Potential Impacts of Four-Byte AS Numbers in Partial Deployment

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Outline

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- Behaviors of Path-Vector Routing
- Behaviors of Policy Routing
- Route Aggregation Concerns
- Scalability Analysis
- Conclusion

Introduction

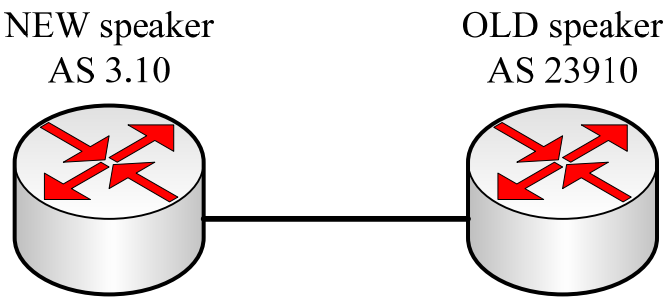
- BGP employs ASN for both its path-vector algorithm and its policy mechanism
  - e.g. *AS_PATH*, *COMMUNITY*
- ASN
  - current: 2-byte, expected to run out in 2010*
  - future: 4-byte

** G. Huston, "32-bit AS Numbers – The View From The Old BGP World", The ISP Column, Jan. 2007*

Introduction

- BGP Transition Scheme†
  - support 4-byte ASN in increment deployment
  - *NEW* speakers: 4-byte-enabled
  - *OLD* speakers: 2-byte-only

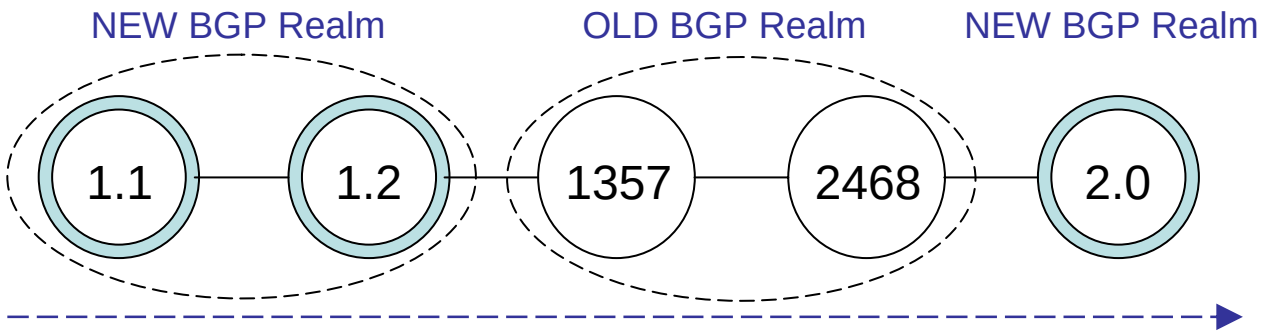
  } co-exist
  - *AS_TRANS*(AS23456) reserved
- Problems
  - robustness
  - scalability



† *Q. Vohra and E. Chen, "BGP Support for Four-Octet AS Number Space", RFC4893*

Behaviors of Path-Vector Routing

- BGP's major distance-based metric:
  - length of AS path vector
  - deny any route contains the speaker's ASN
- Routing with partially deployed 4-byte ASN
  - 2-byte-compatible ASN
  - 4-byte-only ASN → *AS4_PATH*: optional, transitive



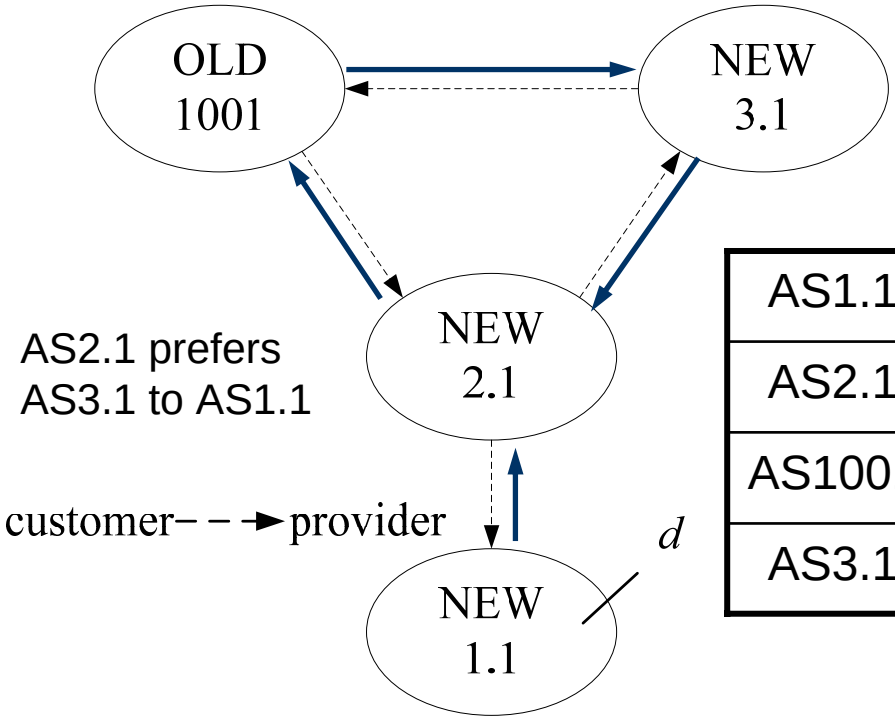
AS_PATH: 2468 1357 23456 23456

~~*AS4_PATH:* 1.2 1.1~~

Behaviors of Path-Vector Routing

- Experiment study: routing oscillation

AS1001 drops *AS4_PATH*



AS1.1	*d*
AS2.1	3.1 – 1001 – 23456 – 23456 – *d*
AS1001	23456 – 23456 – *d*
AS3.1	1001 – 23456 – 23456 – *d*

OSCILLATION!!!

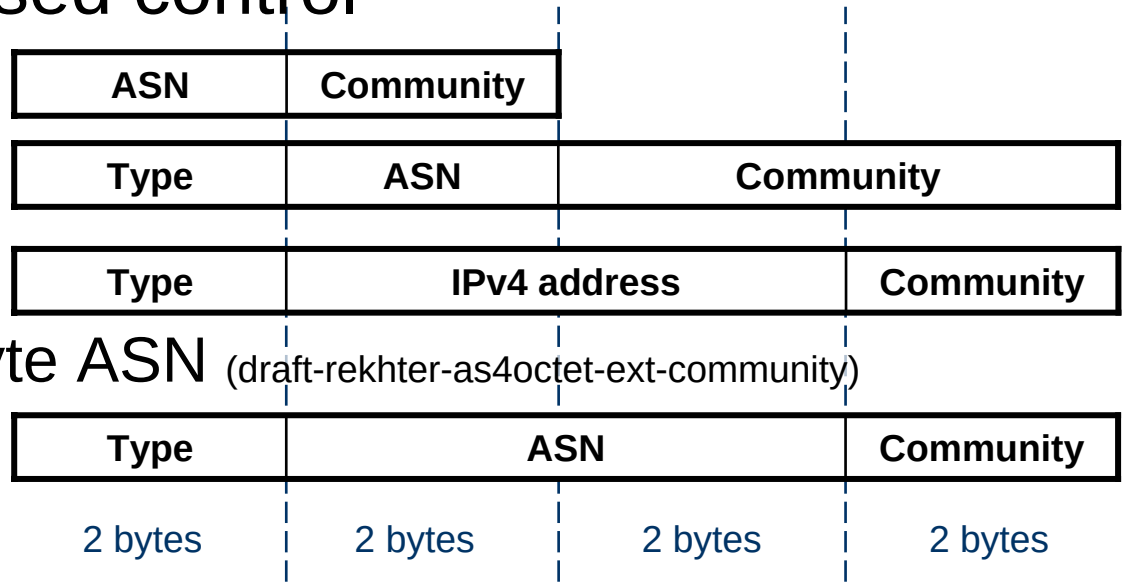
Behaviors of Policy Routing

- *AS_PATH*-based match
  - when 2 or more peers of different types (customer, peer or provider) migrate to 4-byte-only ASN, *AS_PATH*-based match for AS using OLD speakers will fail since the last hop ASN in AS_PATH will have the same value – *AS_TRANS*.
  - avoid this: using “route-map” drawback – configure at the granularity of link rather than AS

Behaviors of Policy Routing

- *COMMUNITY*-based control
  - original (RFC1997)
  - extended

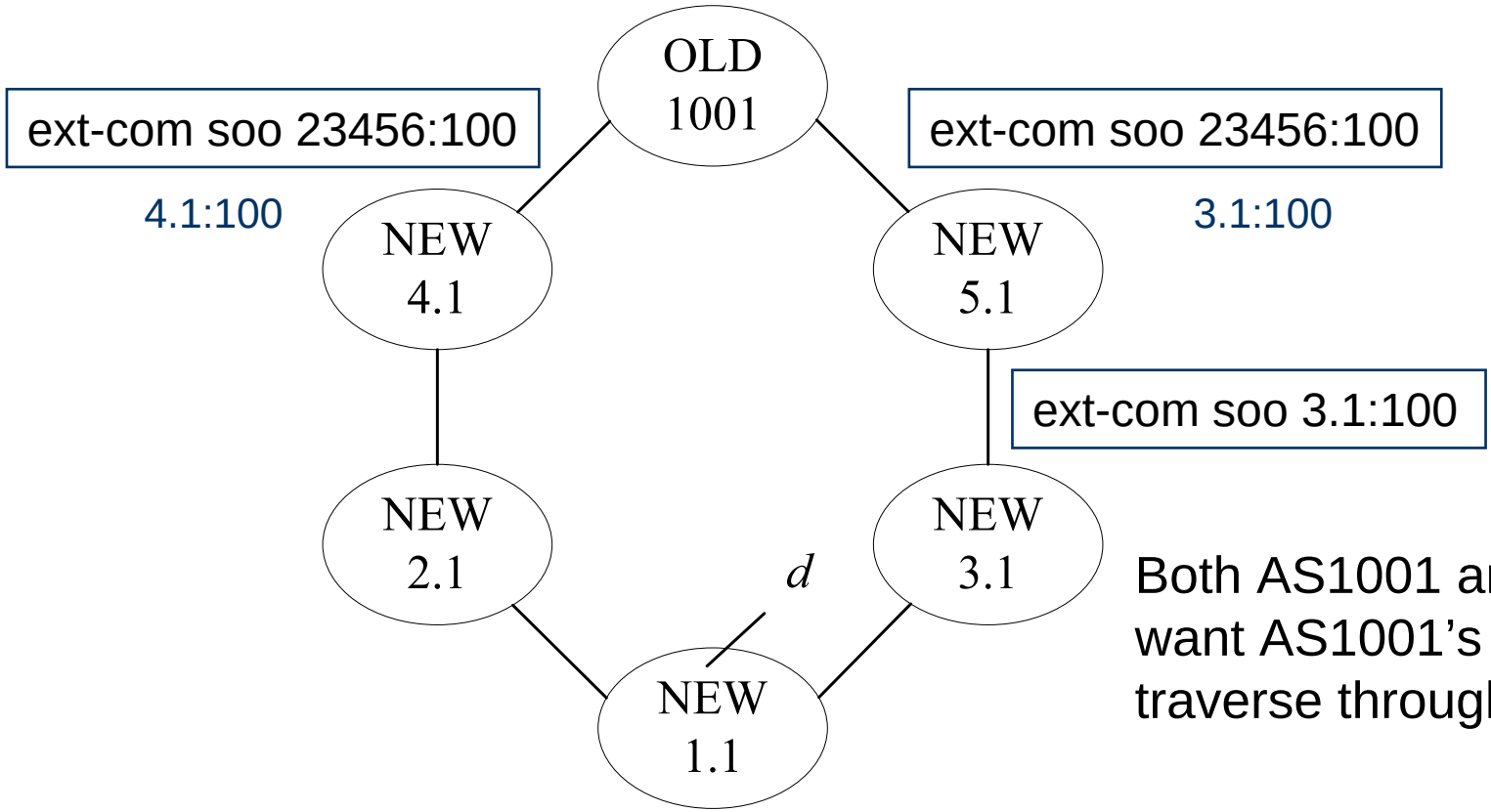
    (RFC4360)
  - extended for 4-byte ASN (draft-rekhter-as4octet-ext-community)



- Problems
  - no standard specifying co-operation and transition issues of extended community
  - current best solution have problems on OLD speakers

Behaviors of Policy Routing

- Experiment study: community control



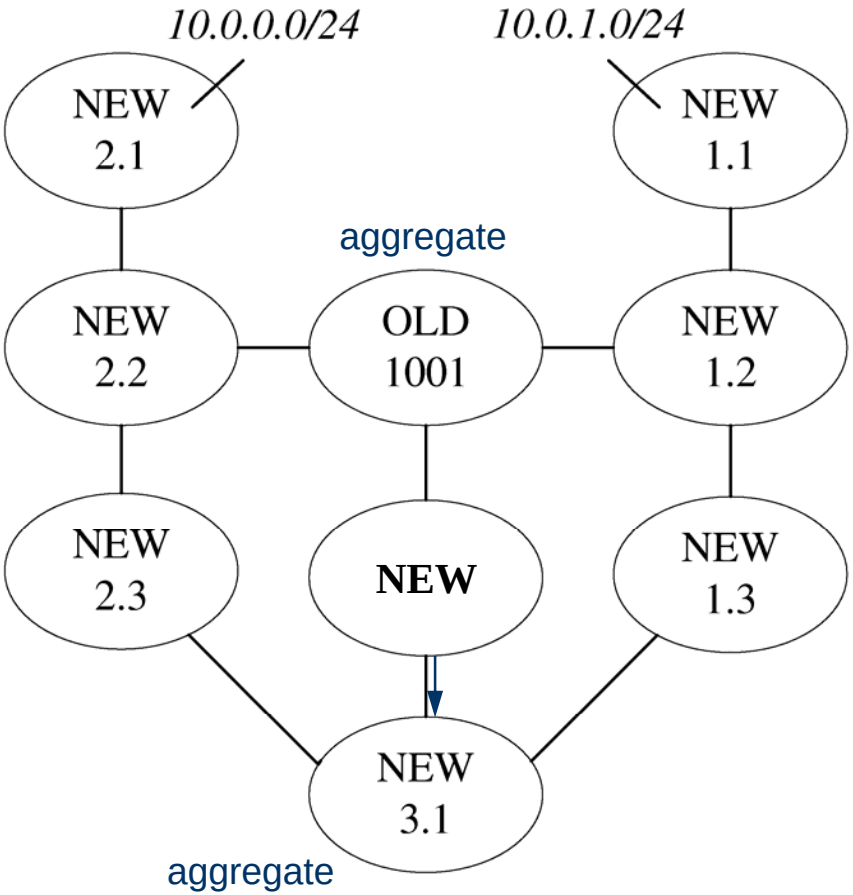
Both AS1001 and AS3.1 want AS1001's traffic to *d* traverse through AS3.1

Route Aggregation Concerns

- Aggregating routes:
  - speakers will generate a new *AS_PATH* attribute according to their knowledge to those routes to be aggregated
  - NEW and OLD speakers will generate different new *AS_PATH* if those routes traverse through different AS using 4-byte ASN

Route Aggregation Concerns

- Experiment study: route aggregation



next-hop	AS1001
1001 – 23456 – 23456	
next-hop	AS23456
23456 {1, 23456, 23456}	
23456, 23456, 23456}	

Summary

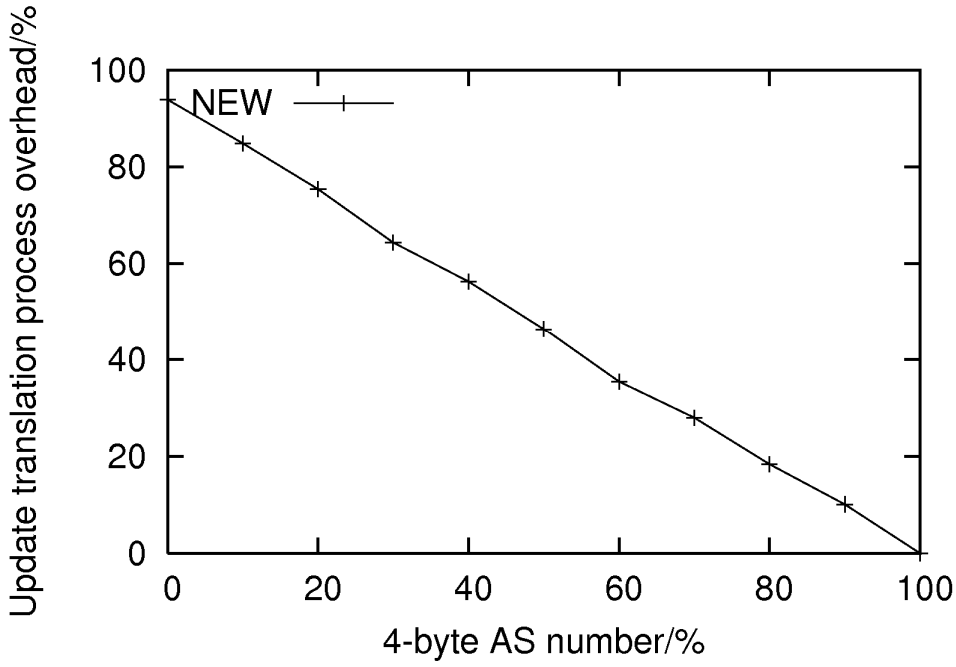
- Protocol Level Analysis

Effects of ASN Related Issues

Speakers	OLD	NEW (2-byte-compatible ASN)	NEW (4-byte-only ASN)
Loop detection	Y	N	Y
AS_PATH-based match	Y	N	N
COMMUNITY-based control	Y	N	Y
Route aggregation	Y	N	N
ASN pre-pending	N	N	N

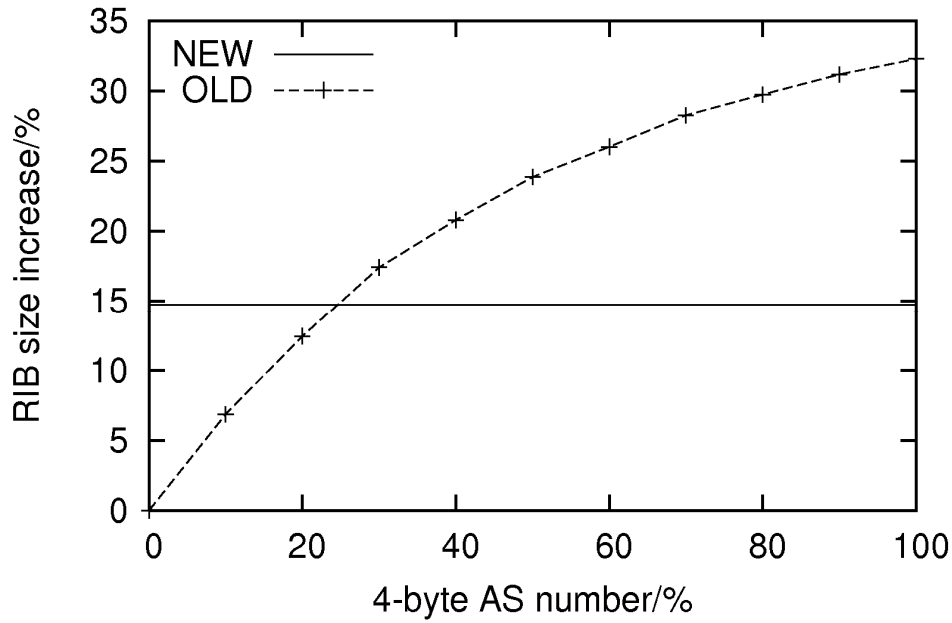
Scalability Analysis

- Processing overhead
  - NEW speakers need to do more calculate for sending and receiving updates to and from OLD speakers, to translate and reconstruct 4-byte ASN information



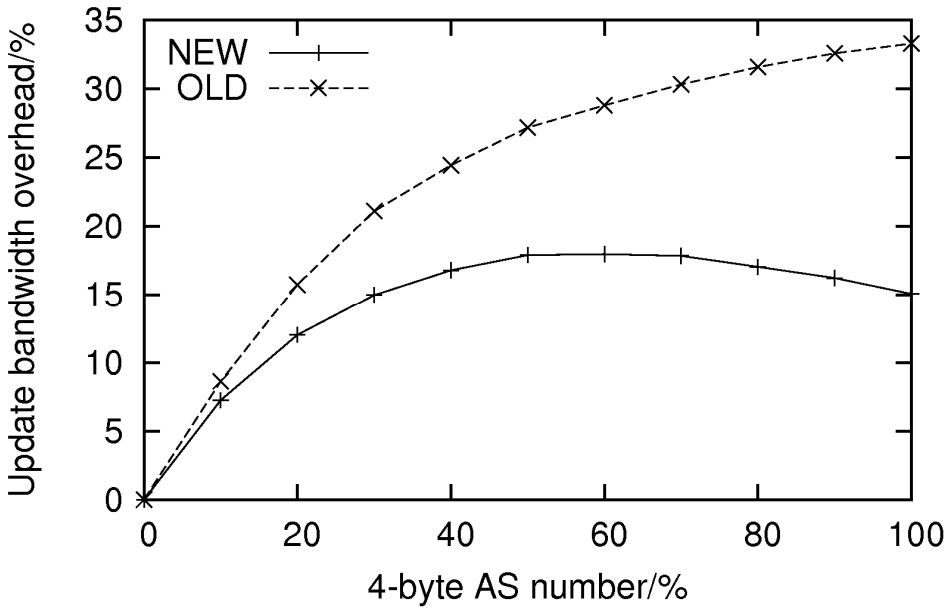
Scalability Analysis

- Memory consumption
  - the size of RIBs on both NEW and OLD speakers will increase as 4-byte ASN are stored, instead of 2-byte ones on NEW, and along with 2-byte ones on OLD



Scalability Analysis

- Bandwidth consumption
  - as update packets containing 4-byte ASN, they will consume more bandwidth for sending and receiving update packets than before



Conclusion

- The practice of the protocol
  - most of the problems are attributable to ASN lost their abilities to identify a dedicated AS
  - some are caused by new formats introduced
- Scalability
  - severer to OLD speakers than NEW ones in the long term
  - mainly due to the nature of doubled size of the format of ASN

Conclusion

- From now on
  - both vendors and network operators working with BGP speakers should be careful when dealing with routing with partially deployed 4-byte ASN
- Future
  - we expect detailed guidelines will be brought forward
  - detailed evaluation of routing security with 4-byte ASN in partial deployment may be required

THANK YOU!

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