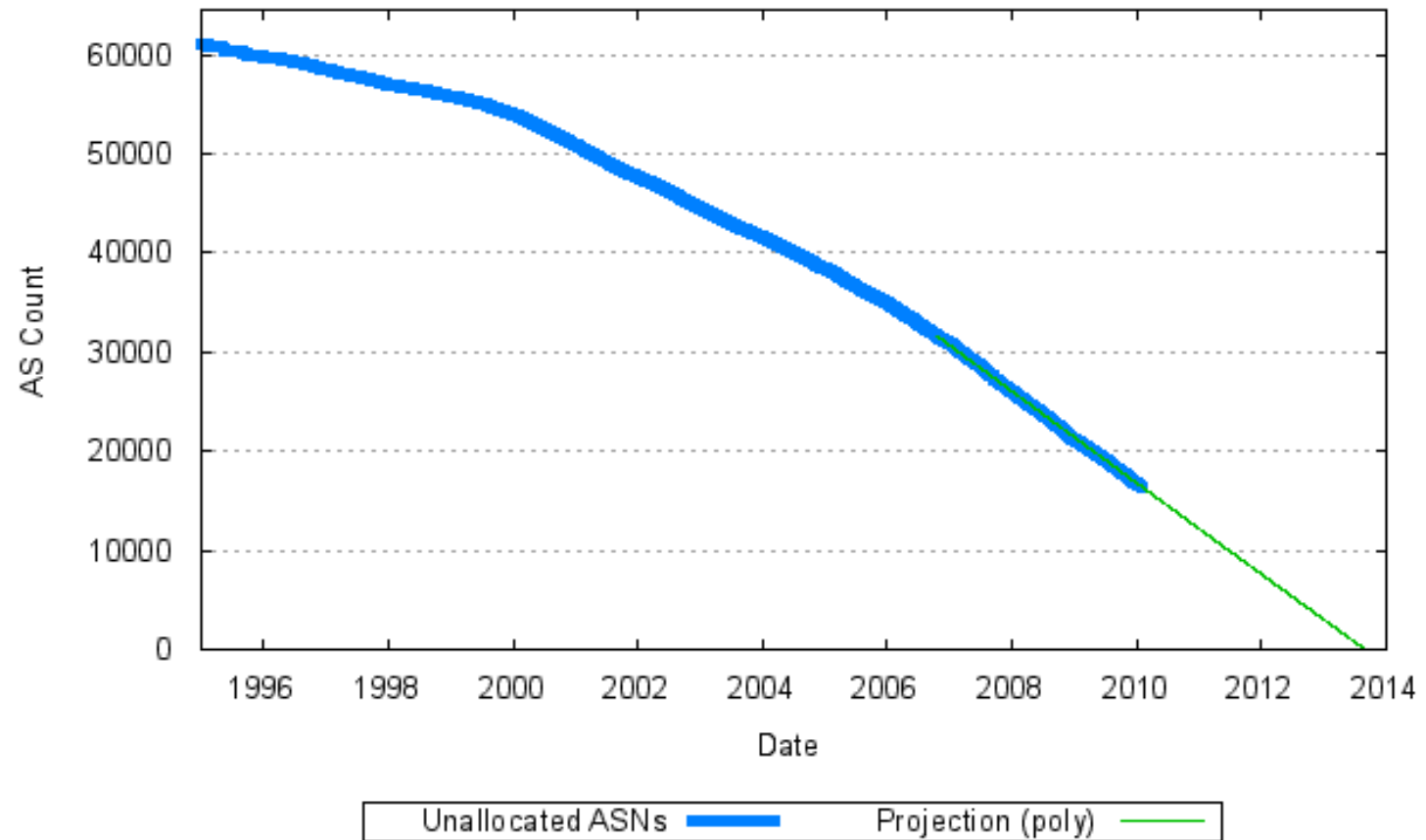
IANA Pool



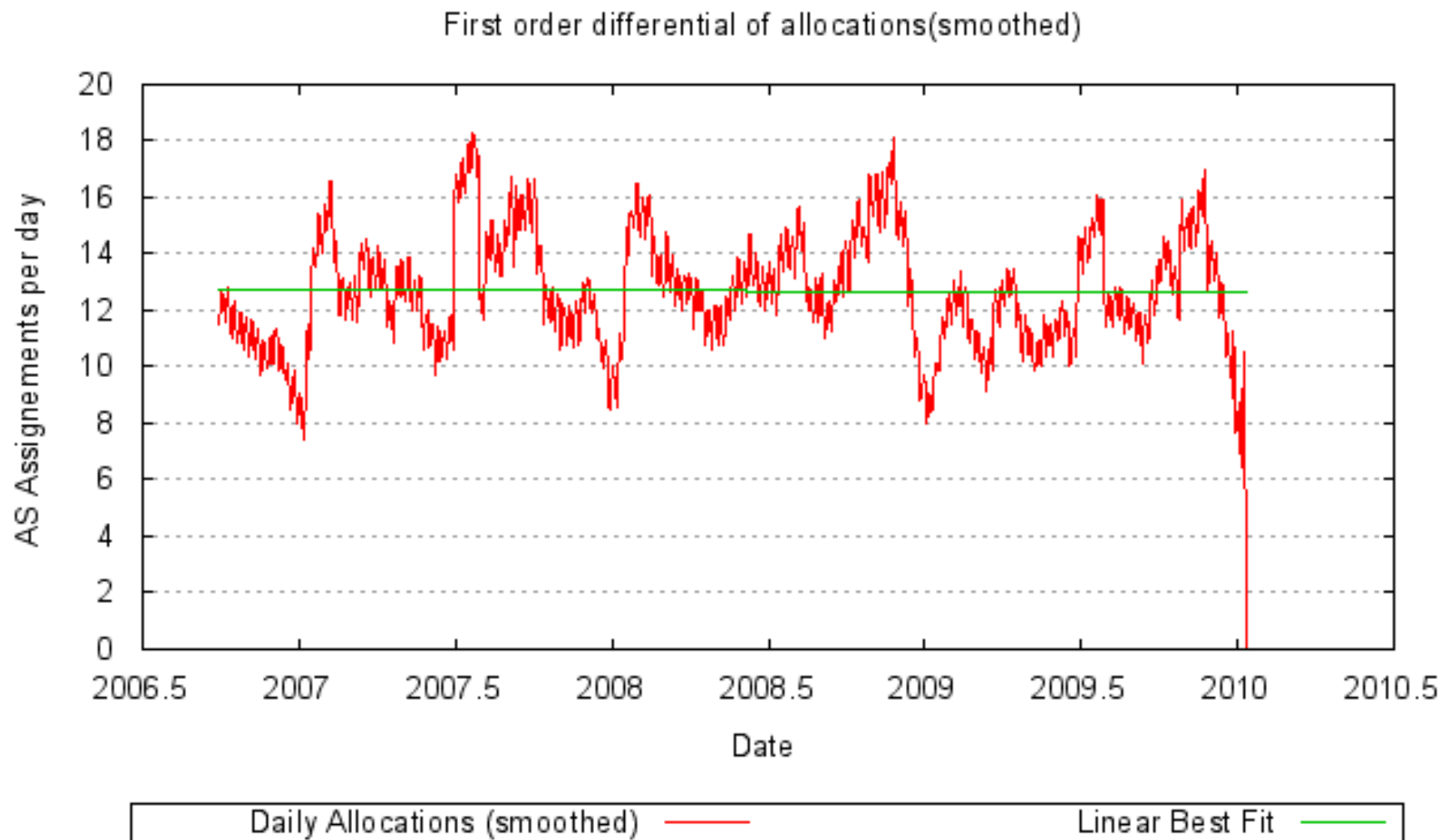
# 16-bit AS Number Map



# Consumption of AS Numbers

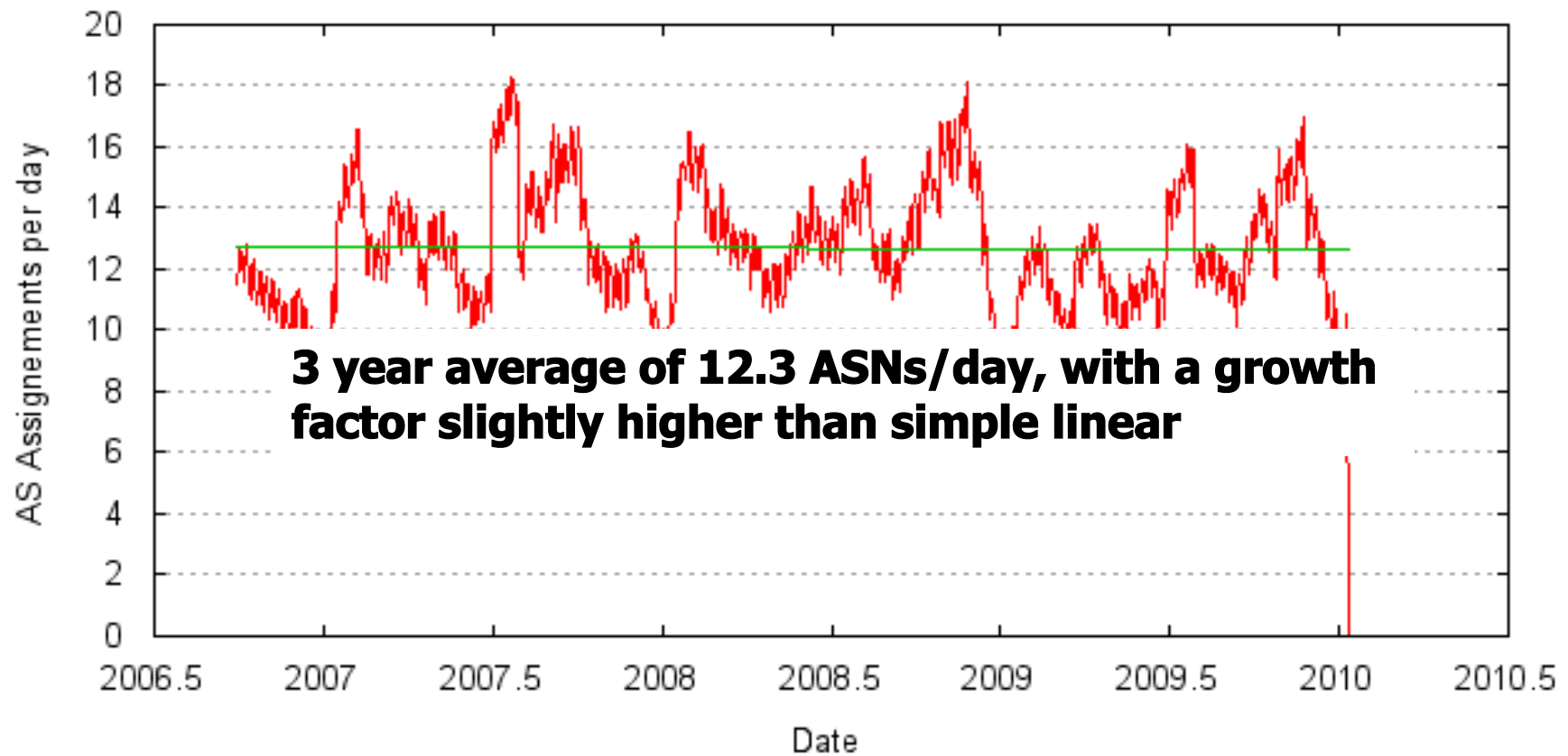


# Consumption Rate



# Consumption Rate

First order differential of allocations(smoothed)



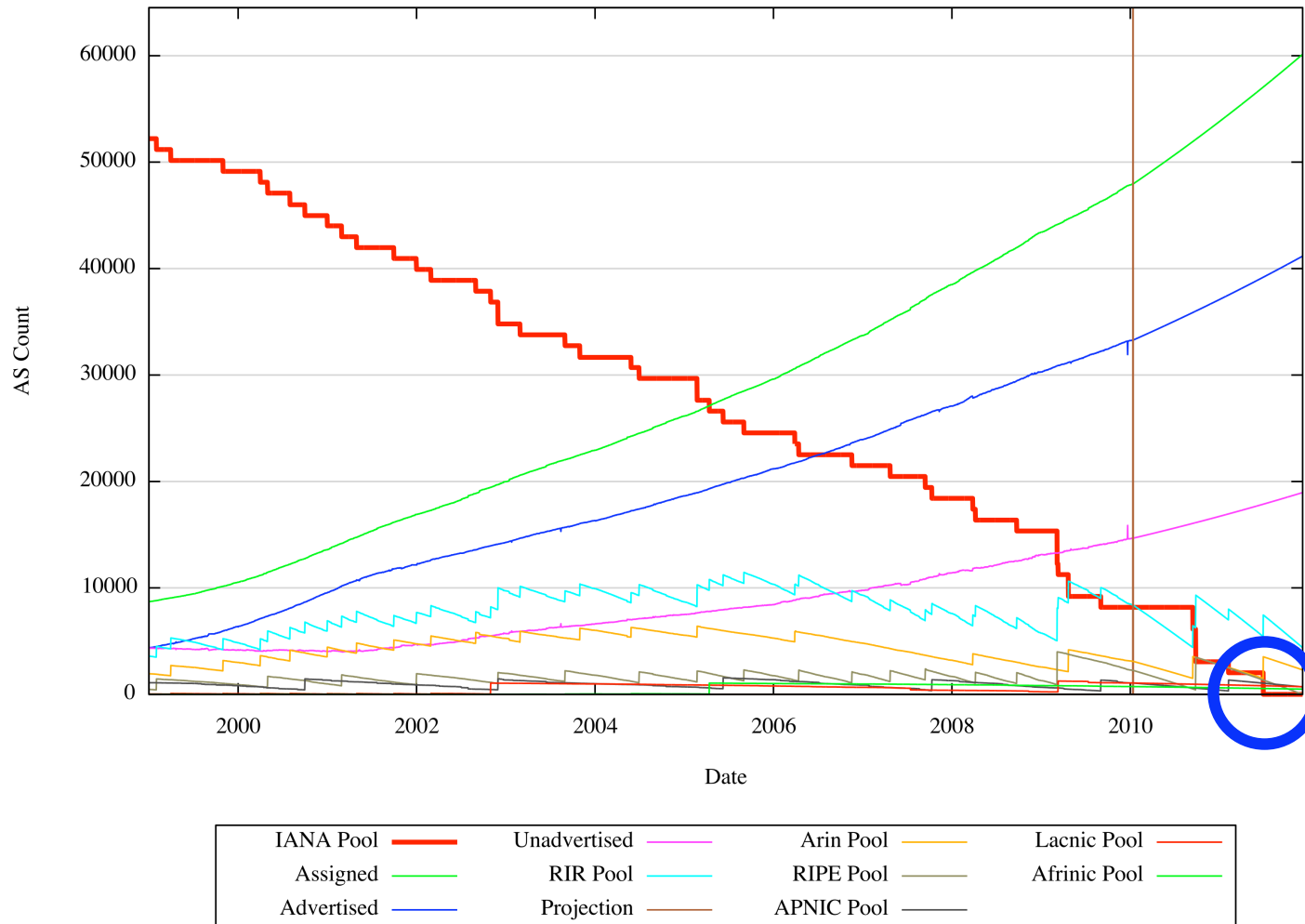
Daily Allocations (smoothed)



Linear Best Fit

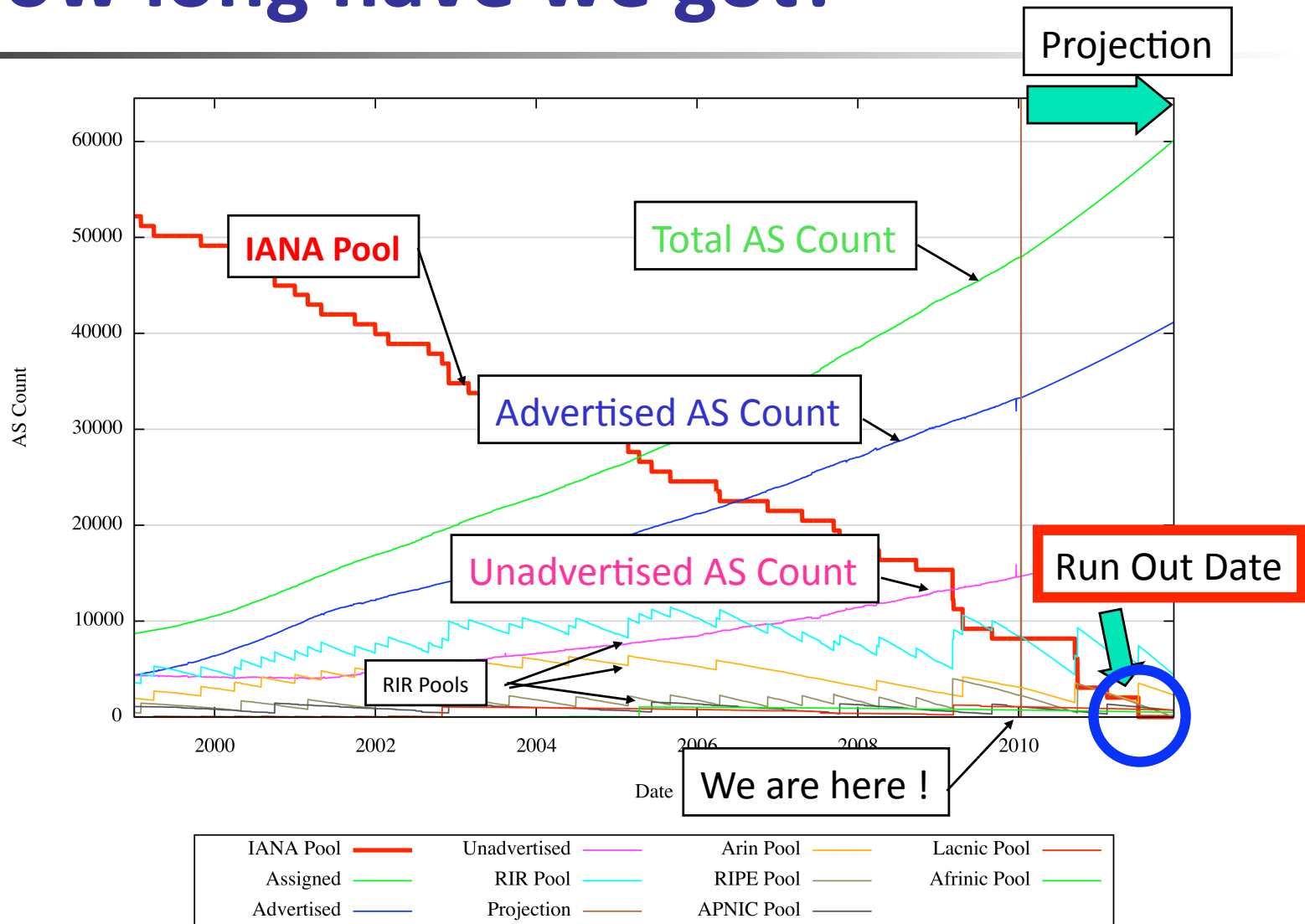


# How long have we got?





# How long have we got?





# 16-bit AS Number Exhaustion

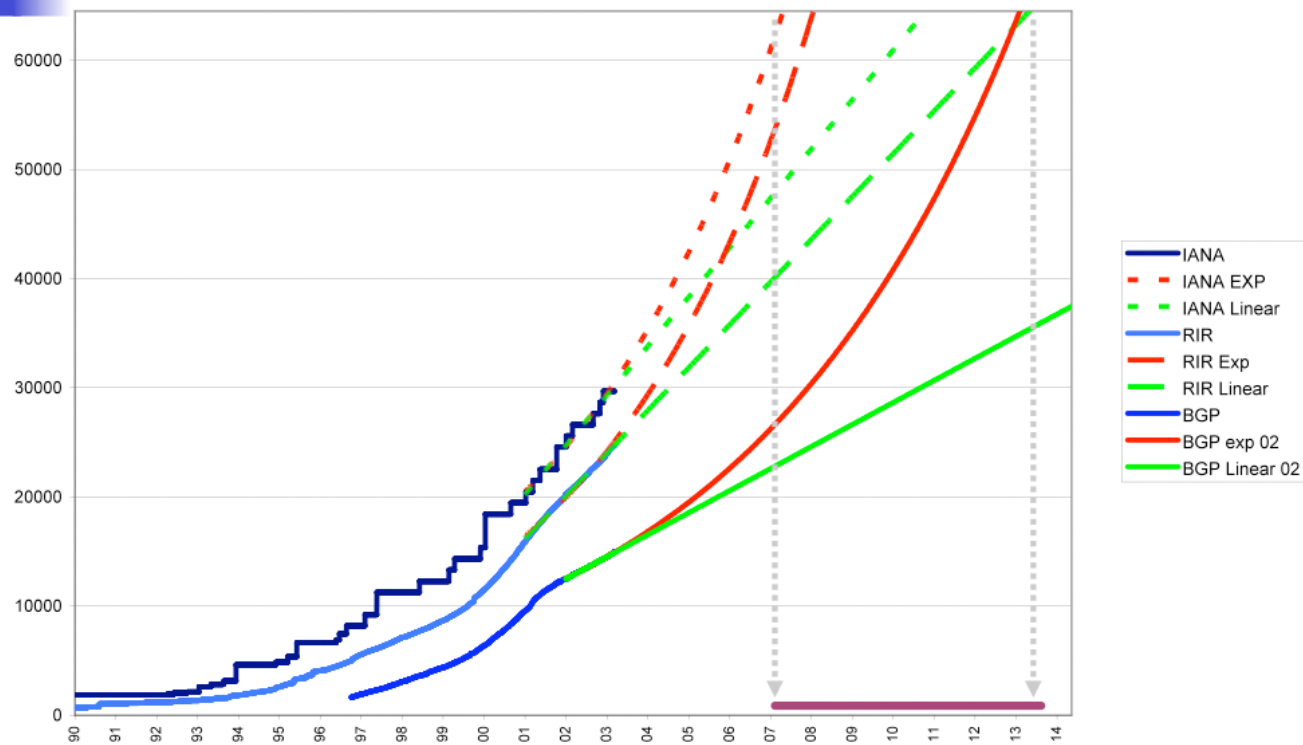
---

- We are exhausting the 16-bit AS Number pool
  - IANA will allocate its last AS number block in **March 2011**
  - RIPE will exhaust its 16 bit AS Number pool in **December 2011**

See <http://www.potaroo.net/tools/asns>

# This is not exactly news!

## Combining these views



# 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!**



# The Agenda for AS Transition

---

1. IETF to complete BGP Standards to support transition mechanisms to 32-bit AS numbers
2. RIRs to start making 32-bit AS numbers available
3. Vendors to provide 32-bit AS number capable BGP implementations
4. BGP networks to commence deployment



# 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



# Design of the 32-bit ASN Transition

---

Objectives of the 32-bit ASN design:

- **Change as little as possible in the BGP spec**
- **Be ‘backward compatible’ with 16-bit AS BGP implementations**
  - Attempt to negotiate 32-bit capability when opening a BGP session
  - Automatically adjust behaviour when peering with 16-bit BGP peers and assume a 16-bit “persona” with 16-bit peers
  - Use 32-bit “persona” only with 32-bit peers
- **Preserve ‘basic’ AS semantics in BGP when peering with 16-bit AS BGP peers**
  - Preserve BGP’s loop detection properties
  - Preserve AS Path length metric properties
- **No ‘flag day’ transition**
  - Allow 16-bit BGP implementations to continue to operate indefinitely in a mixed 16 / 32-bit AS bgp world with complete address prefix reachability
  - Allow for piecemeal deployment of 32-bit BGP implementations





# AS Path Semantics in BGP

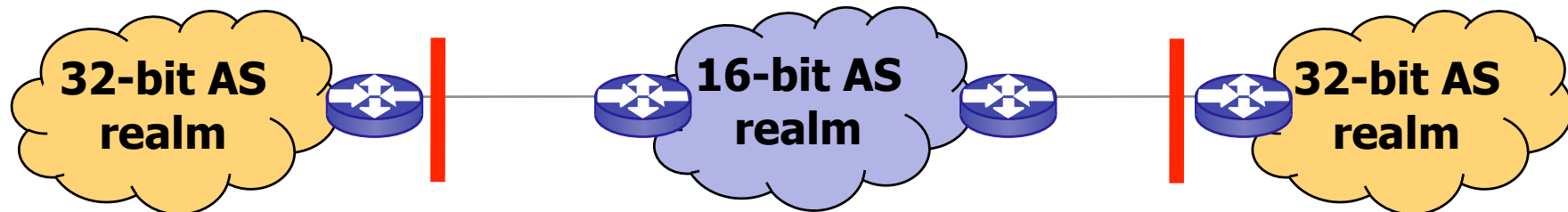
---

- It's a path metric where the length of the AS Path is used as in path selection
- It's a loop detector where the presence of your own AS in a PATH is an indicator of a distance-vector "I'm-going-to-loop-to-infinity-unless-you-stop-me" loop

You don't have to have an **entirely** accurate AS Path – but at a minimum you do have to have path-metric and loop-detecting properties for BGP to function correctly

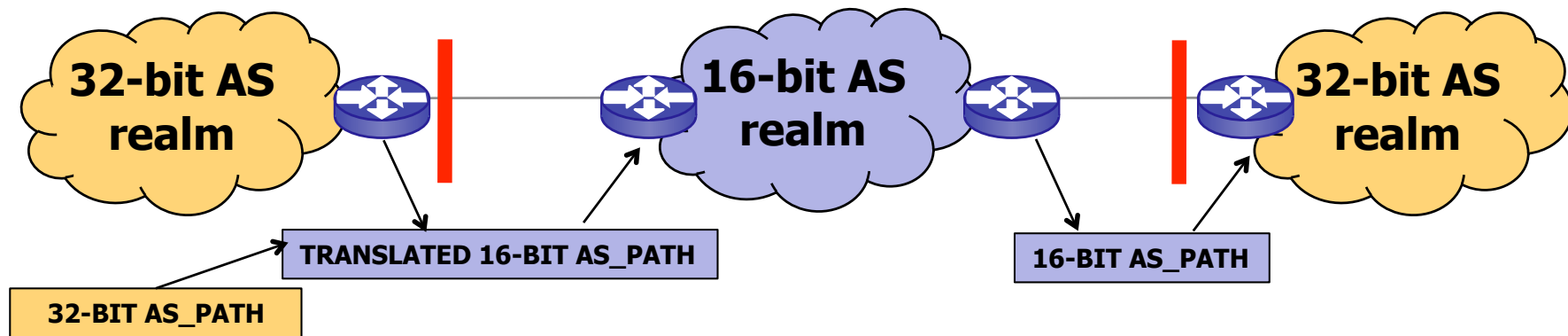
# 32-bit AS Transition

- Think about this space as a set of NEW / OLD boundaries
- Define the NEW / OLD and the OLD / NEW transitions
- Preserve all BGP information at the transition interfaces
  - **Translate** 32-bit AS Path information into a 16-bit representation
  - **Tunnel** 32-bit AS Path information through 16-bit AS domain as an update attribute



# 32-bit AS Transition

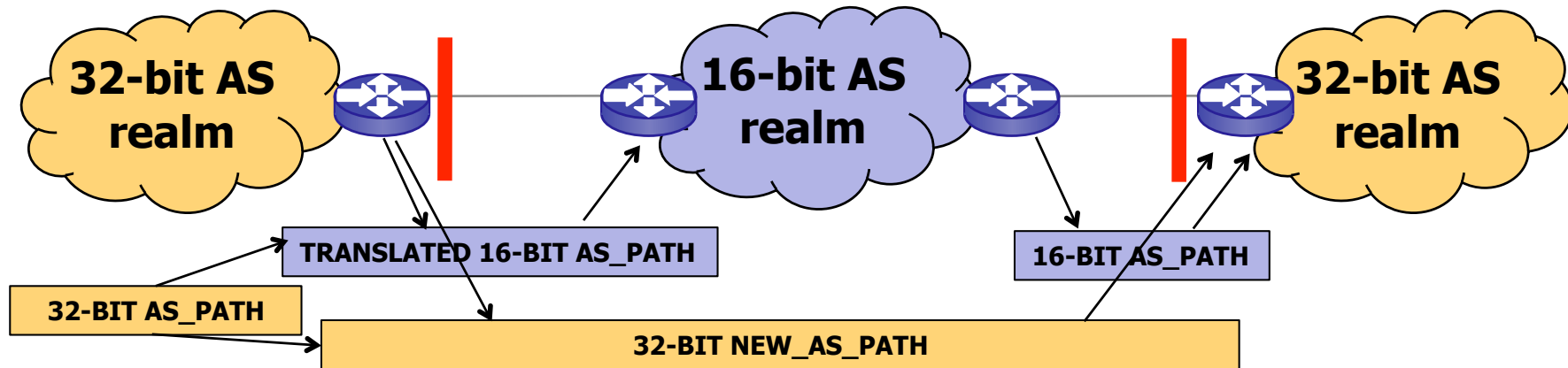
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- Preserve all BGP information at the transition interfaces
  - **Translate** 32-bit AS Path information into a 16-bit representation
  - **Tunnel** 32-bit AS Path information through 16-bit AS domain as an update attribute



**TRANSLATE all 32-bit-only AS numbers to AS23456**

# 32-bit AS Transition

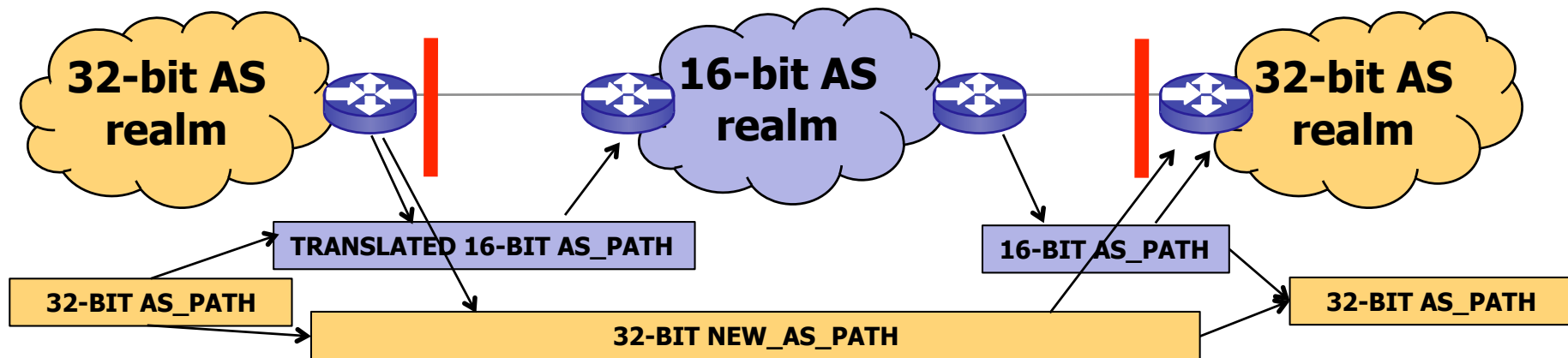
- Think about this space as a set of NEW / OLD boundaries
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- Preserve all BGP information at the transition interfaces
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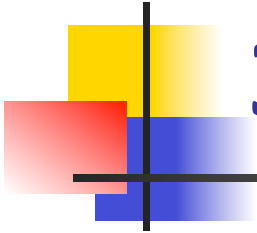
**TUNNEL 32-bit AS\_PATH as NEW\_AS\_PATH**

# 32-bit AS Transition

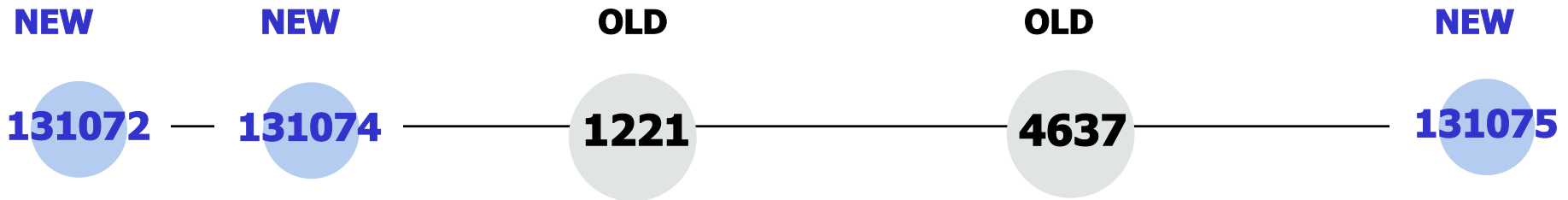
- Think about this space as a set of NEW / OLD boundaries
- Define the NEW / OLD and the OLD / NEW transitions
- Preserve all BGP information at the transition interfaces
  - **Translate** 32-bit AS Path information into a 16-bit representation
  - **Tunnel** 32-bit AS Path information through 16-bit AS domain as an update attribute



**REASSEMBLE 32-bit AS\_PATH**



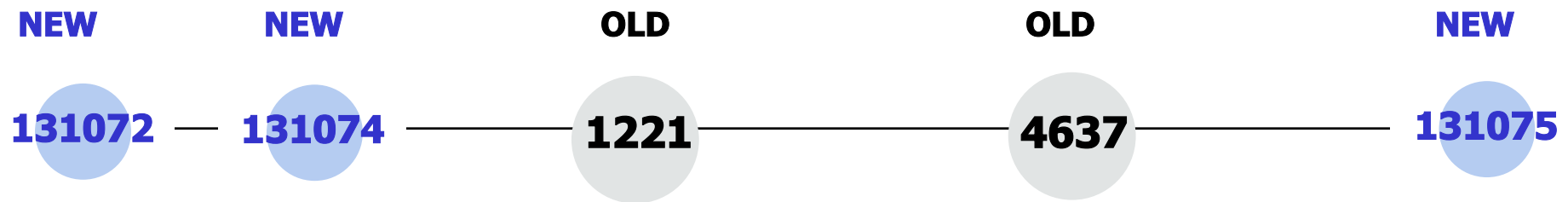
# 32-bit / 16-bit BGP Example



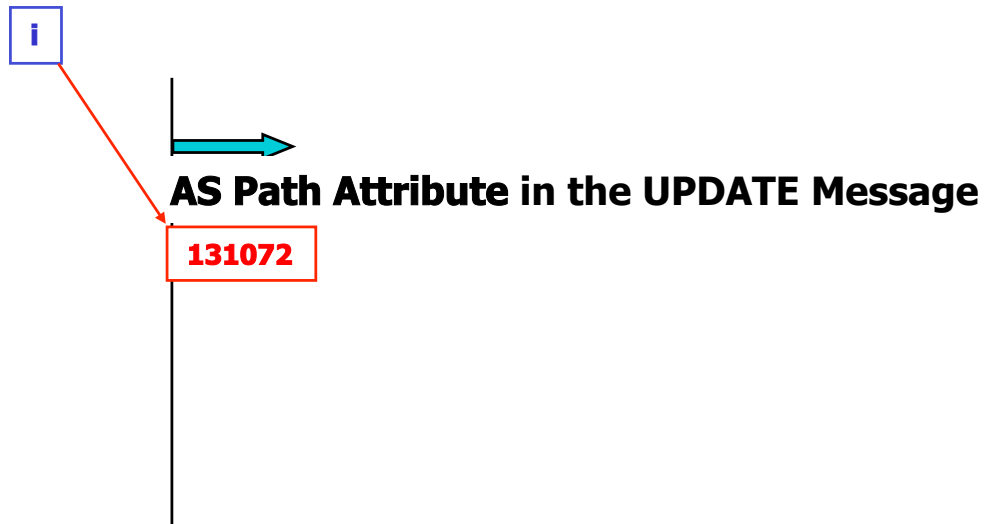
**AS Path in the RIB**



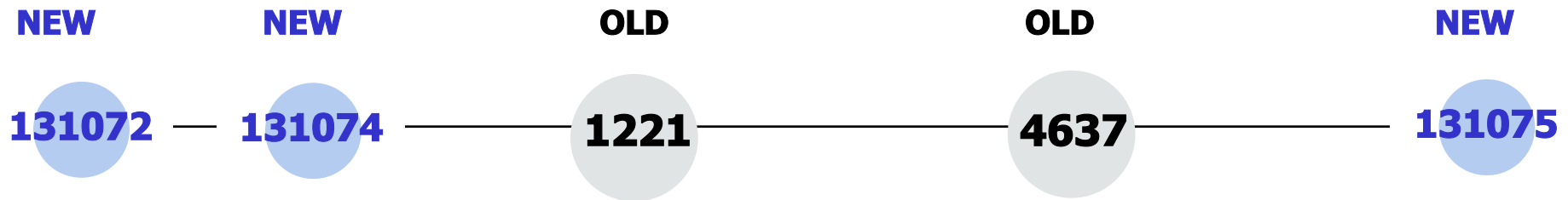
# 32-bit / 16-bit BGP Example



**AS Path in the RIB**



# 32-bit / 16-bit BGP Example



## AS Path in the RIB

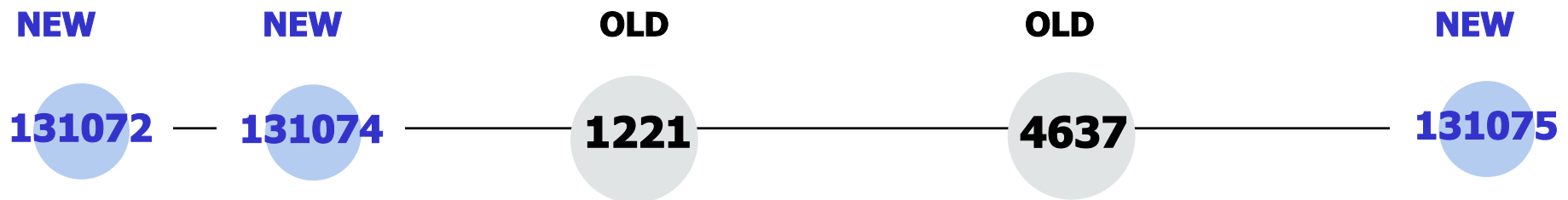


## AS Path Attribute in the UPDATE Message

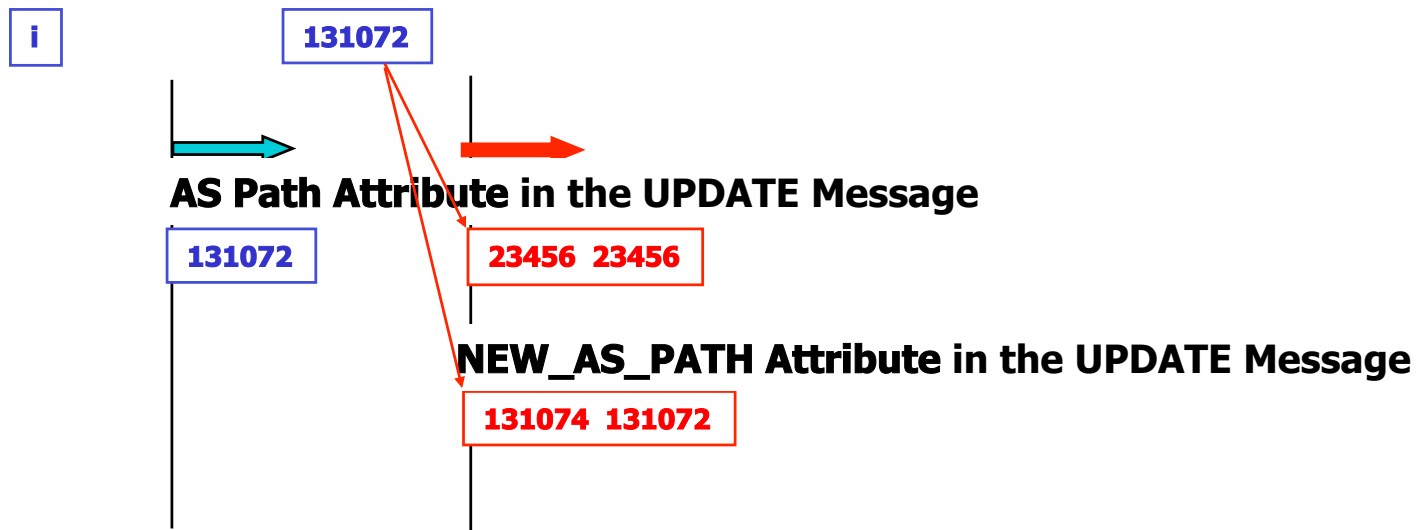




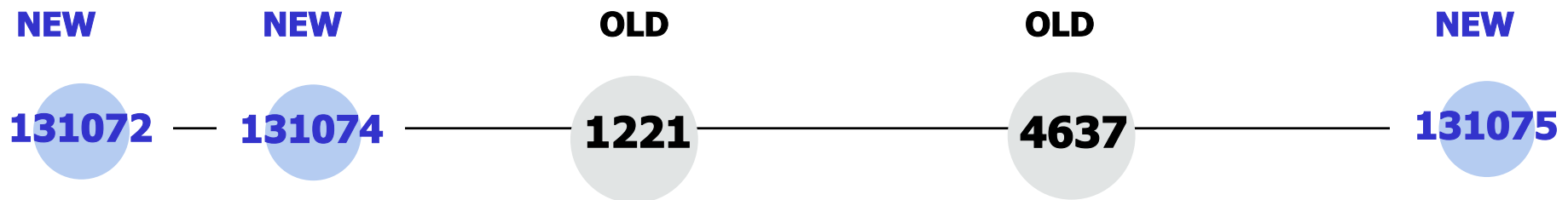
# 32-bit / 16-bit BGP Example



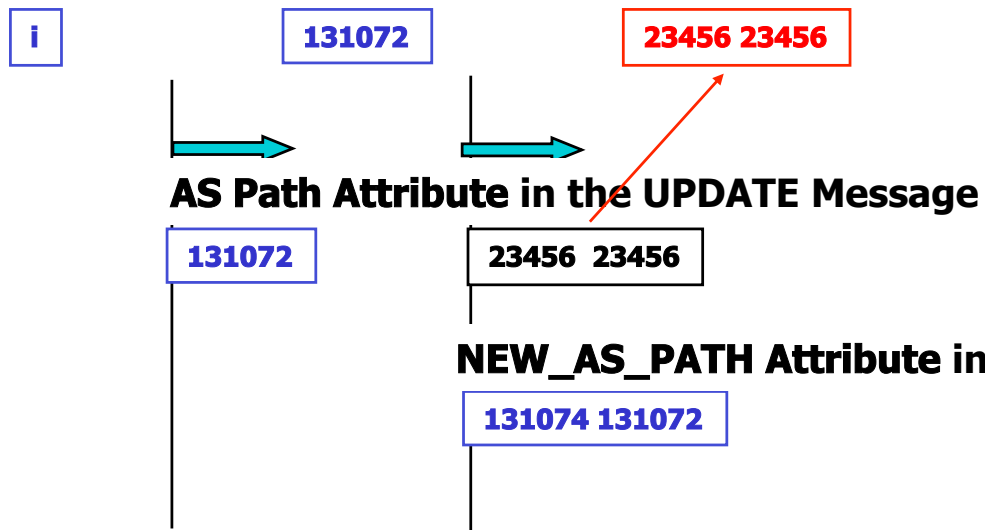
## AS Path in the RIB



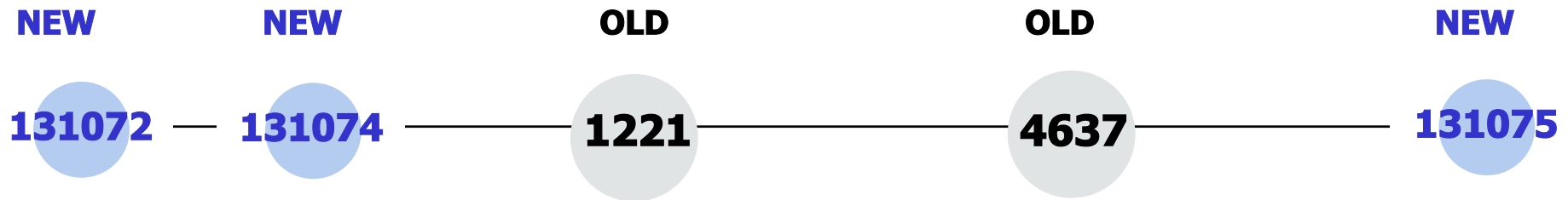
# 32-bit / 16-bit BGP Example



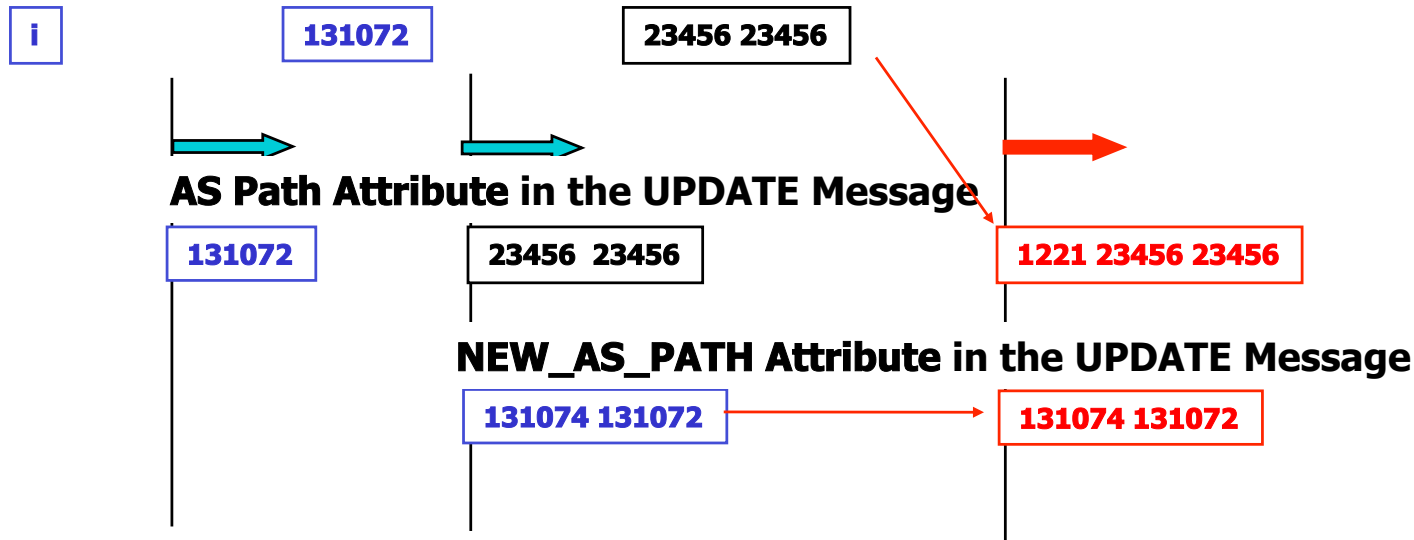
## AS Path in the RIB



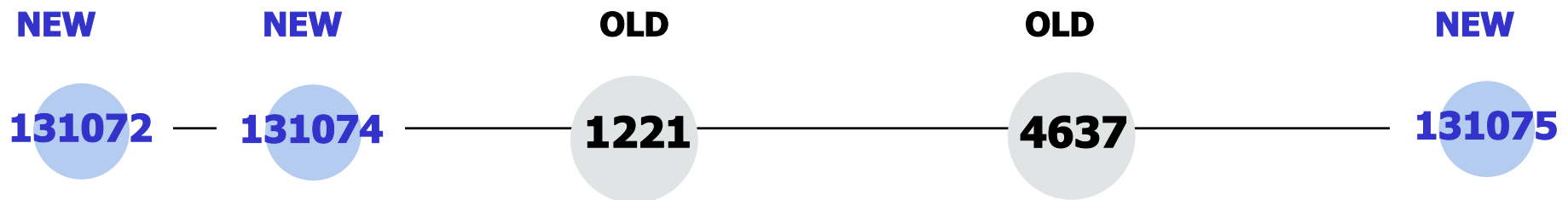
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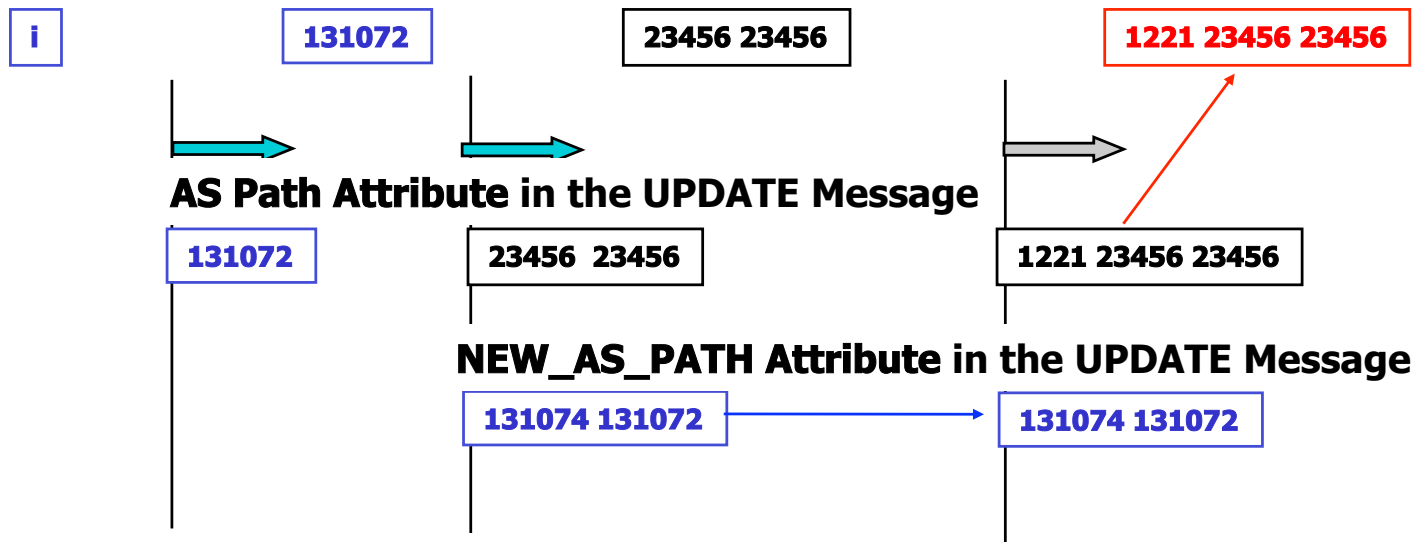
## AS Path in the RIB



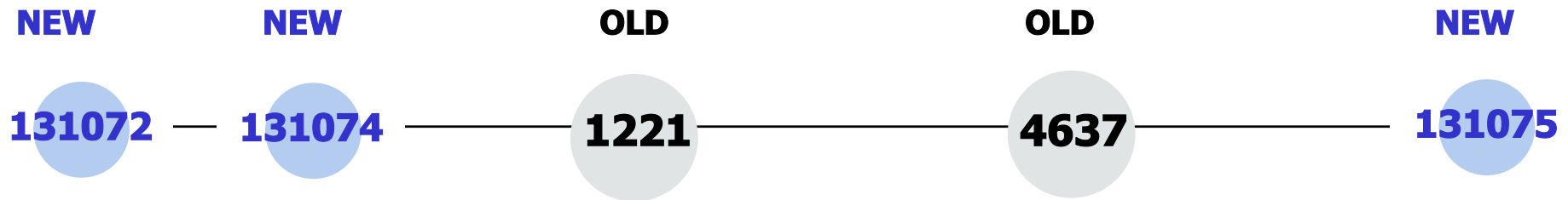
# 32-bit / 16-bit BGP Example



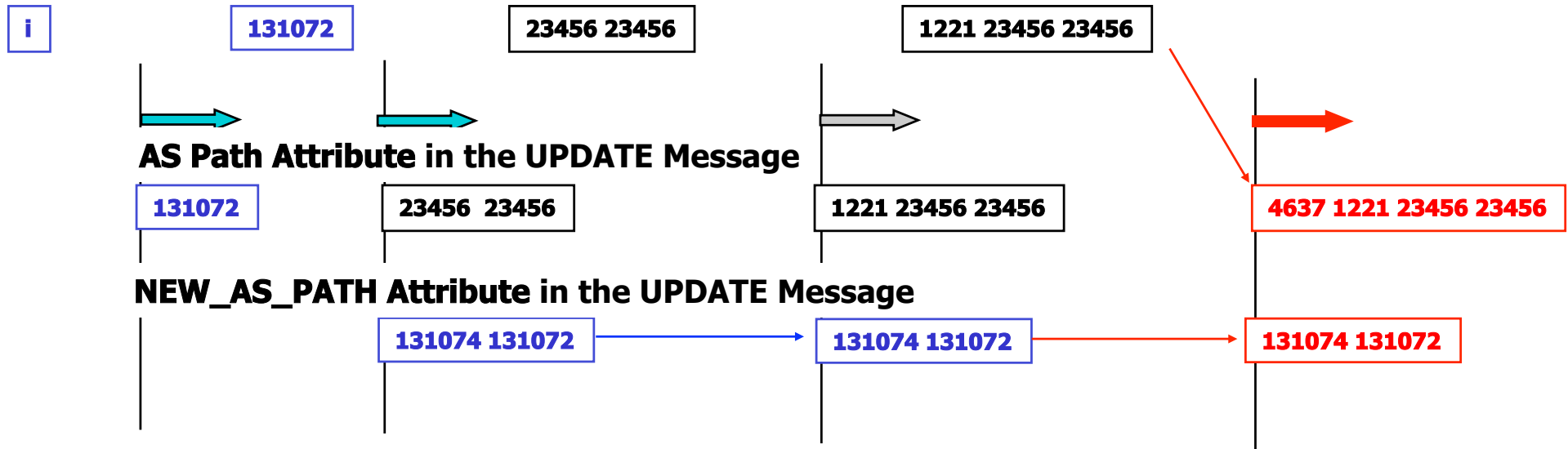
## AS Path in the RIB



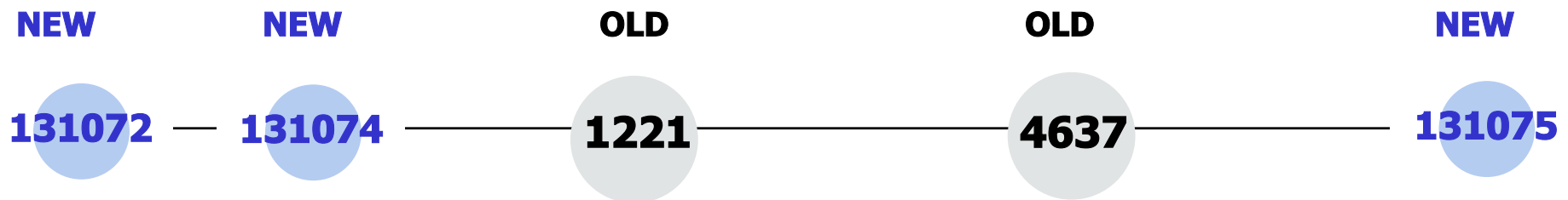
# 32-bit / 16-bit BGP Example



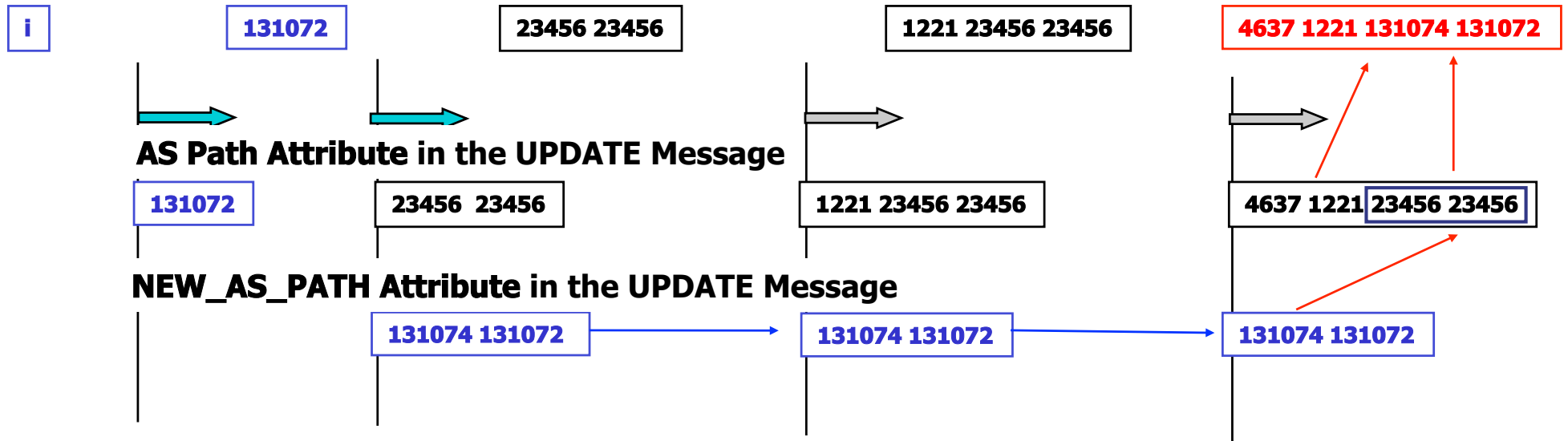
## AS Path in the RIB



# 32-bit / 16-bit BGP Example



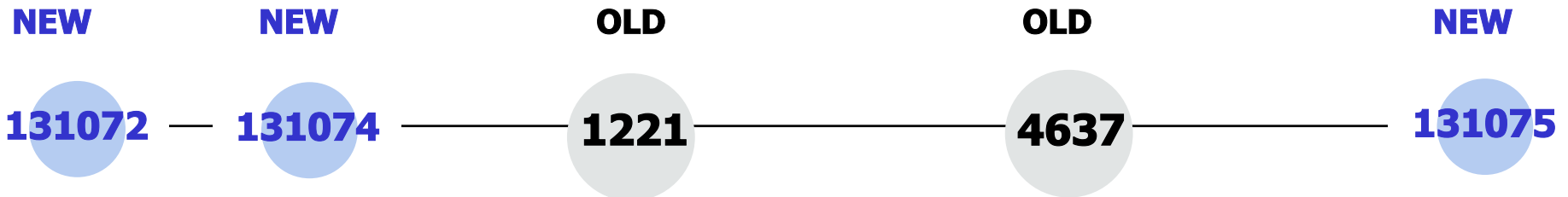
## AS Path in the RIB





# 32-bit / 16-bit BGP Example

---



AS Path in the RIB

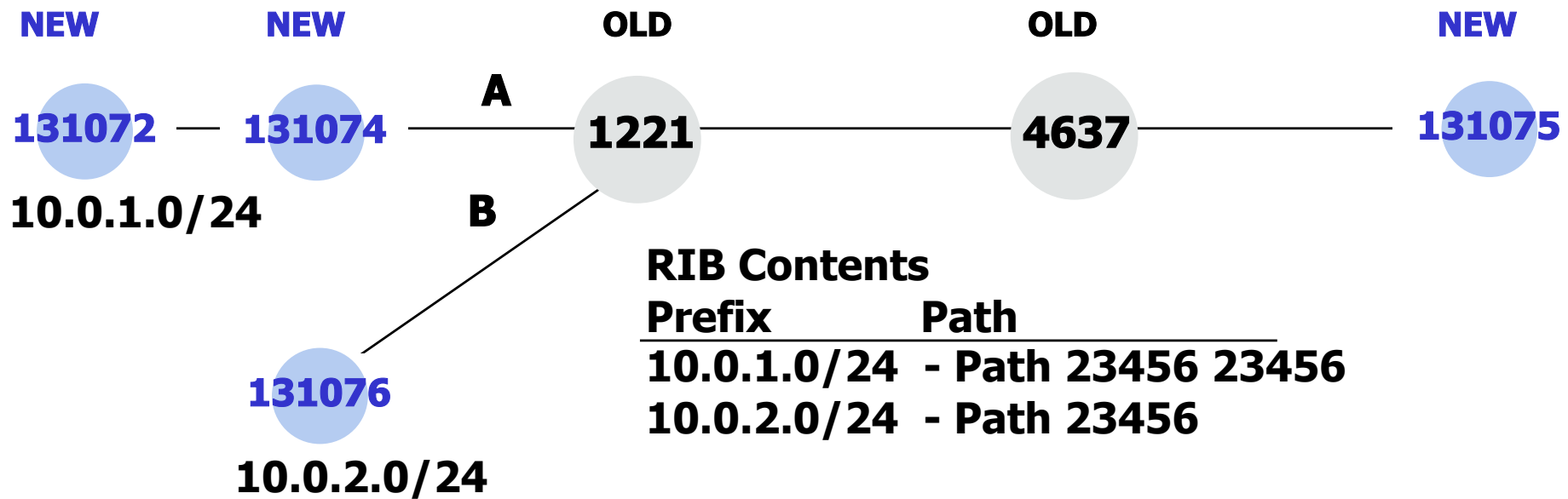


32-bit AS Paths

Equivalent 16-bit AS Paths

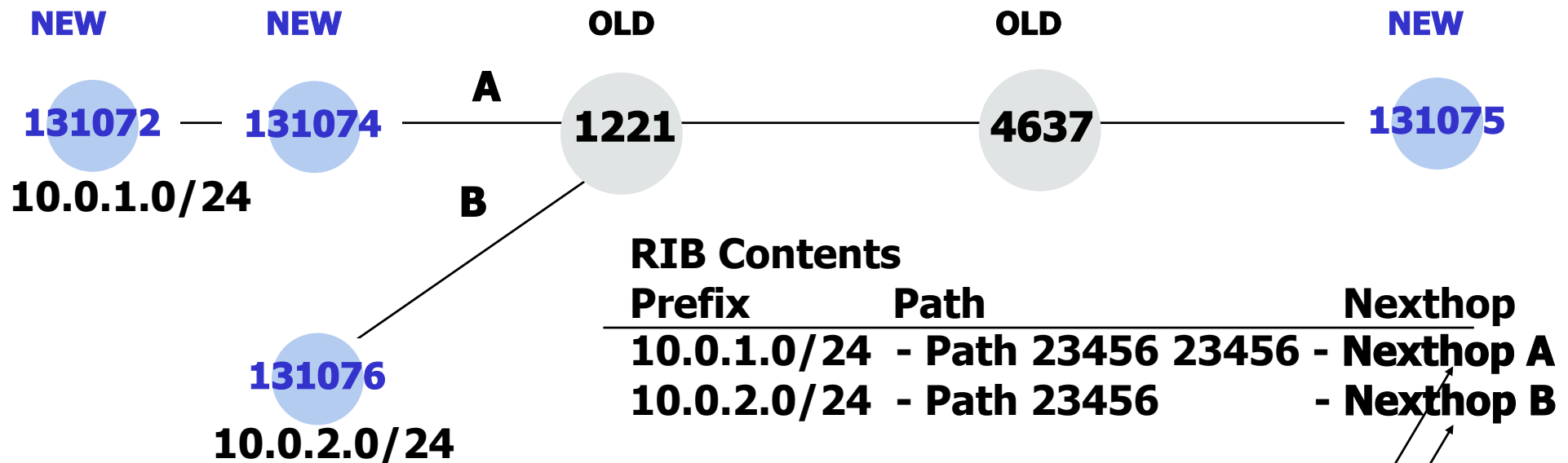
32-bit AS Path

# Can old-BGP get Confused?





# NO! BGP Nexthop is the key!



Traffic from AS 1221 to 10.0.1.0/24 will be forwarded on interface A  
Traffic from AS 1221 to 10.0.2.0/24 will be forwarded on interface B

This is standard BGP behaviour – nothing changes here for BGP as it is used today



# The Agenda for AS Transition

---

1. IETF to complete BGP standards to support transition mechanisms to 32-bit AS numbers  
*RFC 4893 - May 2007*
2. RIRs to start making 32-bit AS numbers available
3. Vendors to provide 32-bit AS number capable BGP implementations
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:
  - 2007 – 32 bit ASNs available upon request
  - 2009 – 32 bit ASNs available by default
  - 2010 – transition projected to be complete



# The Agenda for AS Transition

---

1. IETF to complete BGP Standards to support transition mechanisms to 32-bit AS numbers  
*RFC 4893 - May 2007*
2. RIRs to start making 32-bit AS numbers available  
*32 bit AS Policy - 2006*
3. Vendors to provide 32-bit AS number capable BGP implementations
4. BGP networks to commence deployment

# 3. Vendor Support in BGP

Name	Version	Notation
<a href="#">Alcatel-Lucent SR OS</a>	7.0	asplain
<a href="#">Arbor Peakflow SP</a>	5.5	asplain
<a href="#">BIRD</a>	1.0.12	asplain
<a href="#">Brocade (Foundry) IronWare</a>	4.0.00 for the NetIron MLX and XMR, 2.8.00 for the BigIron RX	asdot, asdot+, asplain
<a href="#">Cisco IOS</a>	12.0(32)S12, 12.0(32)SY8, 12.2(33)SX11, 12.4(24)T	asdot (asplain planned for future)
<a href="#">Cisco IOS XE</a>	2.3	asplain (asdot optional)
<a href="#">Cisco IOS XR</a>	3.4(1)	asdot (asplain planned for 3.9)
<a href="#">Cisco NX-OS</a>	4.0(1)	asdot (asplain planned for 4.1(3))
<a href="#">ExtremeXOS</a>	Need Information	Need Information
<a href="#">Juniper JUNOS</a>	9.1R1	asplain (asdot optional)
<a href="#">Juniper JUNOSe</a>	4.1.0	asplain
<a href="#">Force10 FTOS</a>	7.7.1.0	asplain (asdot, asdot+ optional)
<a href="#">OpenBGPD</a>	4.2, patches for 3.9 and 4.0	asdot
<a href="#">Quagga</a>	0.99.10, patches for 0.99.6 and other versions	asplain
<a href="#">Redback SEOS</a>	2.0	ascalon (asplain planned for end of 2009)

[http://as4.cluepon.net/index.php/Software\\_Support](http://as4.cluepon.net/index.php/Software_Support)

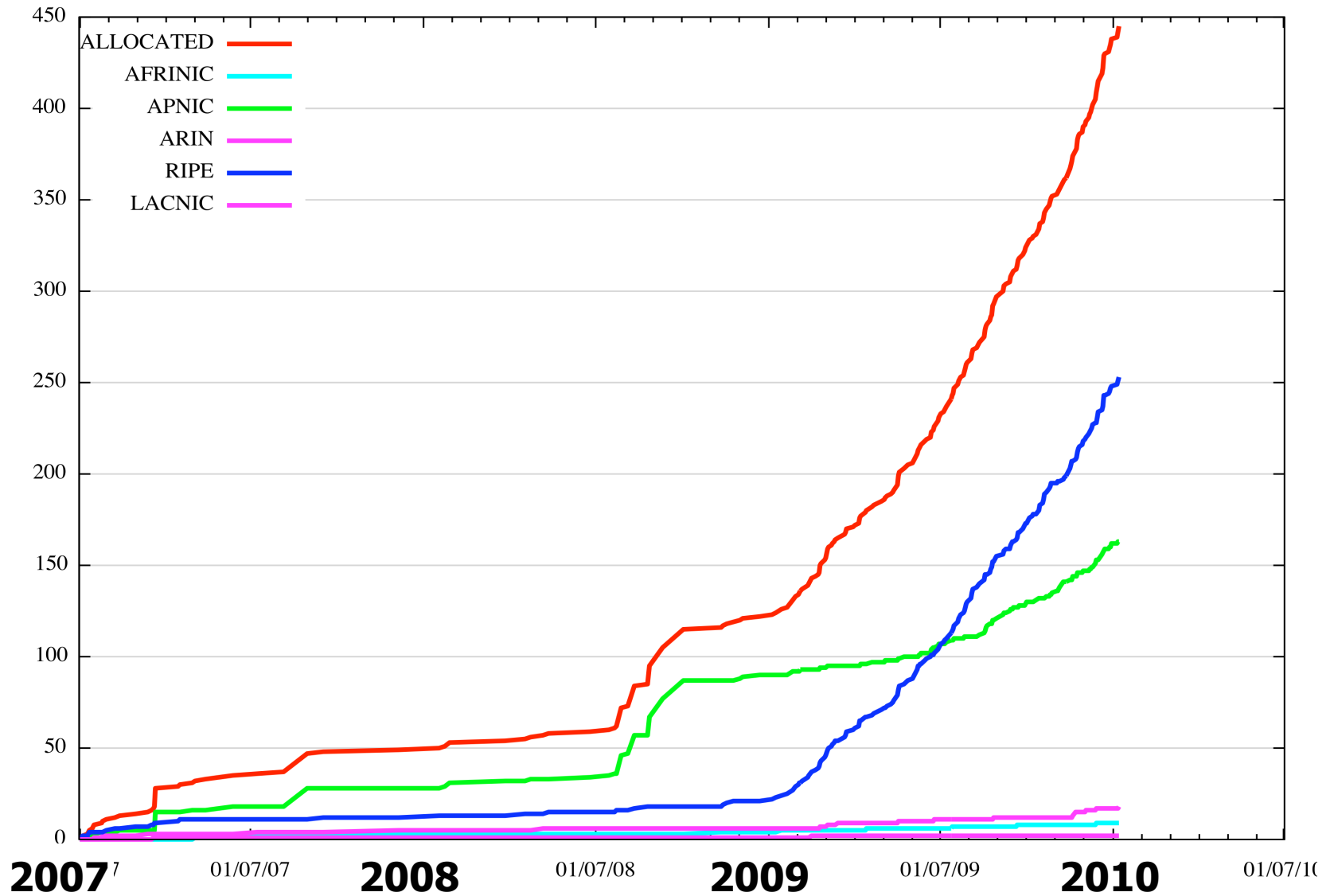
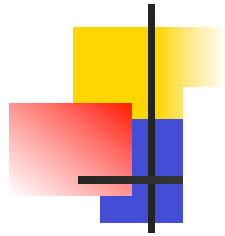


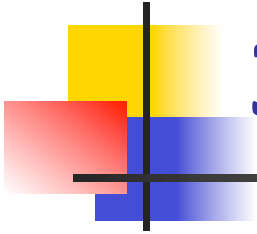
# The Agenda for AS Transition

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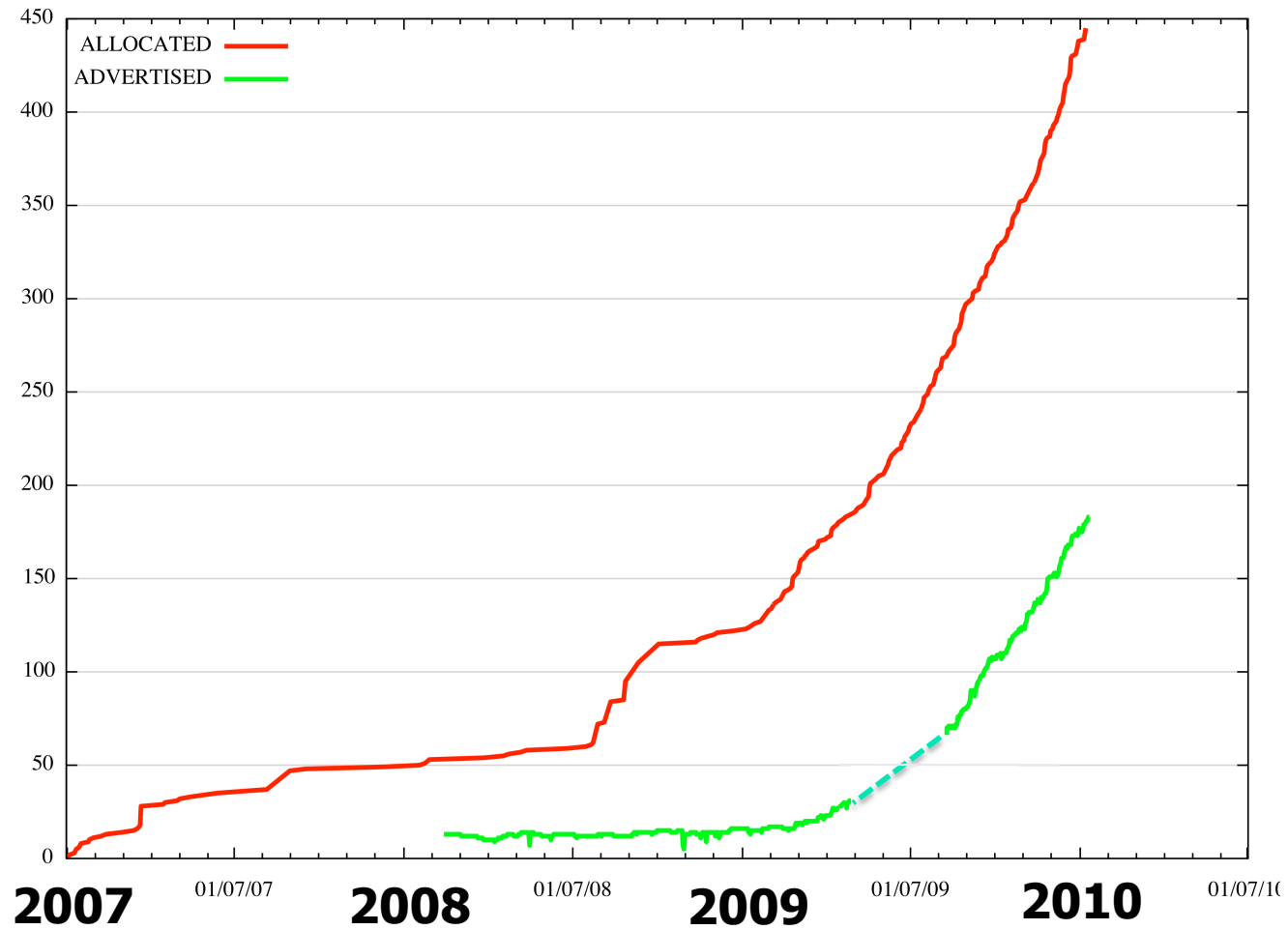
1. IETF to complete BGP Standards to support transition mechanisms to 32-bit AS numbers  
*RFC 4893 - May 2007*
2. RIRs to start making 32-bit AS numbers available  
*32 bit AS Policy - 2006*
3. Vendors to provide 32-bit AS number capable BGP implementations  
*Currently gathering pace: 2010*
4. BGP networks to commence deployment

# RIR Allocation Data of 32-bit AS's





# 32-bit ASNs in BGP



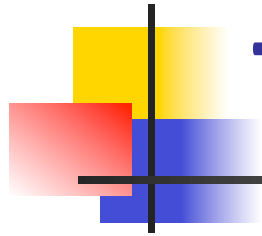




# 32-bit ASN Deployment

---

- Allocation status as of January 2010:
  - Advertised: 183
  - Unadvertised: 262
- In 2009 the RIRs allocated 4,761 ASNs
  - 4,445 were 16-bit ASNs
  - 316 were 32 bit ASNs



# The Agenda for Transition

---

1. IETF to complete BGP standards to support transition mechanisms to 32-bit AS numbers  
*RFC 4893 - May 2007*
2. RIRs to start making 32-bit AS numbers available  
*32 bit AS Policy - 2006*
3. Vendors to provide 32-bit AS number capable BGP implementations  
*currently gathering pace 2009 - 2010*
4. BGP networks to commence deployment  
*Lagging - badly!*



# How can we assist with 32-bit 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



# NEW\_AS\_PATH Attribute

---

- BGP speakers in 16-bit AS domains should support **NEW\_AS\_PATH** as a transitive optional attribute in UPDATE messages
  - because that's where the 32-bit path is hiding
  - That's a "SHOULD" not a "MUST", by the way
  - Its better if you do, but nothing fatally breaks if you don't
    - Mixed 2 / 4 Byte loops will get detected in the 16-bit world as a fallback

*Default BGP configurations will do the right thing here*



# NEW\_AGGREGATOR Attribute

---

- BGP speakers in 16-bit AS domains should support **NEW\_AGGREGATOR** as a transitive optional attribute in UPDATE messages
  - because that's where the 32-bit Aggregator AS is hiding
  - That's a "SHOULD" not a "MUST", by the way
  - Its better if you do, but nothing fatally breaks if you don't

*Default BGP configurations should do the right thing here*



# AS 23456

---

- **AS 23456** is going to appear in many 16-bit AS paths – both origin and transit

*This is not an error – it's a 16-bit token holder for a 32-bit AS number*



# Netflow and Sflow

---

- Netflow analyzers may need to be reviewed
  - Netflow version 9 supports 32-bit AS numbers
    - But may not report the 32-bit ASN unless the netflow collector is a 32-bit BGP
    - Does your analyzer support 32-bit AS numbers?
  - Netflow version 8 and earlier are 16-bit AS constrained
    - Which implies that you'll be seeing AS 23456 more than you may want!
- Sflow
  - Appears to define a source and dest AS using a 32 bit field
  - So it *should* be ok!



# BGP Communities

---

- If you want to explicitly signal to a 32-bit AS using communities in BGP then you will need to explicitly signal the 32-bit AS using **BGP Extended Communities**
  - Attempting to use AS 23456 in this context will have unintended consequences!

See:

- RFC 4630
- RFC 5568





# BGP Memory requirements

---

- BGP memory requirements will increase
  - 32-bit BGP speakers will need twice the memory used to hold AS paths<sup>1</sup>
  - 16-bit BGP speakers will need up to three times the memory used to hold AS paths plus NEW\_AS\_PATH extended community attribute<sup>2</sup>
    - 30,000 unique AS paths with an average length of 4 implies an additional memory requirement of 240Kb for 32-bit BGP and up to a further 480Kb for 16-bit BGP

**1 - Not "twice the memory" but "twice the memory used for AS Path storage"**

**2 - Not "three times the memory", but "three times the memory used for AS Path Storage"**



# BGP Bandwidth requirements

---

- BGP bandwidth requirements will increase (ever so slightly!)
  - 32-bit BGP speakers will need twice the size used to carry AS paths
  - 16-bit BGP speakers will need up to three times the size used to carry AS paths (factoring in the NEW\_AS\_PATH attribute)
    - The update will grow by an average of 20 bytes, assuming an average AS path length of 4



# Performance

---

- 32-bit to 16-bit BGP session startup may be considerably slower
  - The 32-bit speaker will need to compress all the AS Paths into their 16-bit equivalent prior to generating updates
    - (assuming that the 16-bit Paths for Update messages are generated on demand)
  - This may take some time to compute for some 30,000 distinct AS Paths (depending on the internal structure of the BGP implementation)



# Performance

---

- BGP convergence times may increase in some cases
  - Any instance of 16-bit BGP world destruction of the tunnelled NEW\_AS\_PATH attribute implies extended times on loop detection in order to fully complete prefix withdrawal
  - Its not that the withdrawal will loop forever, its that the loop will take additional AS hops before it is detected in the 16-bit realm
  - The time to complete the withdrawal of a route may be extended



# Proxy Aggregation

---

- If you proxy aggregate in the 16-bit world then make sure that the aggregate is strictly larger than the components
  - Or loop detection may be harder
    - As the AS Set object generated in the 16-bit word as a result of this proxy aggregation is not cleanly translatable into the 32-bit world, so 32-bit information is lost
- But proxy aggregation is not a common occurrence in today's BGP environment



# Mixed environments

---

- No dynamic capability for 16/32-bit ASN mode shift
  - You cannot flick from “16-bit OLD” to “32-bit NEW” mode within an active BGP session
  - You need to clear the session and then perform a clean start to trigger the initial capability exchange



## Transition within an AS

---

- In a complex iBGP AS that wants to transition to using a 32-bit “home” AS then you are going to have to think about the transition VERY carefully
  - You can undertake this transition one router at a time, but care and attention are required



# Operational Support Systems

---

What happens when you have a customer / transit / peer with a 32-bit AS Number?

- What's in the route registries and what your customers tell you about their AS and what's in your OSS and your routing system will differ:
  - E.g.: **AS 65538** needs to be auto-translated into **AS 23456** in a number of places, including in your OSS
  - Your BGP routers may need to peer with **AS 23456**, transit across **AS 23456**, and have multiple customers on **AS 23456** at the same time, while also understanding that these refer to different external parties





# Related Systems

---

- Anything that wants to manipulate AS numbers, including your local support systems, scripts and databases



# 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?*



# 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?*

**NO!**



# 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?*

- 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?*



## Common Questions

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

**NO!**



# Common Questions

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

- 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

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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

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



# Common Questions

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

**YES and NO**



# Common Questions

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

- **NO** - if your BGP does not support RFC5668
  - 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 RFC5668
  - Ask your vendor when they will be supporting BGP extended communities with 4-byte ASNs – RFC5668
- **YES** – if your BGP supports RFC5668



# Common Questions

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



# Common Questions

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

**MAYBE!**



# Common Questions

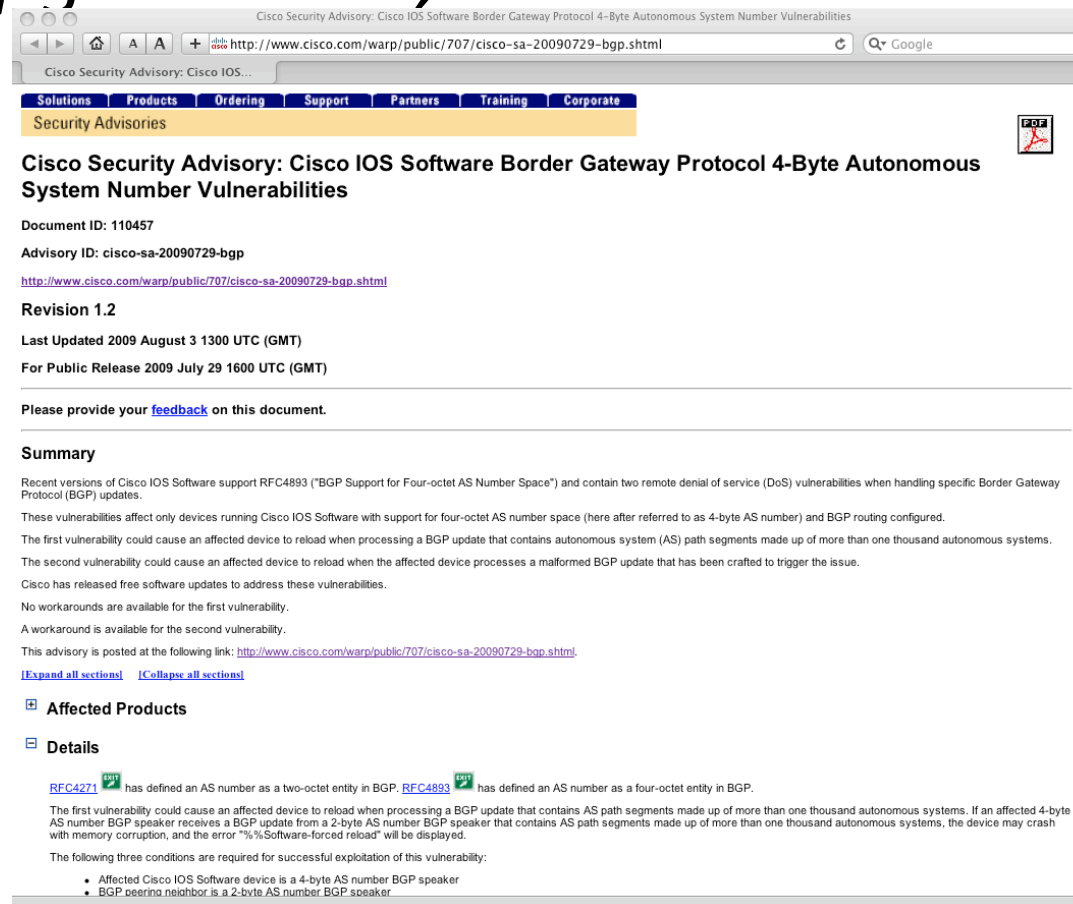
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## *4. If I upgrade BGP, will BGP crash?*

- 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

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



Cisco Security Advisory: Cisco IOS Software Border Gateway Protocol 4-Byte Autonomous System Number Vulnerabilities

Document ID: 110457  
Advisory ID: cisco-sa-20090729-bgp  
<http://www.cisco.com/warp/public/707/cisco-sa-20090729-bgp.shtml>

Revision 1.2  
Last Updated 2009 August 3 1300 UTC (GMT)  
For Public Release 2009 July 29 1600 UTC (GMT)

Please provide your [feedback](#) on this document.

### Summary

Recent versions of Cisco IOS Software support RFC4893 ("BGP Support for Four-octet AS Number Space") and contain two remote denial of service (DoS) vulnerabilities when handling specific Border Gateway Protocol (BGP) updates.

These vulnerabilities affect only devices running Cisco IOS Software with support for four-octet AS number space (here after referred to as 4-byte AS number) and BGP routing configured.

The first vulnerability could cause an affected device to reload when processing a BGP update that contains autonomous system (AS) path segments made up of more than one thousand autonomous systems. The second vulnerability could cause an affected device to reload when the affected device processes a malformed BGP update that has been crafted to trigger the issue.

Cisco has released free software updates to address these vulnerabilities.

No workarounds are available for the first vulnerability.  
A workaround is available for the second vulnerability.

This advisory is posted at the following link: <http://www.cisco.com/warp/public/707/cisco-sa-20090729-bgp.shtml>

[Expand all sections](#) | [Collapse all sections](#)

### Affected Products

### Details

[RFC4271](#) has defined an AS number as a two-octet entity in BGP. [RFC4893](#) has defined an AS number as a four-octet entity in BGP.

The first vulnerability could cause an affected device to reload when processing a BGP update that contains AS path segments made up of more than one thousand autonomous systems. If an affected 4-byte AS number BGP speaker receives a BGP update from a 2-byte AS number BGP speaker that contains AS path segments made up of more than one thousand autonomous systems, the device may crash with memory corruption, and the error "%Software-forced reload" will be displayed.

The following three conditions are required for successful exploitation of this vulnerability:

- Affected Cisco IOS Software device is a 4-byte AS number BGP speaker
- BGP peer/neighbor is a 2-byte AS number BGP speaker



# Common Questions

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## *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

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## *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

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



# Common Questions

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

**Calm down!**



# Common Questions

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

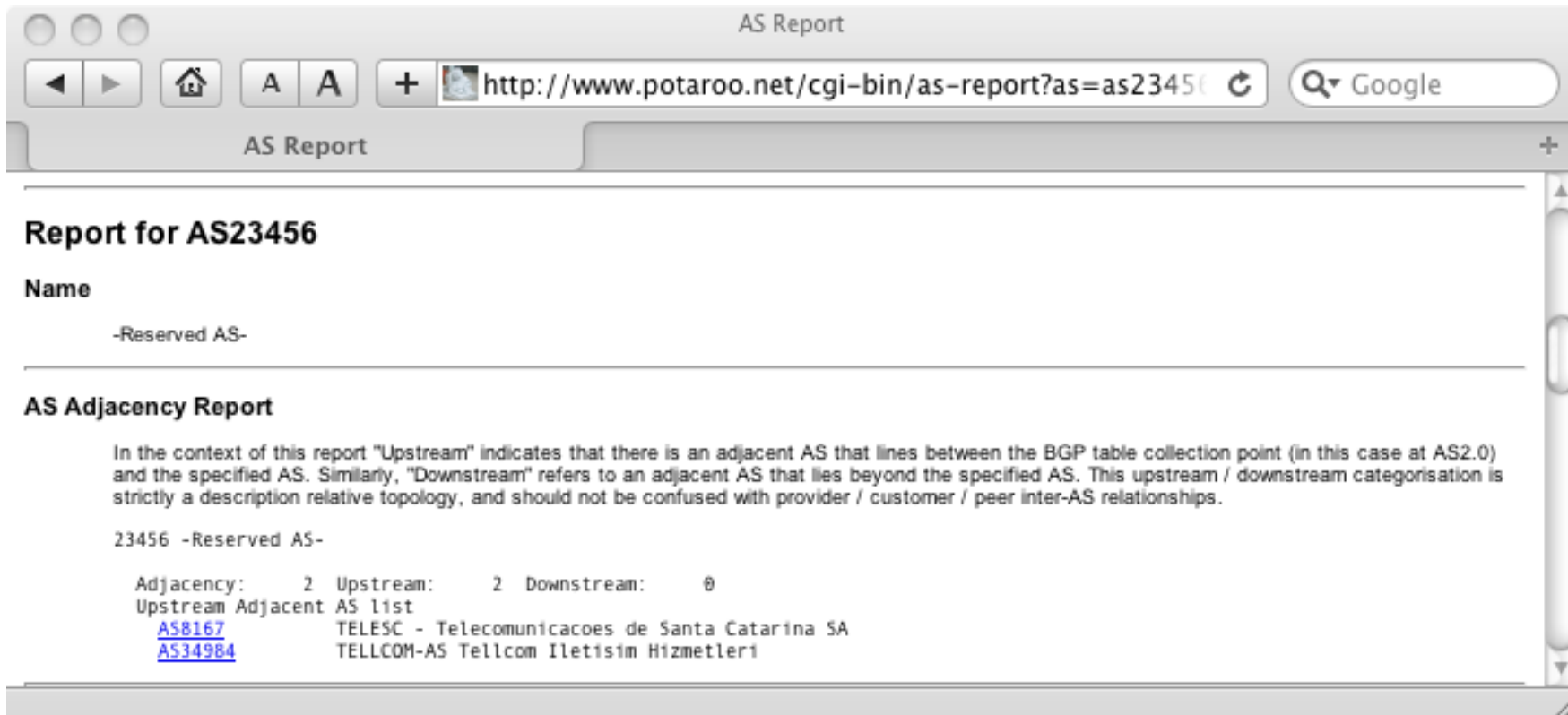
It may be abnormal, but its not fatal

```
Terminal — ssh — 131x21
[gih@wattle /var/data/bgp/as2.0]$ grep 23456 bgptable.txt
* 94.102.0.0/20 203.119.76.3 0 4608 1221 4637 3549 9121 34984 23456 i
* 94.102.0.0/20 202.12.28.190 0 4777 2516 3549 9121 34984 23456 i
* 95.173.160.0/19 203.119.76.3 0 4608 1221 4637 174 34984 34984 34984 23456 i
* 95.173.160.0/19 202.12.28.190 0 4777 2497 781 1299 9121 34984 23456 i
* 187.63.208.0/20 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.208.0/20 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.209.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.209.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.210.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.210.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.211.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.211.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.212.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.212.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.213.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.213.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.214.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.214.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
* 187.63.215.0/24 203.119.76.3 0 4608 1221 4637 6453 8167 23456 i
* 187.63.215.0/24 202.12.28.190 0 4777 2497 6453 8167 23456 i
```



# Common Questions

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



AS Report

AS Report

## Report for AS23456

**Name**

-Reserved AS-

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**AS Adjacency Report**

In the context of this report "Upstream" indicates that there is an adjacent AS that lies between the BGP table collection point (in this case at AS2.0) and the specified AS. Similarly, "Downstream" refers to an adjacent AS that lies beyond the specified AS. This upstream / downstream categorisation is strictly a description relative topology, and should not be confused with provider / customer / peer inter-AS relationships.

23456 -Reserved AS-

Adjacency:	2	Upstream:	2	Downstream:	0
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Upstream Adjacent AS list

<a href="#">AS8167</a>	TELESC - Telecomunicacoes de Santa Catarina SA
<a href="#">AS34984</a>	TELLCOM-AS Tellcom Iletisim Hizmetleri



# Common Questions

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

It may be abnormal, but its not fatal

- 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



# 32-bit ASN Resources

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- **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](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**

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