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Riad Mazloun, Marc-Olivier Buob, Jordan Auge, Bruno Baynat, Timur Friedman, et al.. On multi-exit routings and AS relationships. ISMA 2013 - 5th AIMS Workshop, Feb 2013, San Diego, United States. hal-01698837

**HAL Id: hal-01698837**

**<https://hal.science/hal-01698837>**

Submitted on 2 Feb 2018

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# On multi-exit routings and AS relationships

**Riad Mazloum**, Marc-Olivier Buob<sup>1</sup>, Jordan Augé<sup>1</sup>, Bruno Baynat<sup>1</sup>, Timur Friedman<sup>1</sup> and Dario Rossi<sup>2</sup>

<sup>1</sup>UPMC, France

first.last@lip6.fr

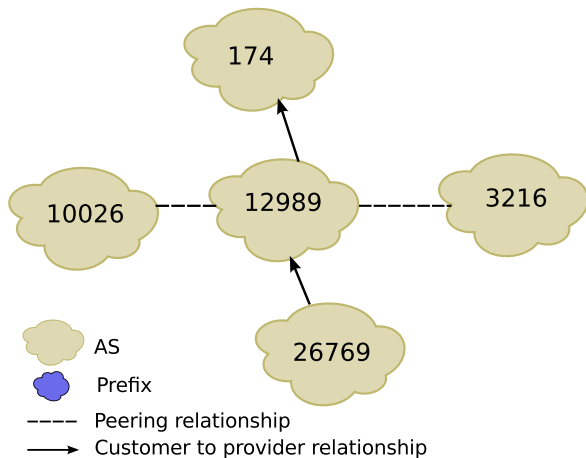
<sup>2</sup>Telecom ParisTech, France

dario.rossi@enst.fr

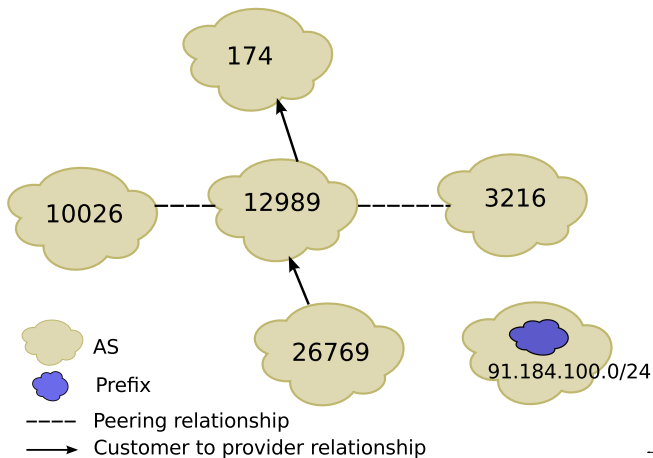
February 06th, 2013 – ISMA 2013 AIMS 5



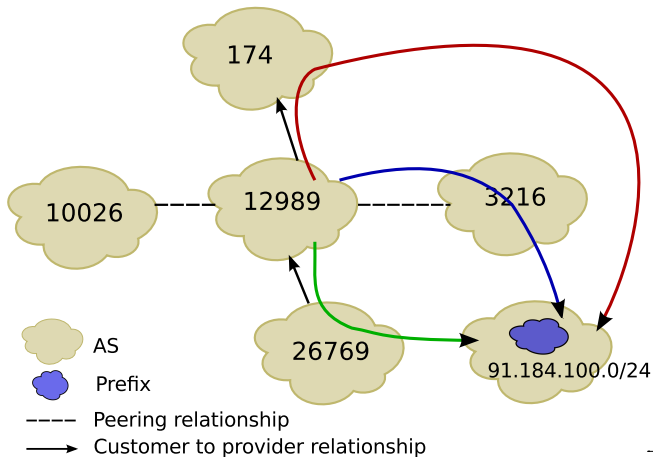
# Internet routing example



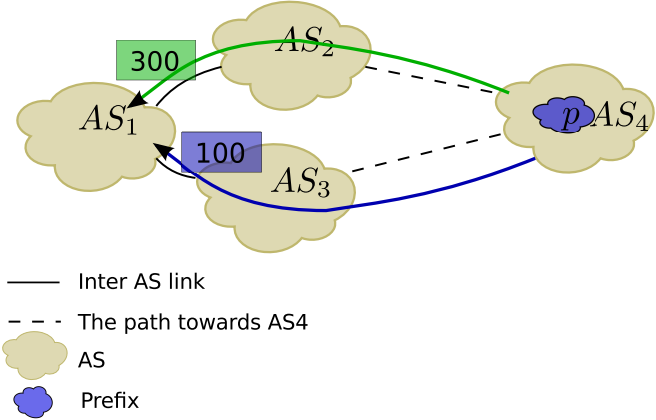
# Internet routing example



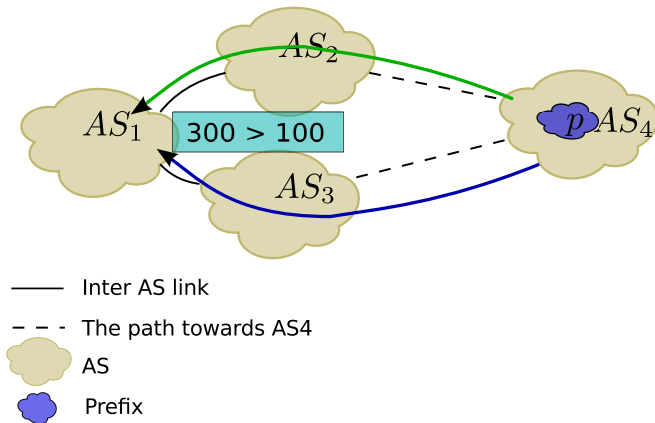
# Surprising observations



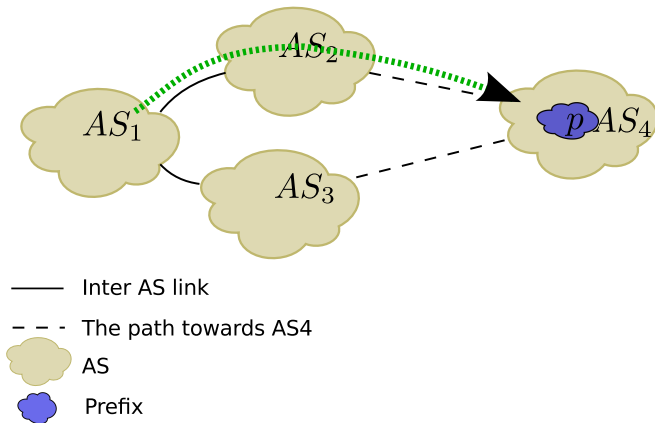
# BGP route with higher LP



## A route has a higher LP

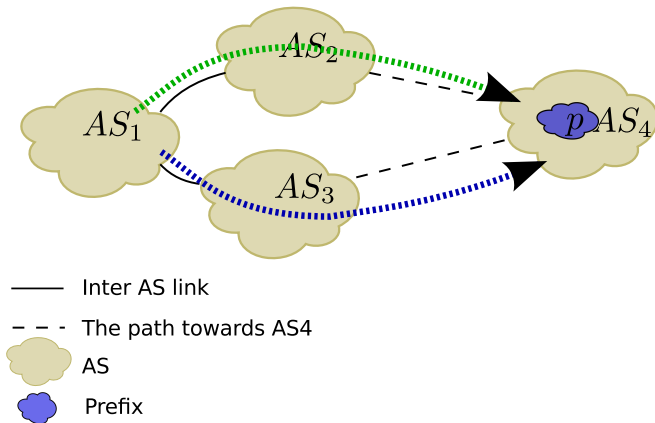


## Single next-hop AS

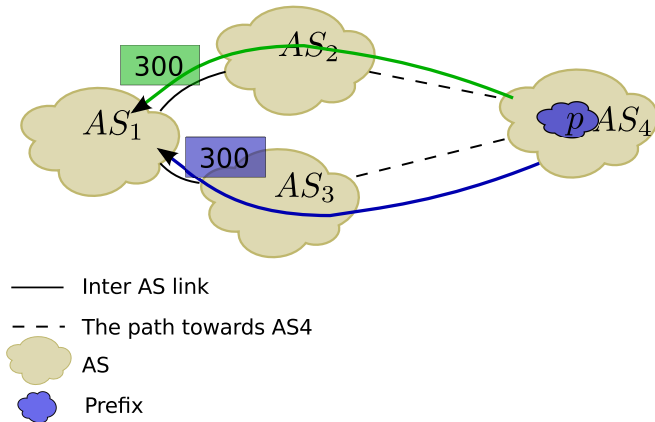




## Multi next-hop ASes



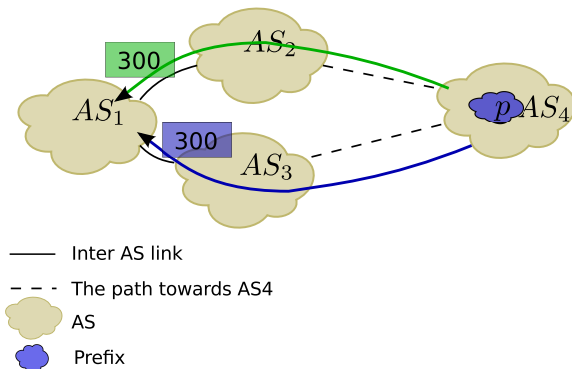
## Equal LP for all next-hop ASes



# Observed ME $\implies$ equal LP for next-hop ASes

Observed ME  $\implies$  equal LP (ME)

$$ME(AS_1, p) = \{AS_2, AS_3\} \implies LP_{AS_1}(AS_2) = LP_{AS_1}(AS_3)$$



## Implementation of AS economical policies

Observed ME  $\implies$  equal LP (ME)

$$ME(AS_1, p) = \{AS_2, AS_3\} \implies LP_{AS_1}(AS_2) = LP_{AS_1}(AS_3)$$

Implementation of AS economical policies (POLICY)

*client > peer > provider*

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## (ME) + (POLICY)

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## (ME) + (POLICY)

$ME(AS_1, p) = \{AS_2, AS_3\} \implies$  same type of relationship between  $AS_1$  and  $AS_2, AS_3$

## Does it work?

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Check with CAIDA's inference dataset

- Get types of relations of cases such between  $AS_1$  and  $AS_2, AS_3$  from CAIDA's inference dataset
- Check whether all of the next-hop ASes have the same relationship



## Does it work?

(ME) + (POLICY)

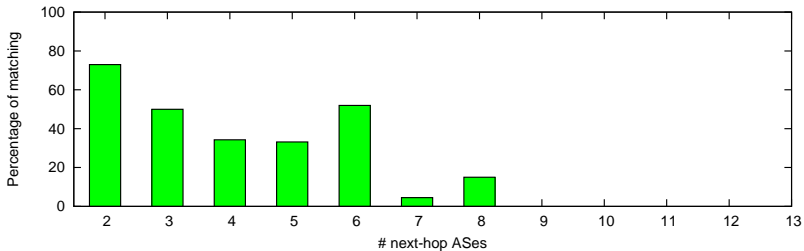
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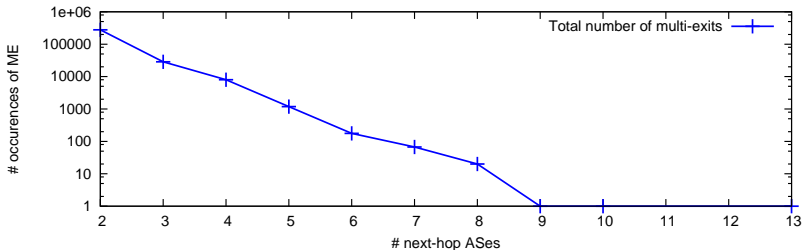
- Get types of relations of cases such between  $AS_1$  and  $AS_2, AS_3$  from CAIDA's inference dataset
- Check whether all of the next-hop ASes have the same relationship
- About **70% matching** **30% mismatching**

# Multi-exit occurrences and relationship matching

Percentage of matching between multi-exit nex-hop relationships and CAIDA inference



Occurrences of multi-exit routing



# Data

Multi-exit discovery:

- BGP: BGPmon, Colorado State University project<sup>1</sup>

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<sup>1</sup><http://bgpmon.netsec.colostate.edu/>

<sup>2</sup><http://www.top-hat.info/>

<sup>3</sup><http://www.team-cymru.org/Services/ip-to-asn.html>

<sup>4</sup><http://www.caida.org/data/active/as-relationships/>

# Data

## Multi-exit discovery:

- BGP: BGPmon, Colorado State University project<sup>1</sup>
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AS relationships:

- CAIDA AS relationship inference database<sup>4</sup>

Our data is available on request.

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## Discussion

Observed ME  $\implies$  equal LP (ME)

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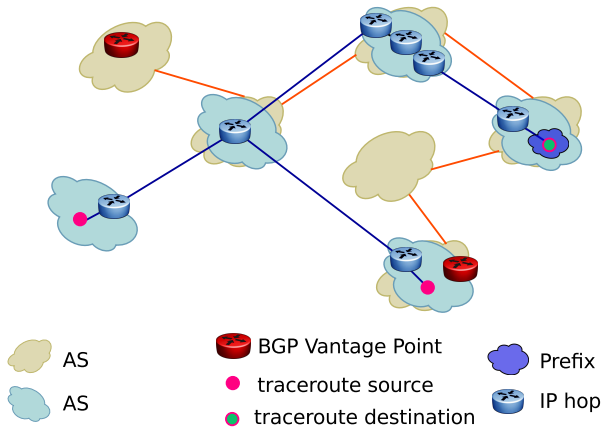


## Have another ideas?

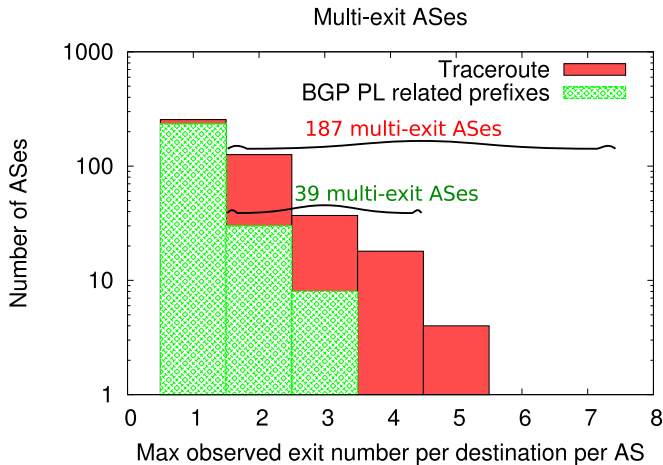
- Feedback about the problem and the analysis process
- Get confirmation about the results (we don't have a ground truth of AS relationships)
- Possible collaborations

Reserved slides...

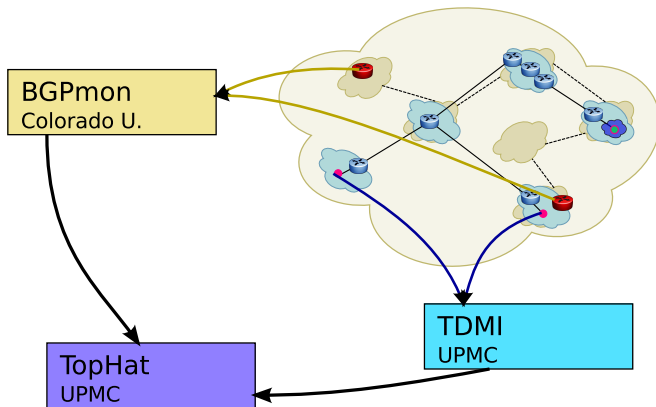
# BGP and IP overlap

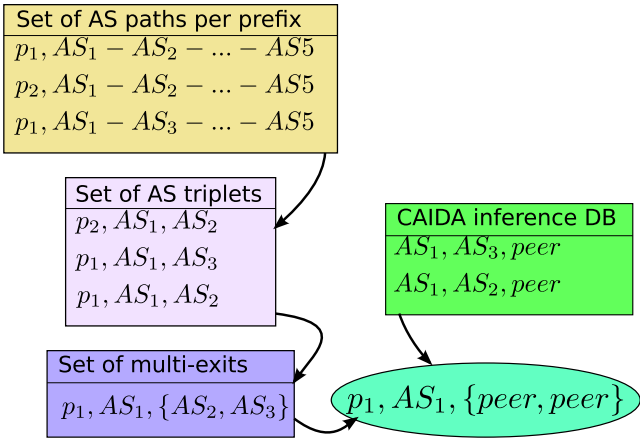


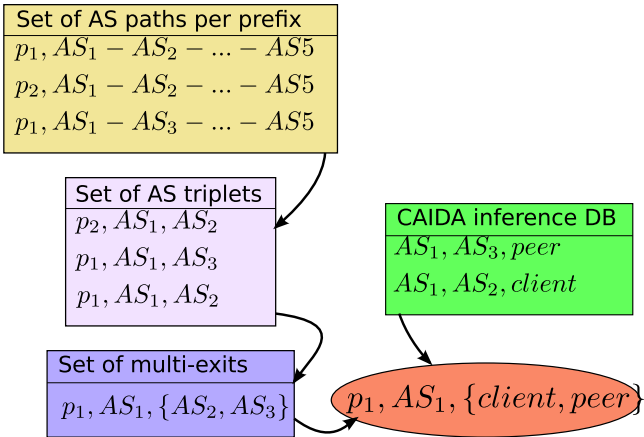
# Multi-exit routing, BGP and IP results

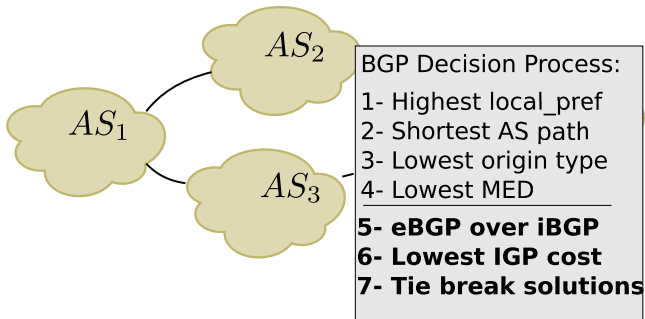




# TopHat interconnection



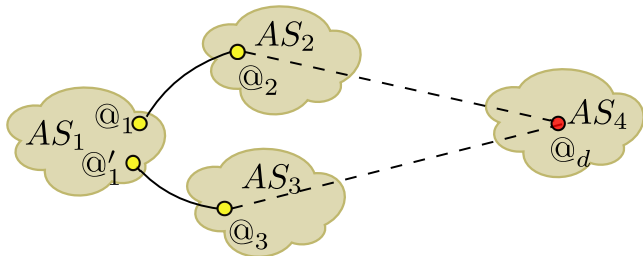









- Inter AS link
- - - Continuation of the link to the announcing AS
-  An Autonomous System (AS)
-  The destination prefix  $p$





- Inter AS link
- - - Continuation of the link to the announcing AS
-  An Autonomous System (AS)
-  IP Hop  $@_i$
-  The destination IP address  $@_d$