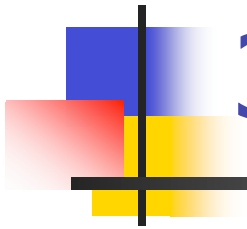
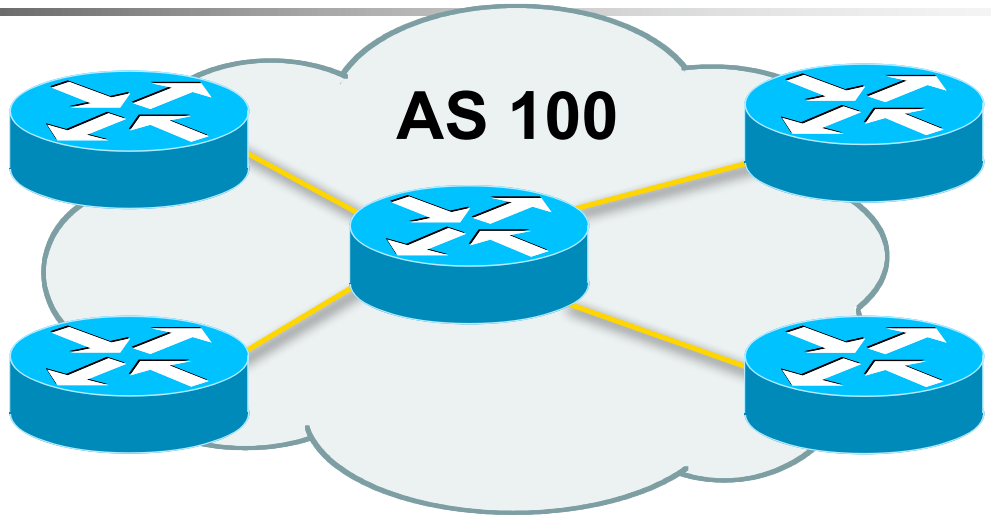


32-bit ASNs

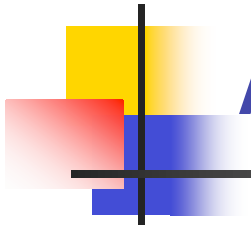
Philip Smith

MENOG 5, Beirut, 29th October 2009

Autonomous System (AS)

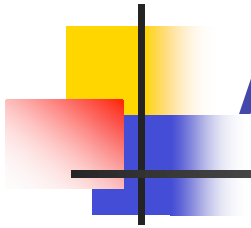


- Collection of networks with same routing policy
- Single routing protocol
- Usually under single ownership, trust and administrative control
- Identified by a unique number



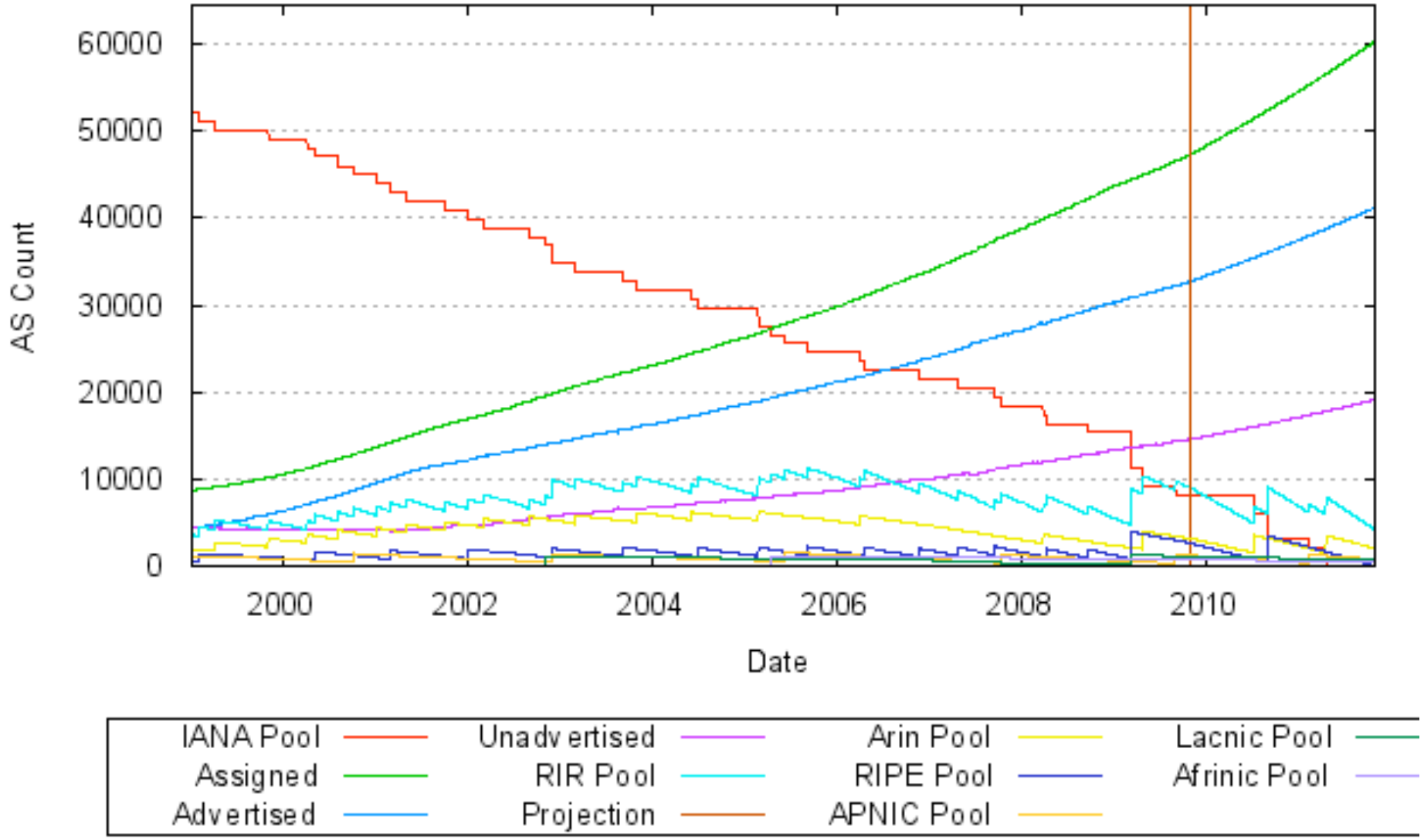
Autonomous System Number

- An ASN is a 16-bit integer
  - 1-64511 are assigned by the Regional Internet Registries
  - 64512-65534 are private ASNs and should never be used on the Internet
  - 0 and 65535 are reserved
- Current allocations up to 56319 have been made to the RIRs

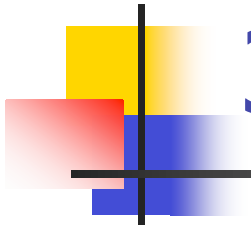


ASN status

- The pool of 16-bit ASNs will soon be exhausted
  - Analysis at http://www.potaroo.net/tools/asns/
  - Current estimates are that the 16-bit ASN pool will be exhausted in 2011
- Work started in 2001 to extend the ASN pool to 32-bits



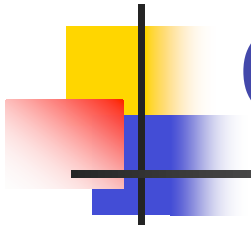
Source: http://www.potaroo.net/tools/asns/fig28.png



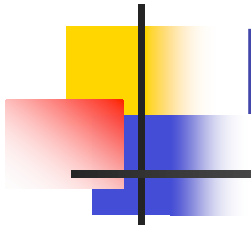
32-bit ASNs

- Standards documents
  - Description of 32-bit ASNs
    - www.rfc-editor.org/rfc/rfc4893.txt
  - Textual representation
    - www.rfc-editor.org/rfc/rfc5396.txt
  - New extended community
    - www.ietf.org/internet-drafts/draft-ietf-idr-as4octet-extcomm-generic-subtype-00.txt
- AS 23456 is reserved as interface between 16-bit and 32-bit ASN world

Getting a 32-bit ASN

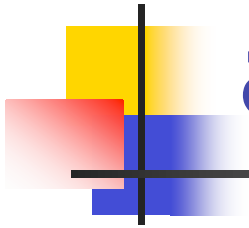


- Sample RIR policy
  - www.apnic.net/docs/policy/asn-policy.html
- From 1st January 2007
  - 32-bit ASNs available on request
- From 1st January 2009
  - 32-bit ASNs assigned by default
  - 16-bit ASNs only available on request
- From 1st January 2010
  - No distinction – ASNs assigned from 32-bit pool



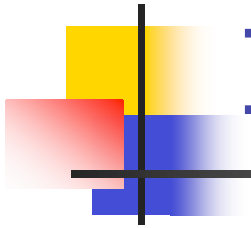
Representation

- 32-bit ASNs extend the pool:
  - 0-65535 extended to 0-4294967295
- Representation of 65536-4294967295 range
  - Most operators favour traditional format (asplain)
  - A few prefer dot notation (X.Y):
    - asdot for 65536-4294967295, e.g 2.4
    - asdot+ for 0-4294967295, e.g 0.64513
  - But regular expressions will have to be completely rewritten for asdot and asdot+ !!!



asplain vs asdot(+)

- Problem:
  - ^[0-9]+$ matches any ASN (16-bit and asplain)
  - This and equivalents extensively used in BGP multihoming configurations for traffic engineering
- Equivalent regexp for asdot is
  - ^([0-9]+)|([0-9]+\.[0-9]+)$
- Equivalent regexp for asdot+ is
  - ^[0-9]+\.[0-9]+$
- ⇒ BGP policy regular expressions will need to be rewritten

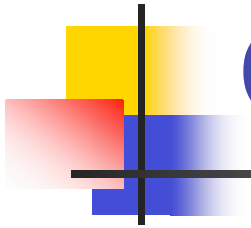


IANA Assignments

- Using dot notation for readability
- 0.0 - 0.65535 16-bit ASN block
- 2.0 - 2.1023 APNIC
- 3.0 - 3.1023 RIPE NCC
- 4.0 - 4.1023 LACNIC
- 5.0 - 5.1023 AfriNIC
- 6.0 - 6.1023 ARIN
- Remainder are reserved or held by IANA

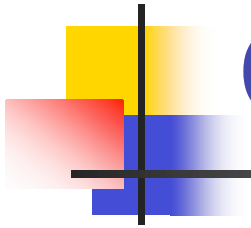
IANA Assignments (Special)

0 & 65535	Reserved
23456	32-bit ASN transition
64512 - 65534	Private ASNs
64496 - 64511	Documentation (16-bit)
65536 - 65551	Documentation (32-bit)



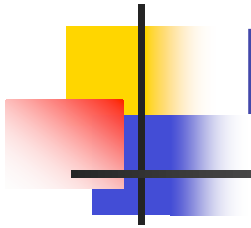
Changes (1)

- 32-bit ASNs are backwardly compatible with 16-bit ASNs
- There is no flag day
- You do NOT need to:
  - Throw out your old routers
  - Replace your 16-bit ASN with a 32-bit ASN



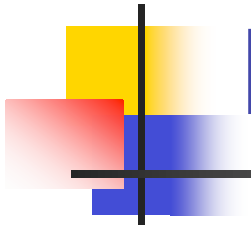
Changes (2)

- You do need to be aware that:
  - Your customers will come with 32-bit ASNs
  - ASN 23456 is not a bogon!
  - You will need a router supporting 32-bit ASNs to use a 32-bit ASN
- If you have a proper BGP implementation, 32-bit ASNs will be transported silently across your network



How does it work (1)?

- Local router only supports 16-bit ASN
- Remote router uses 32-bit ASN
- BGP peering initiated:
  - Remote asks local if 32-bit supported (BGP capability negotiation)
  - When local says “no”, remote then presents AS23456
  - Local needs to be configured to peer with remote using AS23456

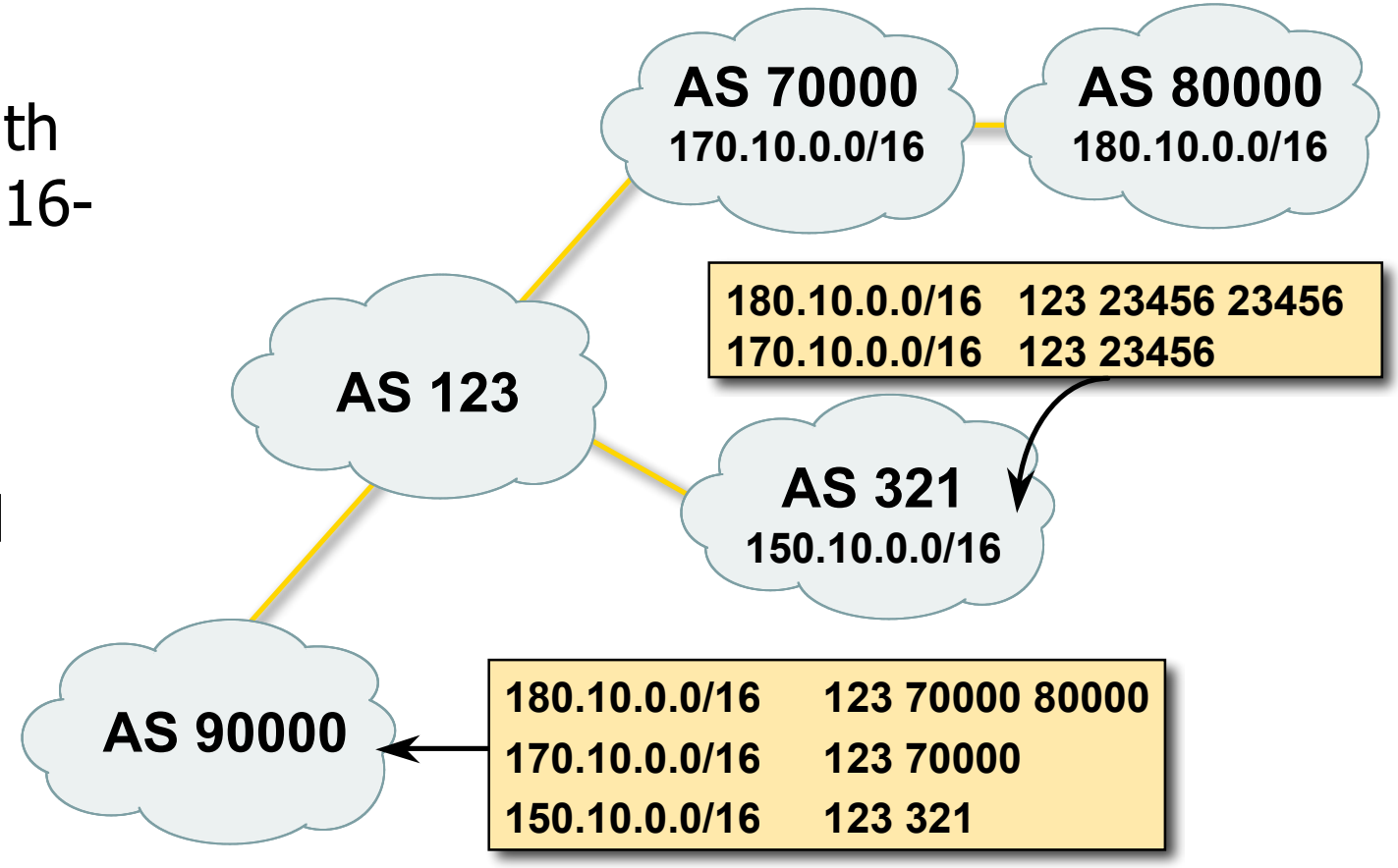


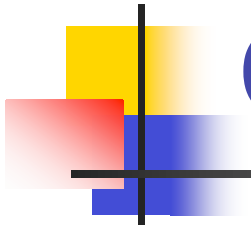
How does it work (2)?

- BGP peering initiated (cont):
  - BGP session established using AS23456
  - 32-bit ASN included in a new BGP attribute called AS4_PATH
    - (as opposed to AS_PATH for 16-bit ASNs)
- Result:
  - 16-bit ASN world sees 16-bit ASNs and 23456 standing in for 32-bit ASNs
  - 32-bit ASN world sees 16 and 32-bit ASNs

Example:

- Internet with 32-bit and 16-bit ASNs
- AS-PATH length maintained





Configuration Example (1)

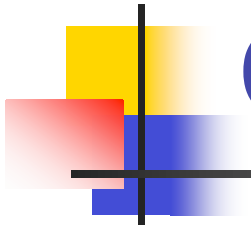
- AS70000 and AS80000 border routers:
  - Configuration on AS80000:

```
router bgp 80000
  neighbor 1.1.1.6 remote-as 70000
```

  - Configuraton on AS70000:

```
router bgp 70000
  neighbor 1.1.1.5 remote-as 80000
```

  - Both routers have to support 32-bit ASNs



Configuration Example (2)

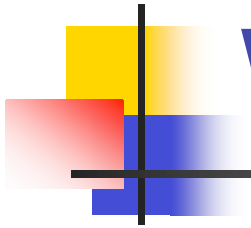
- AS123 and AS70000 border routers:
  - Configuration on AS123:

```
router bgp 123
  neighbor 1.1.1.2 remote-as 23456
```

  - Configuraton on AS70000:

```
router bgp 70000
  neighbor 1.1.1.1 remote-as 123
```

  - AS70000 router supports 32-bit ASNs
  - AS123 router does **not** support 32-bit ASNs



What has changed?

- Two new BGP attributes:
  - AS4_PATH
    - Carries 32-bit ASN path info
  - AS4_AGGREGATOR
    - Carries 32-bit ASN aggregator info
  - Well-behaved BGP implementations will simply pass these along if they don't understand them
- AS23456 (AS_TRANS)

What do they look like?

- IPv4 prefix originated by AS196613

asplain format

```
as4-7200#sh ip bgp 145.125.0.0/20
BGP routing table entry for 145.125.0.0/20, version 58734
Paths: (1 available, best #1, table default)
  131072 12654 196613
    204.69.200.25 from 204.69.200.25 (204.69.200.25)
      Origin IGP, localpref 100, valid, internal, best
```

- IPv4 prefix originated by AS3.5

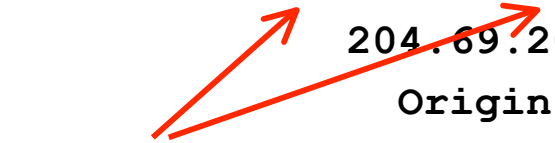
asdot format

```
as4-7200#sh ip bgp 145.125.0.0/20
BGP routing table entry for 145.125.0.0/20, version 58734
Paths: (1 available, best #1, table default)
  2.0 12654 3.5
    204.69.200.25 from 204.69.200.25 (204.69.200.25)
      Origin IGP, localpref 100, valid, internal, best
```

What do they look like?

- IPv4 prefix originated by AS196613
  - But 16-bit AS world view:

```
BGP-view1>sh ip bgp 145.125.0.0/20
BGP routing table entry for 145.125.0.0/20, version 113382
Paths: (1 available, best #1, table Default-IP-Routing-
  Table)
23456 12654 23456
    204.69.200.25 from 204.69.200.25 (204.69.200.25)
      Origin IGP, localpref 100, valid, external, best
```

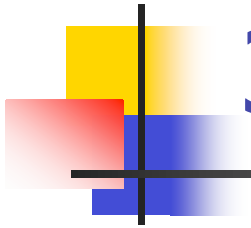


Transition AS

What do they look like?

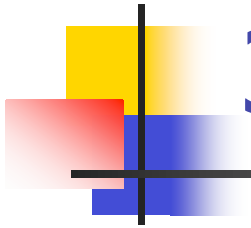
- IPv6 prefix originated by AS 2.9

```
RP/0/0/CPU0:as4byte#show bgp ipv6 unicast 2403:2000::/32
BGP routing table entry for 2403:2000::/32
Versions:
  Process              bRIB/RIB  SendTblVer
  Speaker                    93          93
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  109 6175 2497 2500 18146 2.9
    2001:420:0:8001::1 from 2001:420:0:8001::1 (204.69.200.22)
      Origin IGP, localpref 100, valid, external, best
```



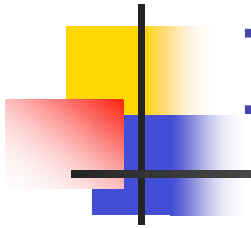
32-bit ASN not supported:

- Inability to distinguish between peer ASes using 32-bit ASNs
  - They will all be represented by AS23456
  - Could be problematic for transit provider's policy
- Inability to distinguish prefix's origin AS
  - How to tell whether origin is real or fake?
  - The real and fake both represented by AS23456
  - (There should be a better solution here!)



32-bit ASN not supported:

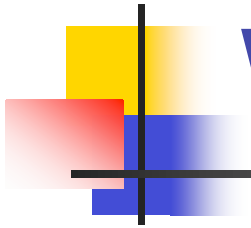
- Incorrect NetFlow summaries:
  - Prefixes from 32-bit ASNs will all be summarised under AS23456
  - Traffic statistics need to be measured per prefix and aggregated
  - Makes it hard to determine peerability of a neighbouring network



Implementations (Sept 09)

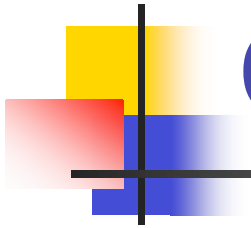
- Cisco IOS-XR 3.4 onwards
- Cisco IOS-XE 2.3 onwards
- Cisco IOS 12.0(32)S12 & 12.4(24)T
- Cisco NX-OS 4.0(1)
- Quagga (patches for 0.99.6)
- OpenBGPd (patches for 3.9 & 4.0)
- Juniper JunOSe 4.1.0 & JunOS 9.1
- Redback SEOS
- Force10 FTOS7.7.1 onwards

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



What next?

- Pester your router vendors for 32-bit ASN support
  - Do you really want to run beta software in your core network?
  - Depletion of the 16-bit pool is not far away
    - Stable software, deployment cycles &c
  - Insist your vendors support “asplain”
    - Otherwise prepare to rewrite all your regular expressions!!



Conclusion

- The Internet will not break
- Your network will not break

- If you have an ASN today:
  - You don’t need to change anything
  - 32-bit ASNs appear as AS 23456
- If you have no ASN today:
  - Your routers will need 32-bit ASN support unless you specifically ask your RIR for a 16-bit ASN