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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>

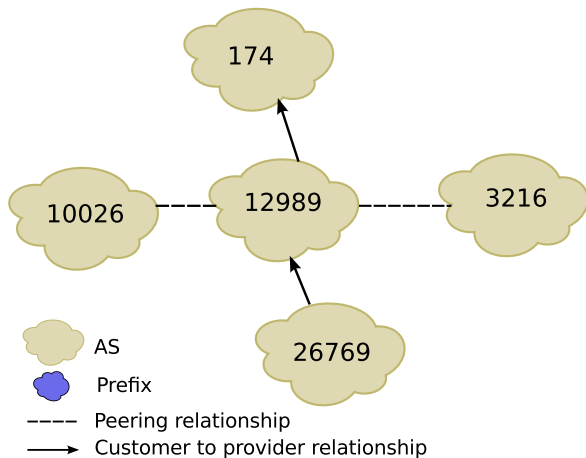
<sup>1</sup>UPMC, France  
first.last@lip6.fr

<sup>2</sup>Telecom ParisTech, France  
dario.rossi@enst.fr

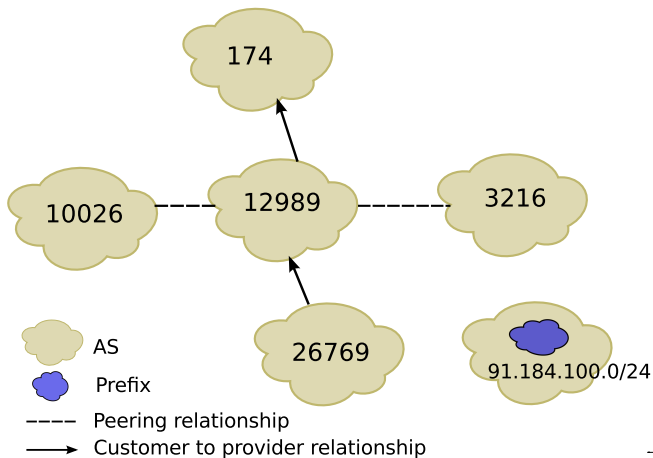
February 06th, 2013 – ISMA 2013 AIMS 5



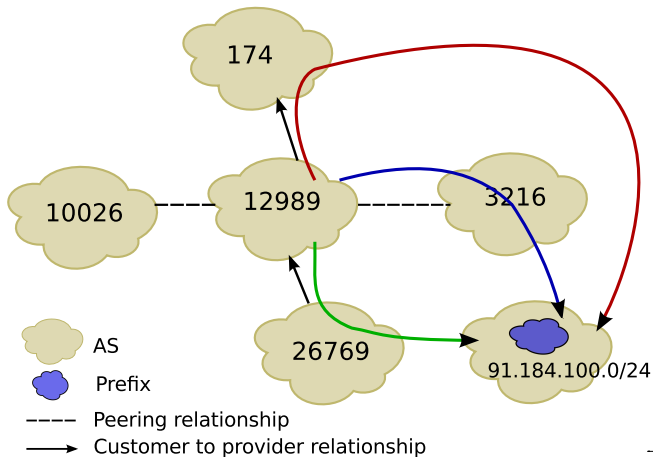
# Internet routing example



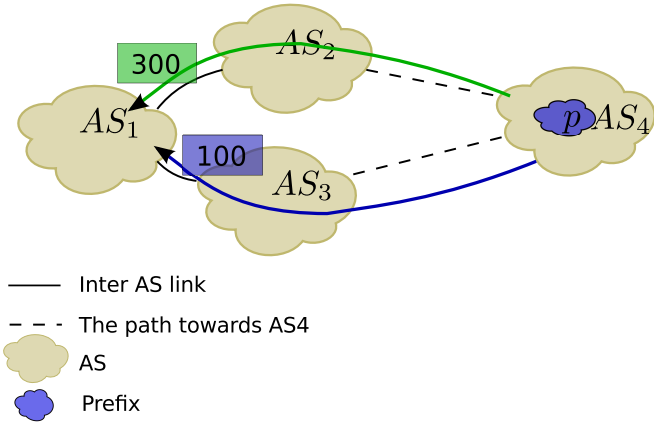
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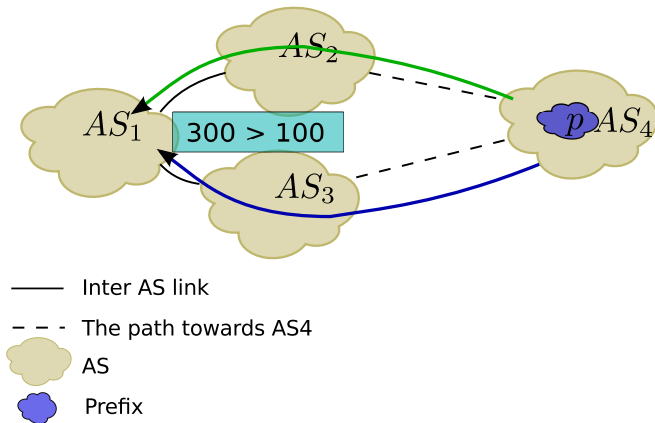
# Surprising observations



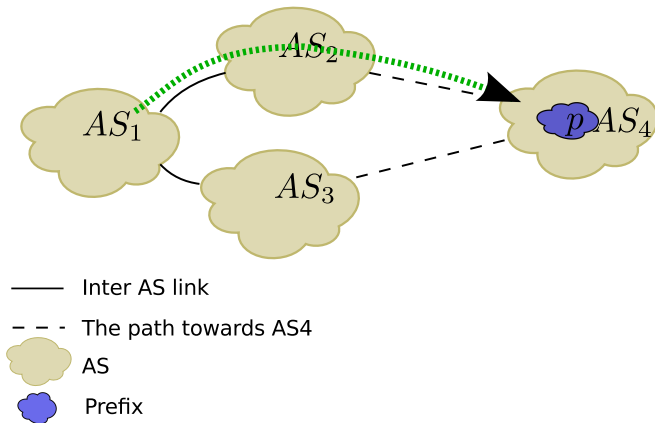
# BGP route with higher LP



## A route has a higher LP

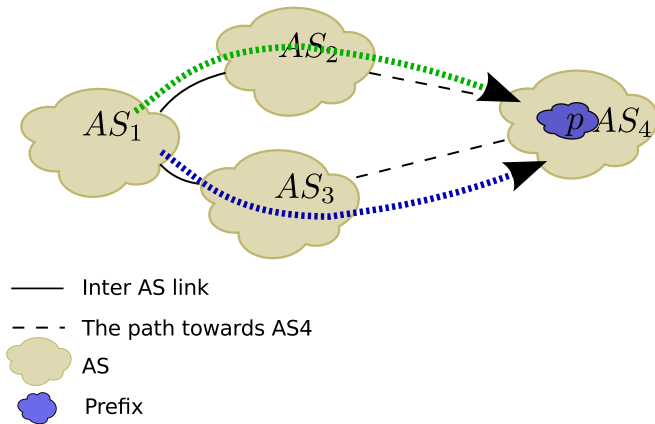


## Single next-hop AS

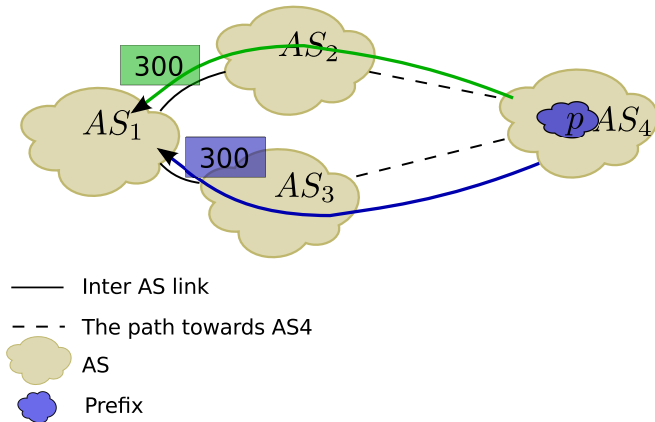




## Multi next-hop ASes



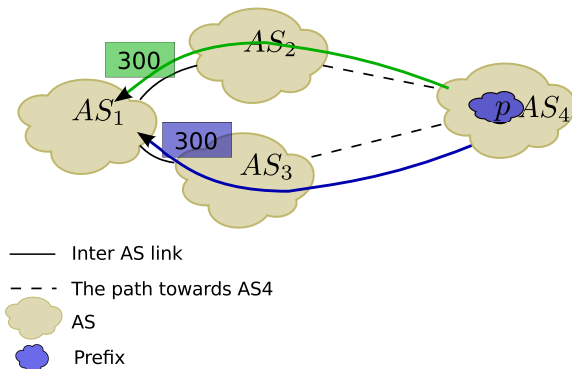
## Equal LP for all next-hop ASes



# 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)

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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?

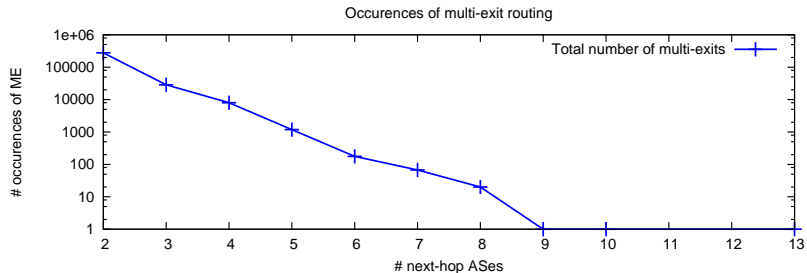
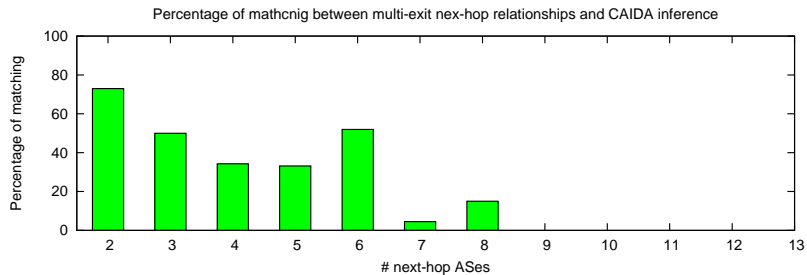
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- About **70% matching** **30% mismatching**

# Multi-exit occurrences and relationship matching



# 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

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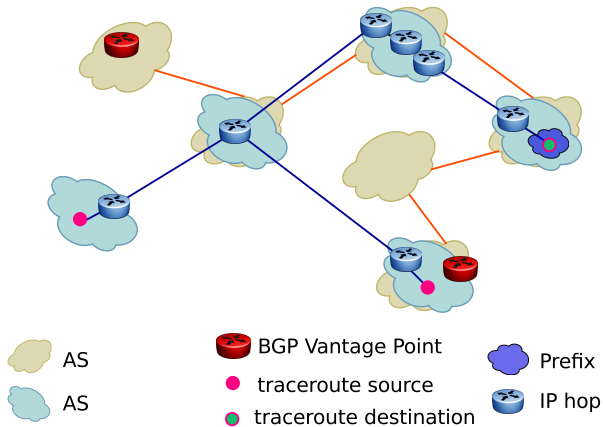


## Have another ideas?

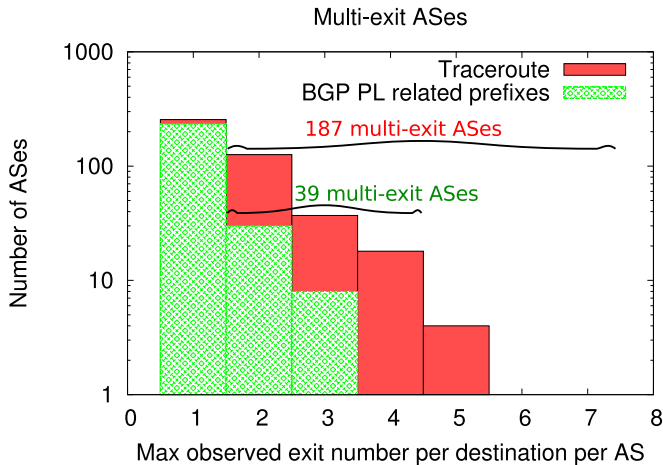
- Feedback about the problem and the analysis process
- Get confirmation about the results (we don't have a ground truth of AS relationships)
- Possible collaborations

Reserved slides...

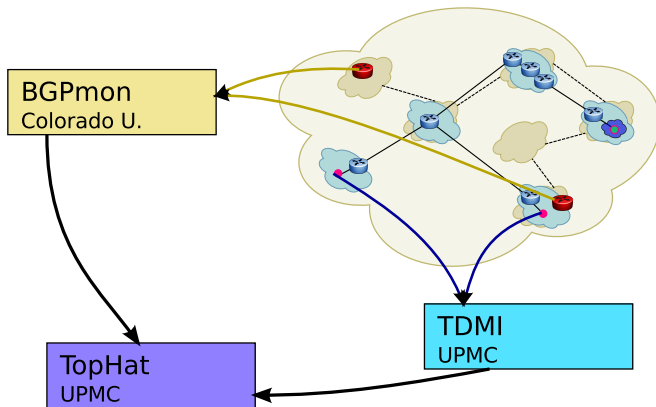
# BGP and IP overlap

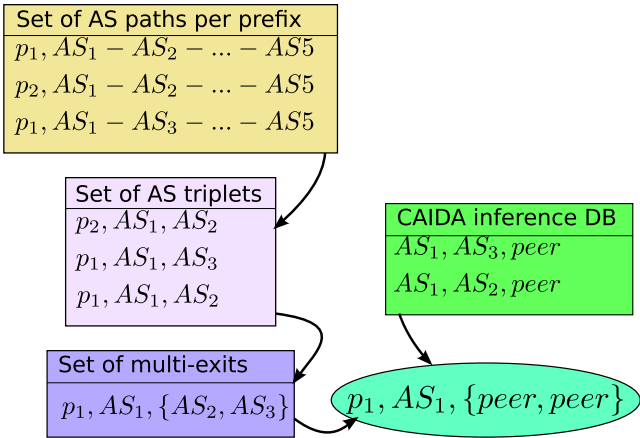


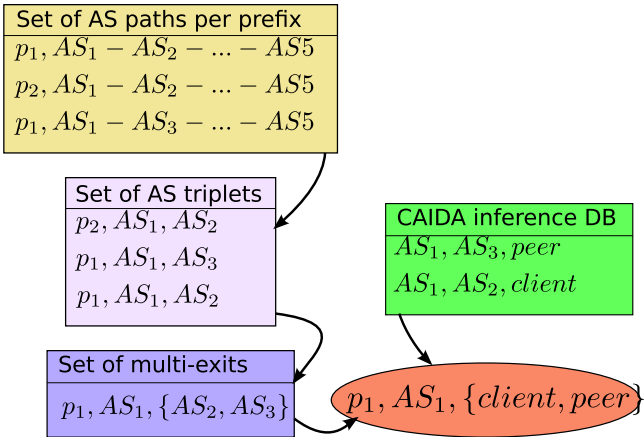
# Multi-exit routing, BGP and IP results

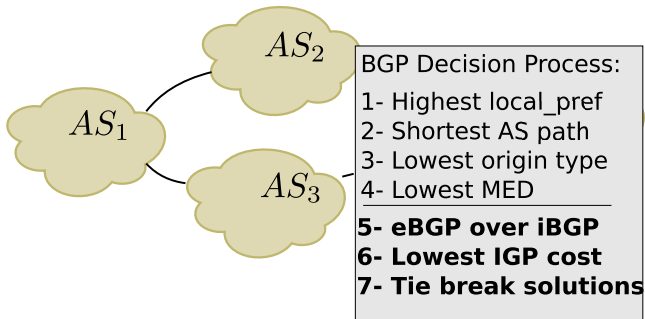




# TopHat interconnection



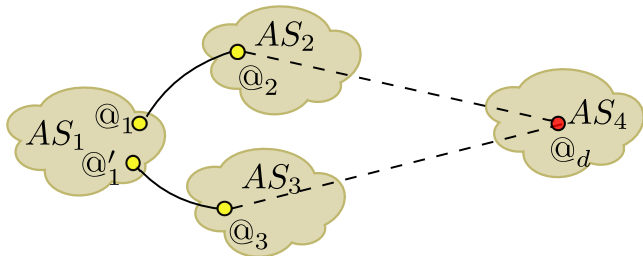









- Inter AS link
- - - Continuation of the link to the announcing AS
-  An Autonomous System (AS)
-  The destination prefix  $p$





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