AS Numbers

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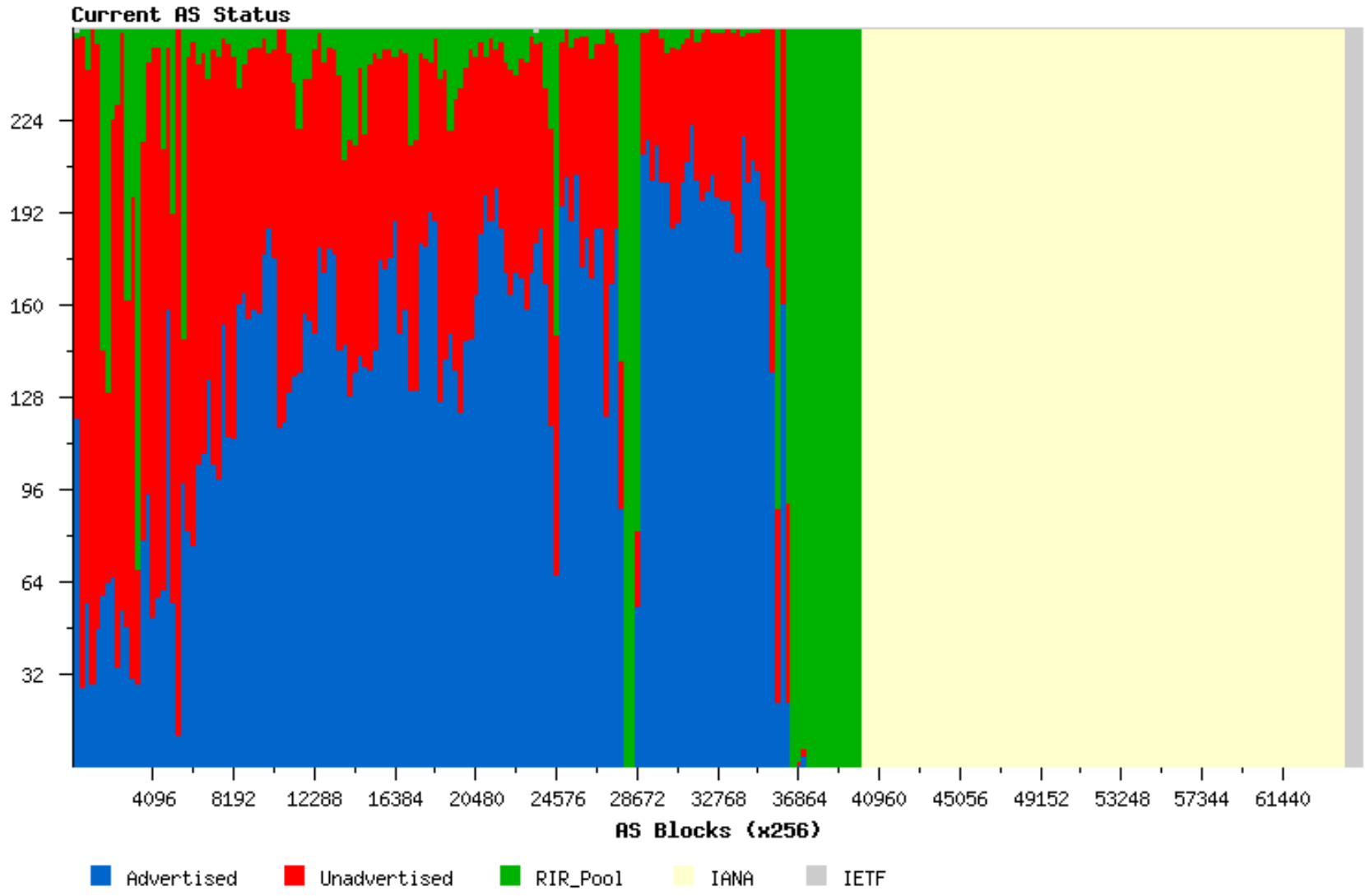
APNIC

Current AS Number Status



AS Numbers

- The 16 bit AS number field in BGP has **64,510** available values to use in the Internet's public routing space
- Some **39,934** AS numbers have already been assigned by the RIRs
- **24,576** AS Numbers remain in the unallocated number pool

This Presentation:

1. **When** will we run through the remaining AS number pool?

2. **What** is the replacement proposal?

3. **How** does transition work? What are the impacts to current operations?

1. When?

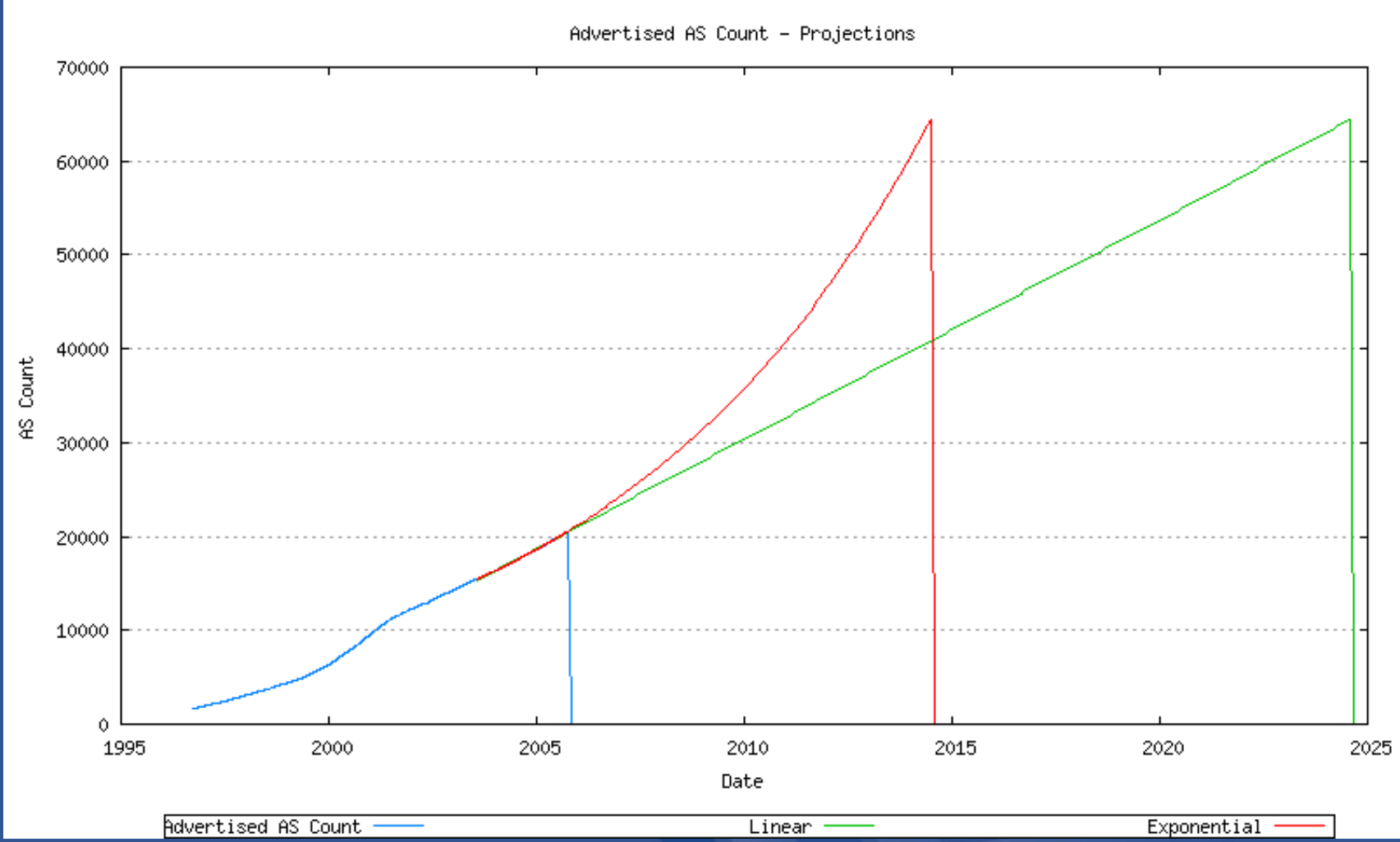
- Assemble data sets of daily snapshots:
  - Advertised AS count
  - RIR Assigned AS count
  - IANA Assigned AS Blocks count
  - Inferred Unadvertised AS count

- Use previous 1000 days to derive best fit model to advertised and unadvertised AS sequences

Assumptions in this model

- No recovery of unused ASs
  - Not clear what the cost / benefit of any such recovery may be
  - This model assumes that there is no initiated effort of unused AS number recovery
- Constant drivers for AS number demands
  - No saturation point for AS Numbers
  - No disruptive change in the use of AS Numbers
  - Constant business drivers for AS number consumption
- No ‘rush’ on remaining AS numbers
  - No scarcity induced rush on remaining AS number pools, and no change in RIR AS allocation policies

Advertised AS Count Projections



Linear or Exponential Trend?

Exponential model has lower error to existing data

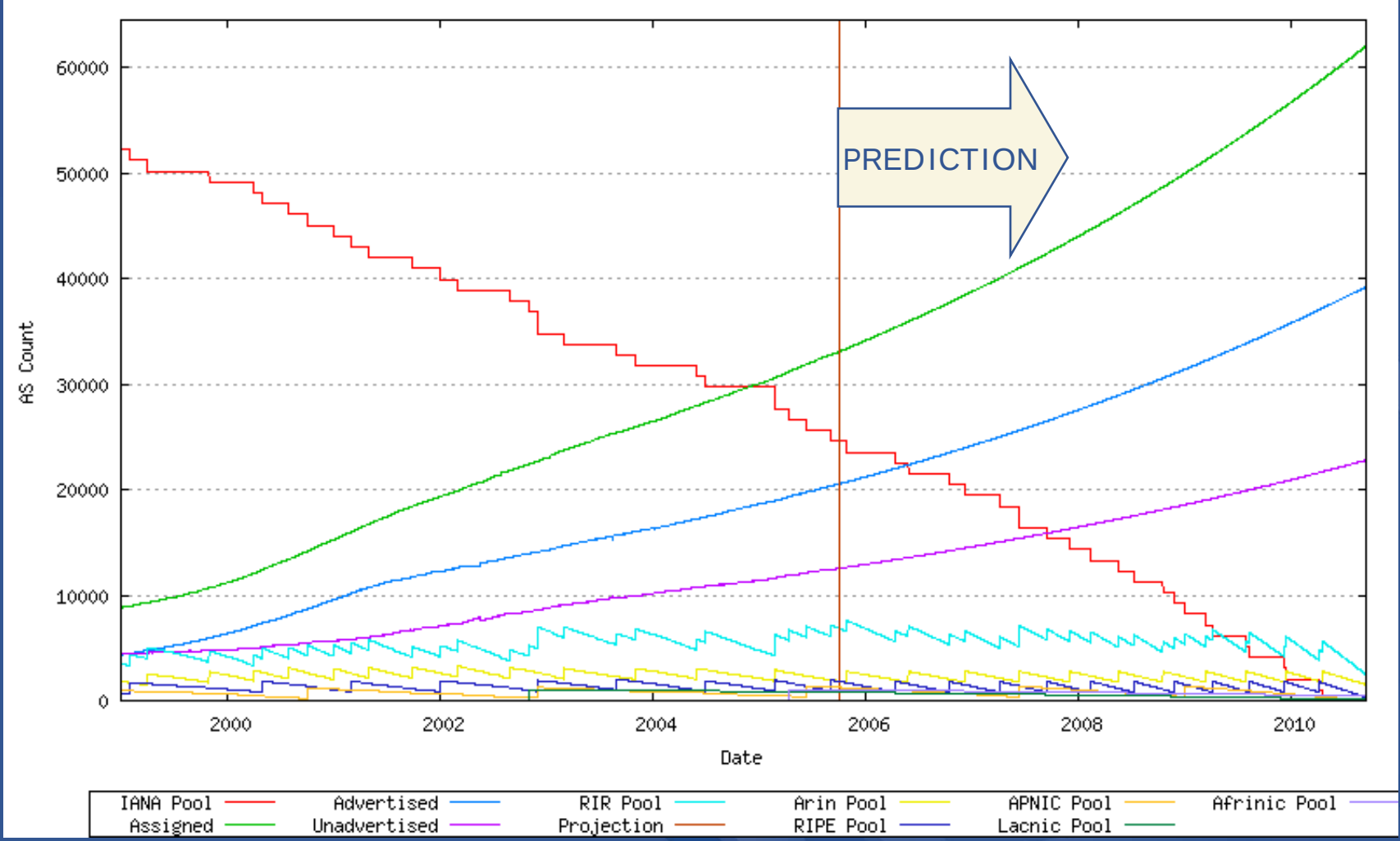
Observations

- Old (low) AS number ranges have the highest unannounced / announced ratios
- AS numbers age out and disappear
  - 5% attrition rate per year
- Recent assignments take some 4 months to be advertised
  - LIR staging point factors

Generating an AS Consumption Model

- Attempt to predict the point when the first RIR is unable to meet a request for an AS number from its pool of useable AS numbers
  - Use Exponential growth model for **advertised** AS numbers
  - Use a linear model of the **unadvertised / advertised ratio** projection
  - Use recent RIR allocation rates to determine **relative consumption** in the model
  - Generate RIR Pool consumption model based on low water thresholds for IANA allocation point
  - Model the RIR pool behaviour and look for the point when the RIR pool is exhausted and there is no further IANA resource to allocate to the RIR

AS Number Consumption Model



Current AS Use Projections

- The model predicts that the available AS number pool will exhaust in the timeframe of **late 2010** (17 September 2010)

  Assumes:

  - No significant reclamation of unadvertised AS's from the allocated AS number space
  - No change in RIRs' AS assignment policies
  - Steadily increasing consumption trend
  - No 'last change rush' on remaining AS numbers

2. What?

- Expand the size of the AS Number pool from 65,536 to 4,294,967,296 values
- Use a 32 bit (4-Byte) field for this value
  - draft-ietf-idr-as4bytes-11.txt describes how
- Carry all AS numbers using 4-Byte fields in BGP messages
  - AS_PATH, AGGREGATOR
- This is proposed for publication as Proposed Standard
  - Two independent implementations (Juniper, Redstone) have been tested for interoperation – proposal now on the path to Proposed Standard within the IETF

3. How?

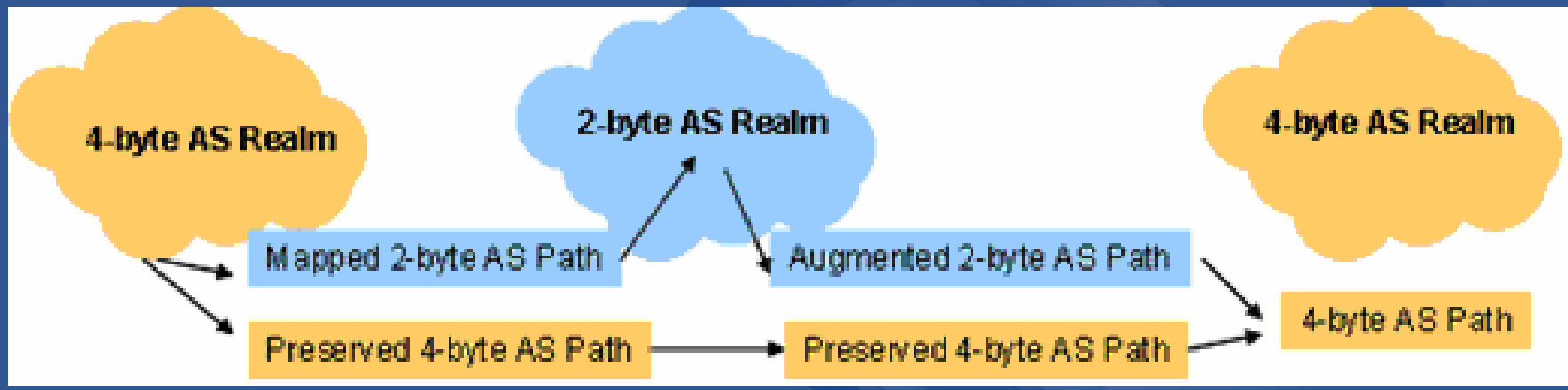
- Existing BGP speakers do not need to upgrade their BGP implementation
- BGP speakers in AS's using 4-Byte ASNs will need to deploy NEW (4-Byte) BGP
- At some point we will need to
  - start field testing various transition plans and vendor implementations,
  - set up a new AS number registry,
  - commence RIR assignments of 4-Byte AS Numbers
  - commence deployment of these extended length protocol objects in BGP
  - phase out RIR assignments of 2-Byte AS Numbers

The 4-Byte Proposal

- Objective
  - Change as little as possible in the BGP spec
  - Be ‘backward compatible’ with 2-Byte BGP implementations
  - Preserve AS semantics
    - Preserve loop detection capability
    - Preserve AS Path length metric
  - No ‘flag day’
    - Allow 2-Byte implementations to continue to operate indefinitely in a mixed 2 / 4-Byte AS world

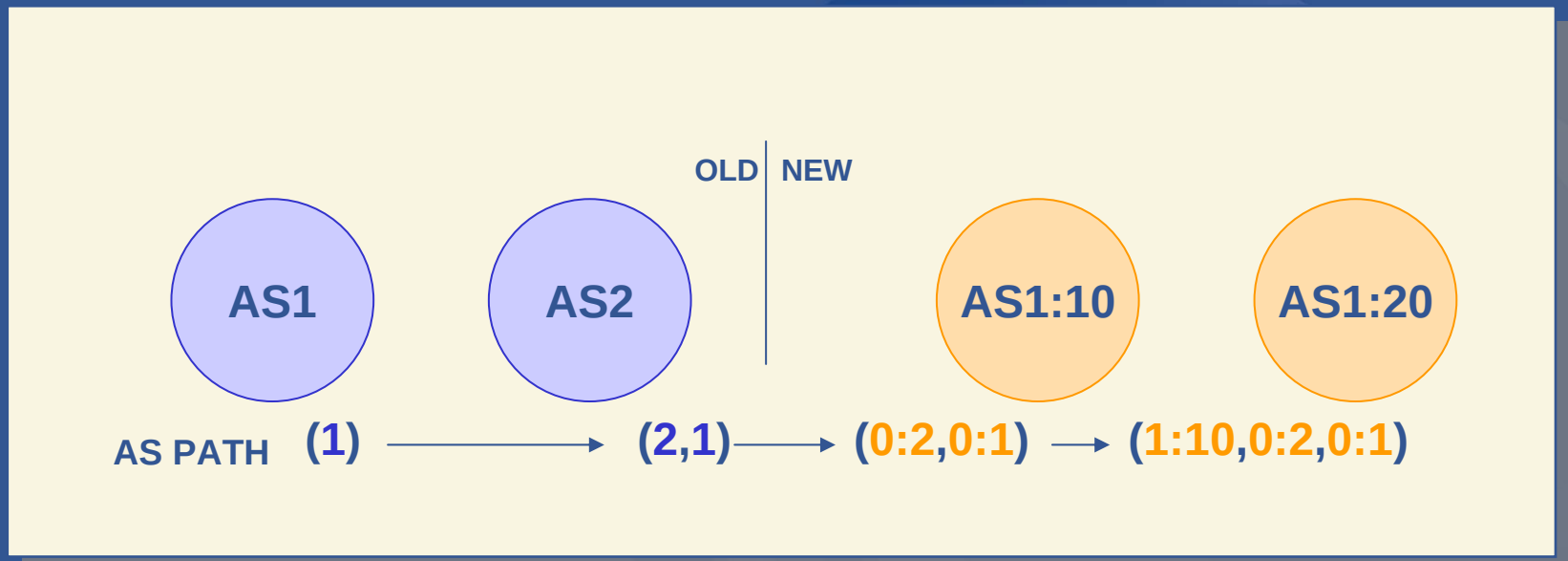
4-Byte AS Transition

- 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** 4-Byte AS Path information into a 2-Byte representation
  - **Tunnel** 4-Byte AS Path information through 2-Byte AS domain



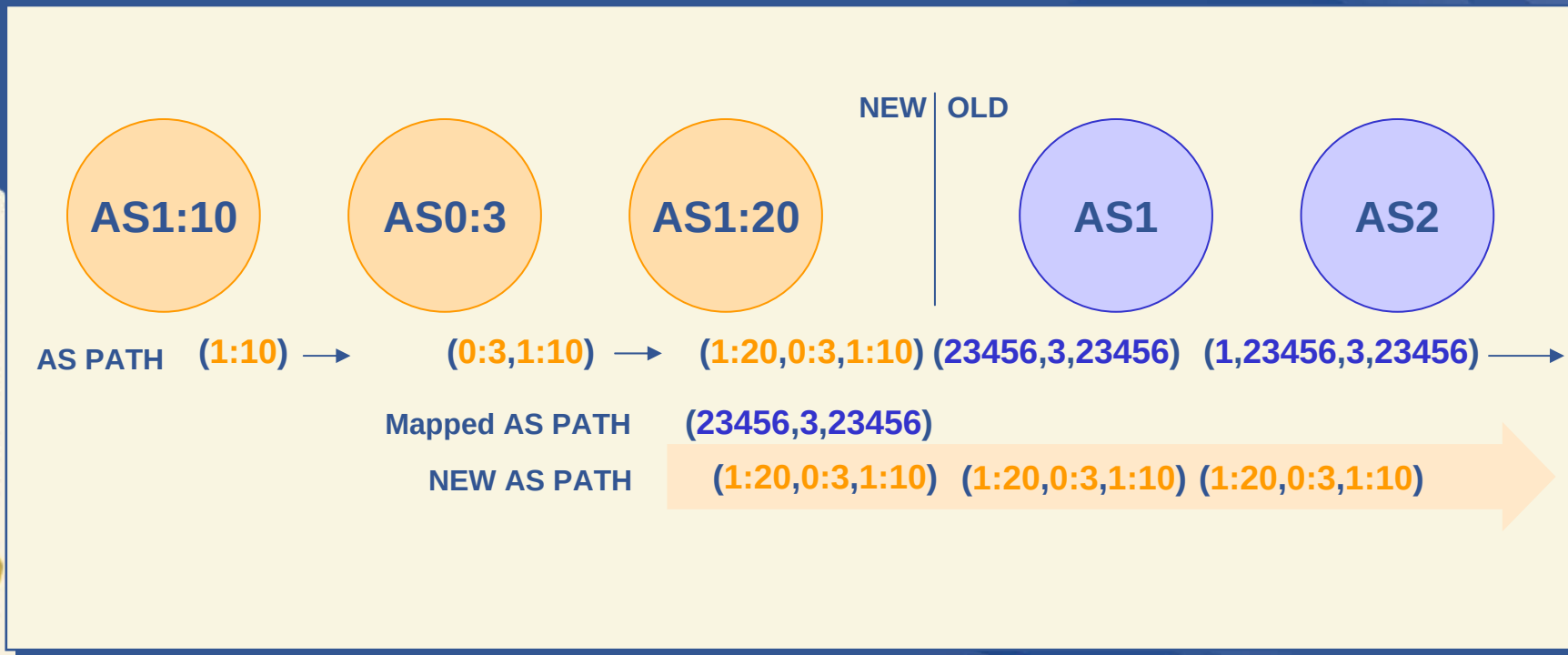
BGP session behaviour

- OLD to NEW transition
  - Map 2 to 4 with zero padding (*)



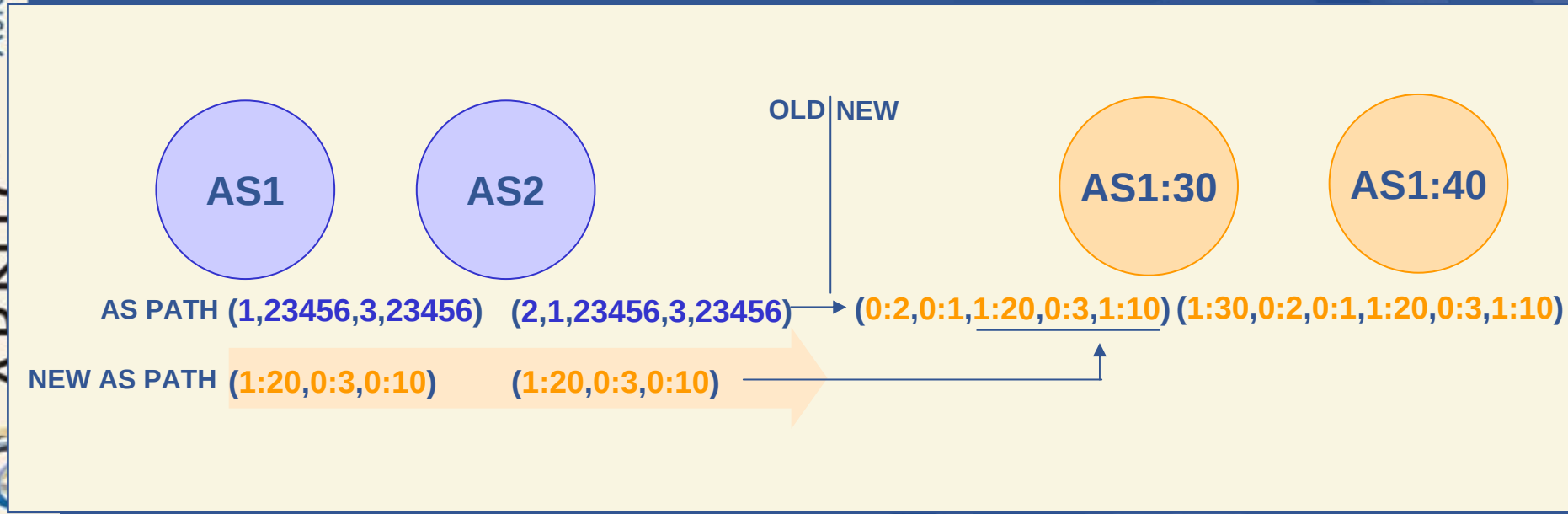
BGP sessions

- NEW to OLD transition
  - Save 4-Byte AS path in NEW_AS_PATH attribute
  - Map all 4-Byte AS's to 2-Byte equivalent
    - (either strip leading 0's or replace with AS 23456)



BGP sessions

- OLD to NEW transition with NEW AS PATH
  - Map 2 to 4 with zero padding
  - Rewrite trailing entries from NEW_AS_PATH



Implications

- BGP speakers in 2-Byte AS domains
  - Must support NEW_AS_PATH as a transitive opaque community attribute
  - Can continue with OLD code indefinitely
  - May run NEW code
- BGP speakers in 4-Byte AS domains
  - Must run NEW code

Observations

- Need to support BGP Extended Communities to specify a 4-Byte AS in community attributes
- No third-party ‘on the wire’ decode of BGP messages unless the initial capability negotiation is visible
  (no ‘on-the-wire’ flag for 4-Byte sessions)
- Cannot flick from “2-Byte OLD” to “4-Byte NEW” mode within an active BGP session
  A single BGP speaker could in theory simultaneously be a NEW and an OLD speaker in different sessions, but this is not required in the specification
- Generation of NEW_AS_PATH is not always required on NEW to OLD transition
  Only generated when there are non-mappable AS entries in the 4-Byte AS Path

The AS Number Report

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

Paper

http://www.potaroo.net/ispcol/2005-08/