

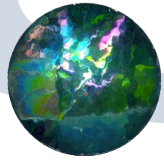
*Techniques for better alias
resolution in Internet topology
discovery*

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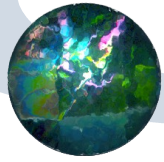
Daniel Morato Oses

Mikel Izal Azkarate



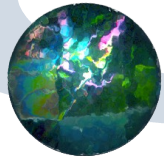
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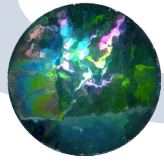
Introduction

- Topology of Internet is still a research challenge
- Important network parameters:
 - Delay
 - Congestion
 - Routing
 - Protocol performance



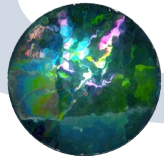
Introduction

- We will focus on the topology at IP router level
- We can not stop on traceroutes probes
 - Based on UDP
 - Each hop are draw as a node
 - Between neighbour nodes are drawn the links
 - We have an overweight net



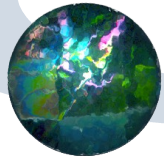
Introduction

- Aliasing methods are able to show IP own to the same router
- Reduce nodes
- Reduce links between them
- Makes possible a network closer to reality



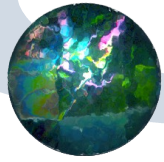
Existing techniques for alias resolution

- The alias methods can be clasified into:
 - Active probing methods
 - Mercator
 - Ally
 - Inference methods
 - Based on graph analysis
 - AAR and APAR
 - Based on DNS
 - Based on name conventions



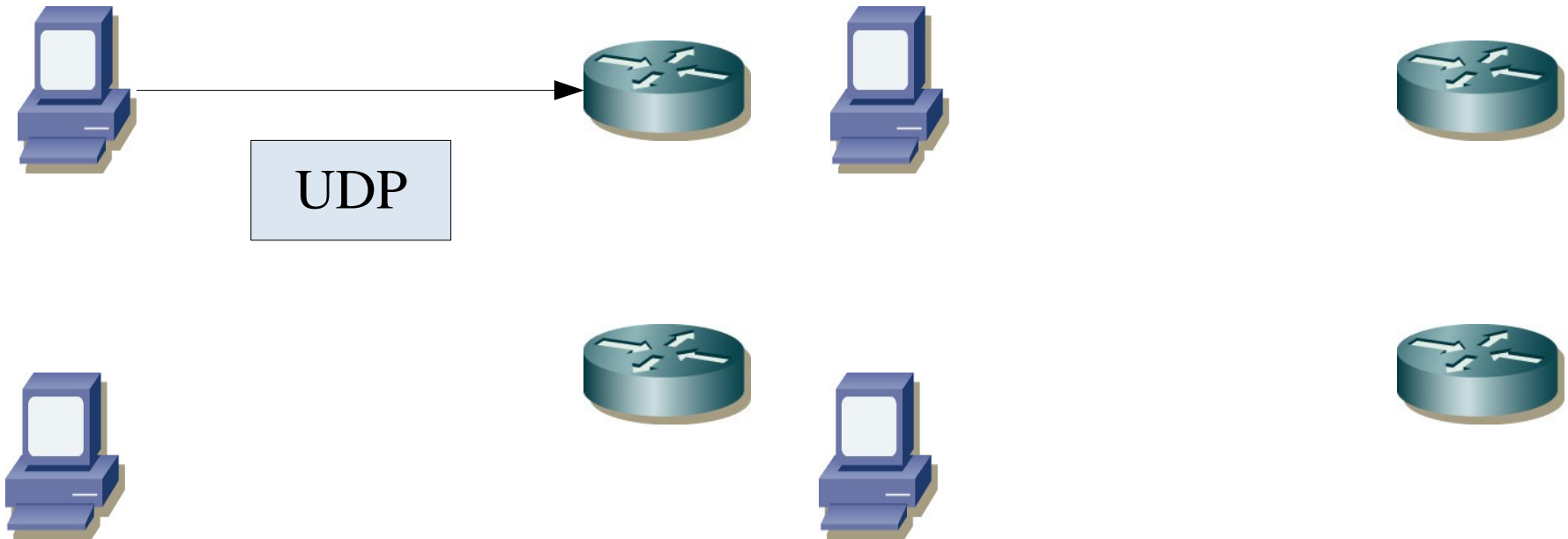
Existing techniques for alias resolution

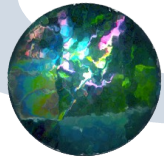
- We have focused on active probing methods.
 - Mercator
 - Based on the behaviour of some routers which send the packets to an IP always from the same interface
 - Ally
 - Based on the fact that some routers have one IPID global counter for all the interfaces.



Existing techniques for alias resolution

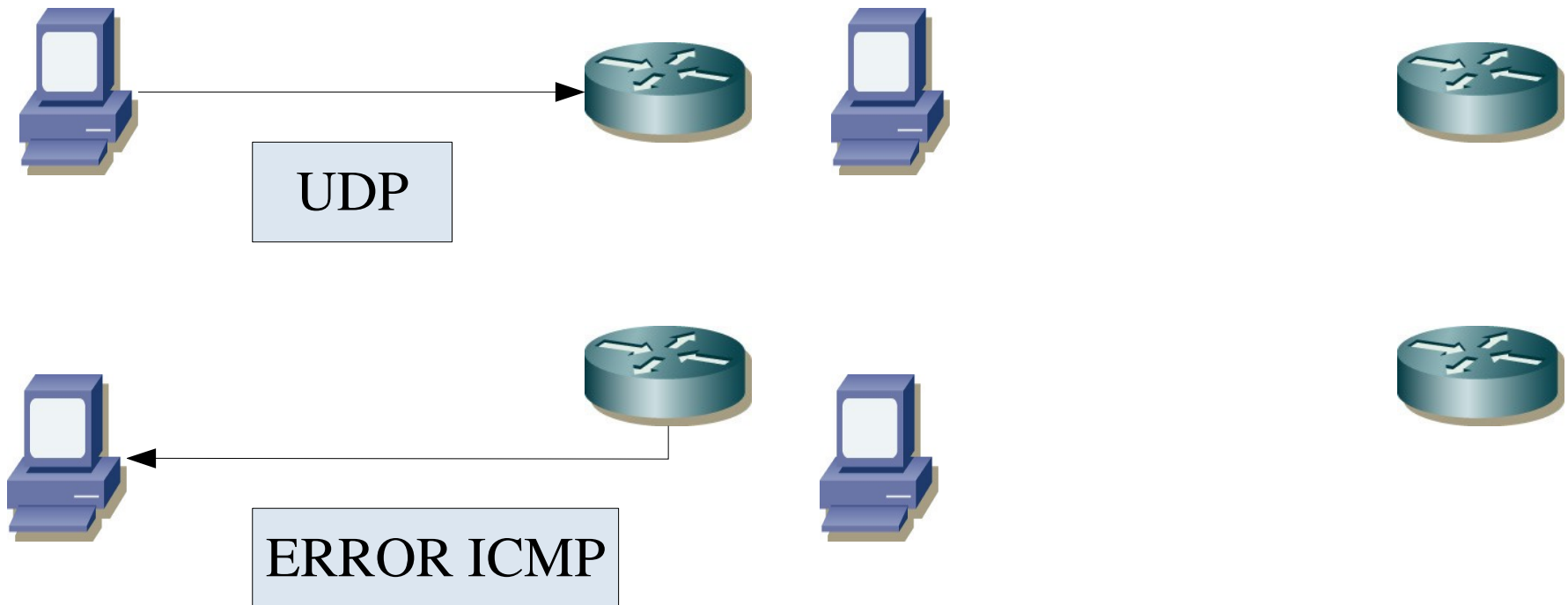
- Mercator

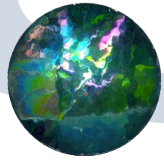




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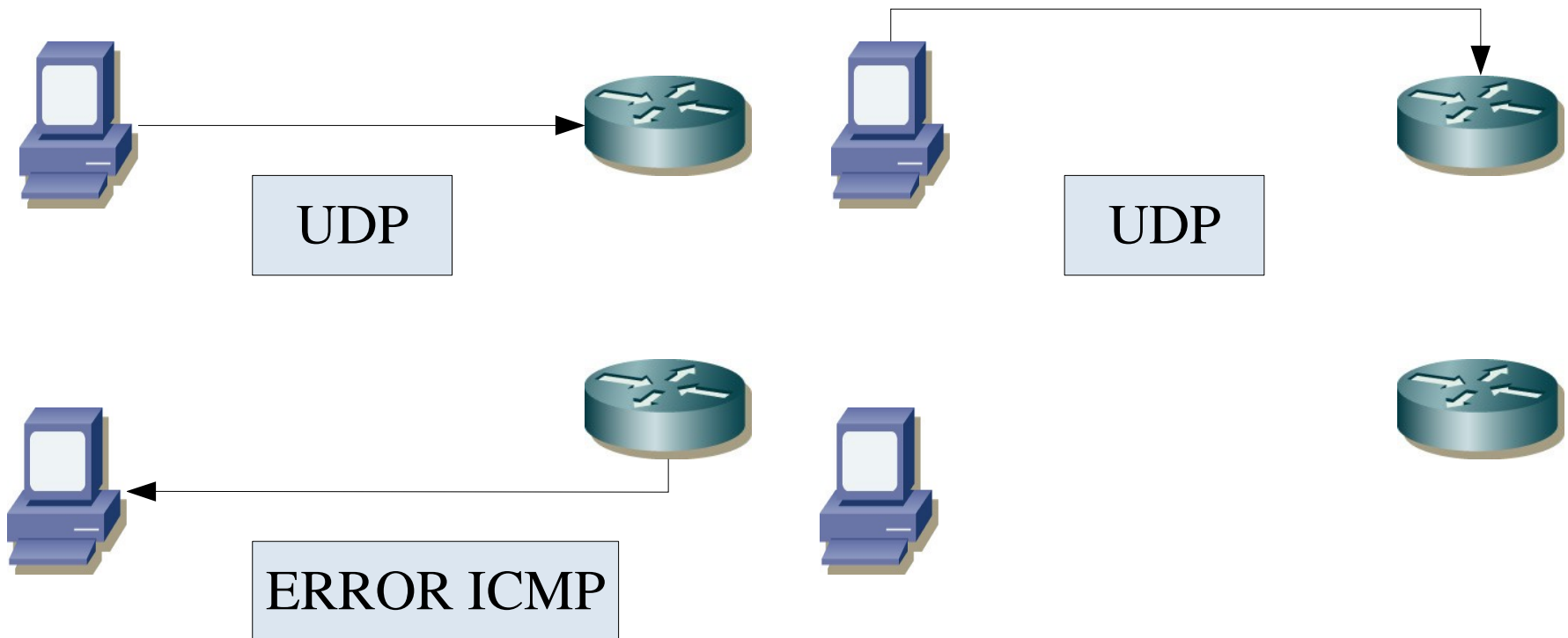
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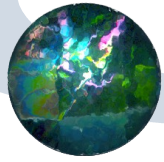




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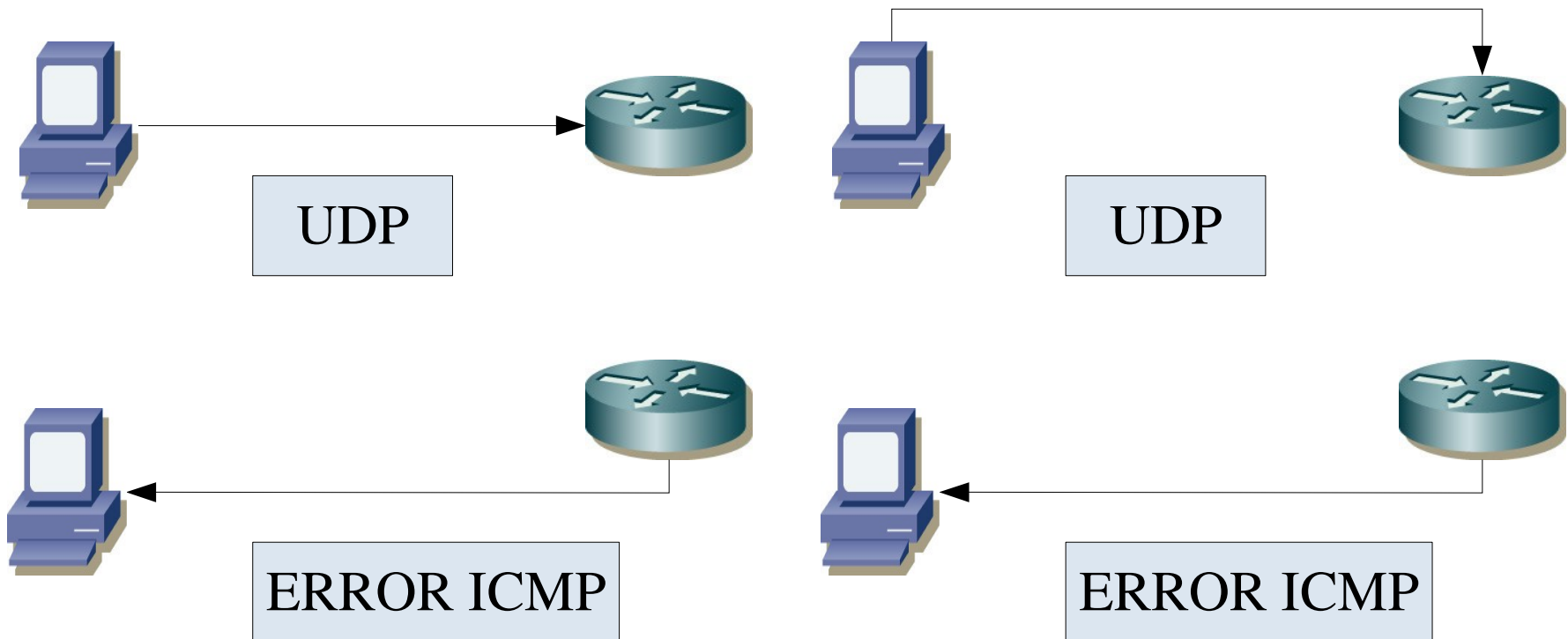
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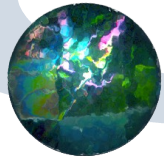




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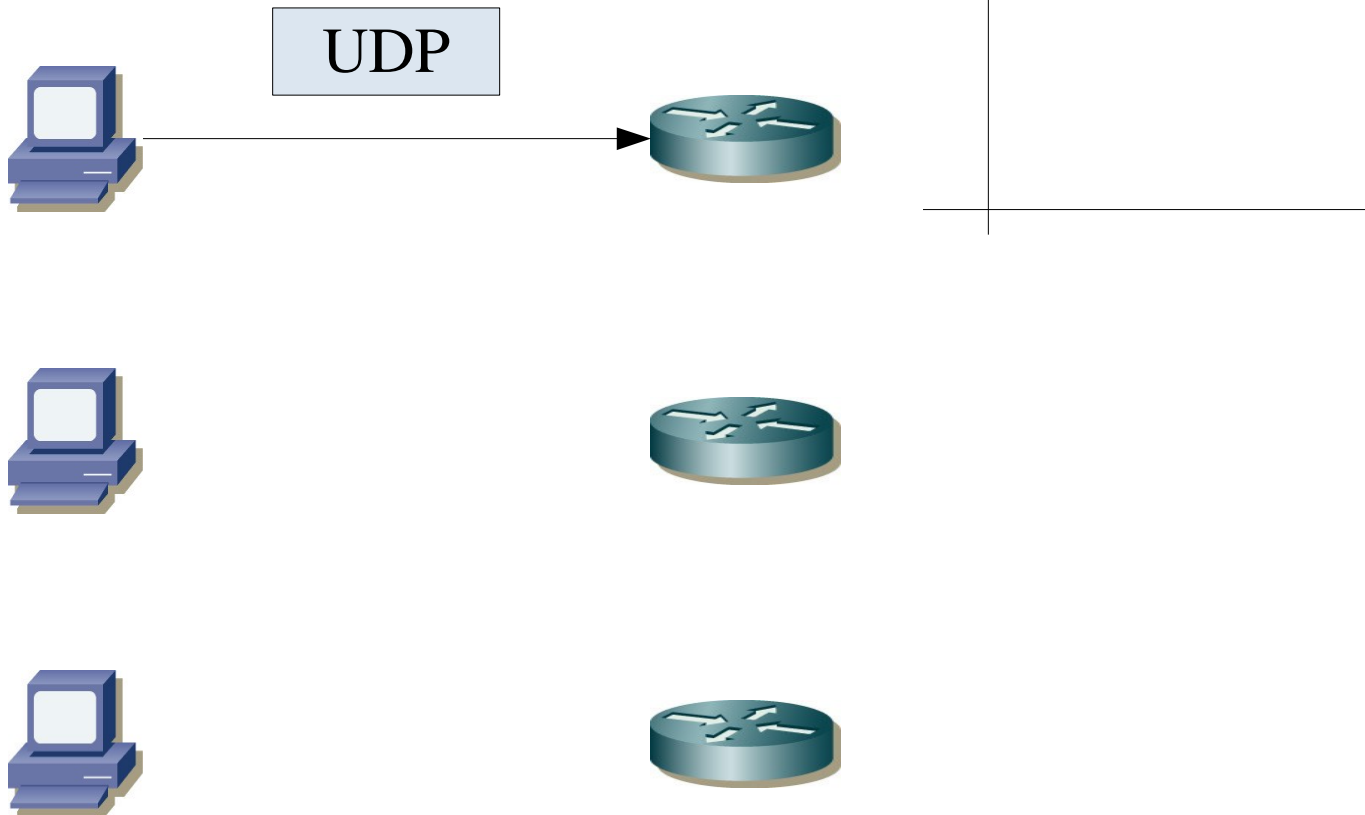
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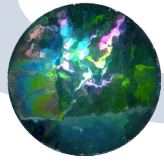




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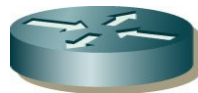
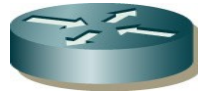
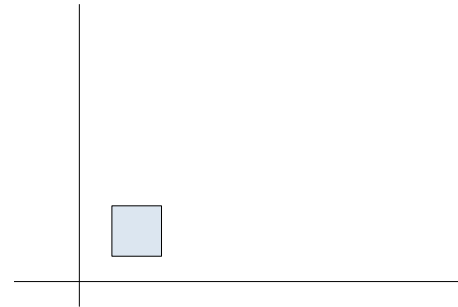
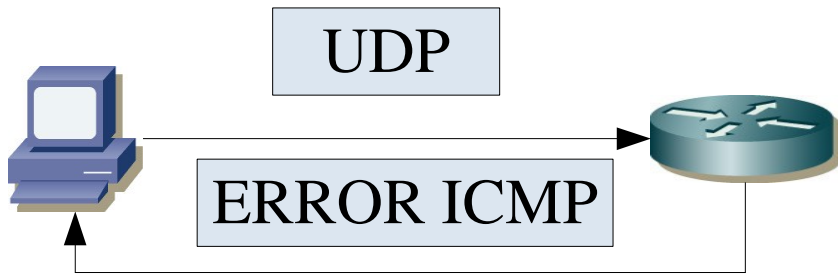
- Ally

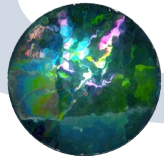




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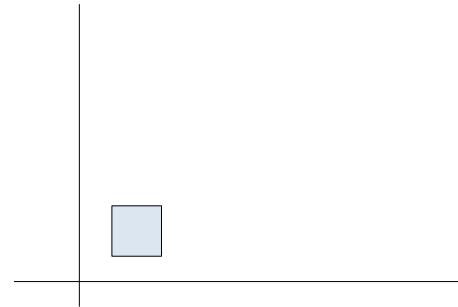
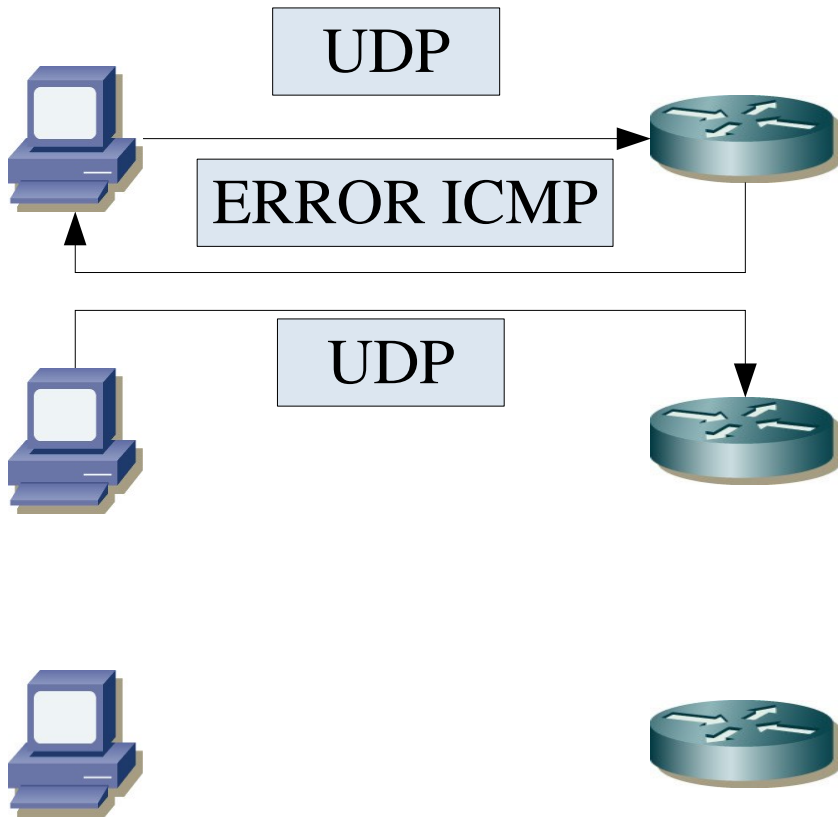
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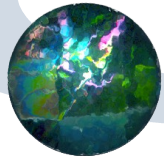




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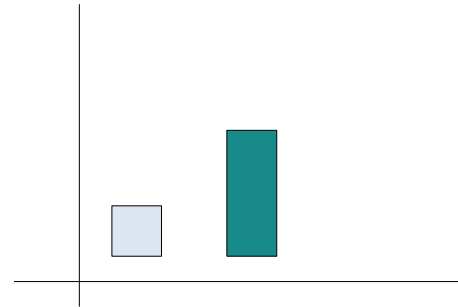
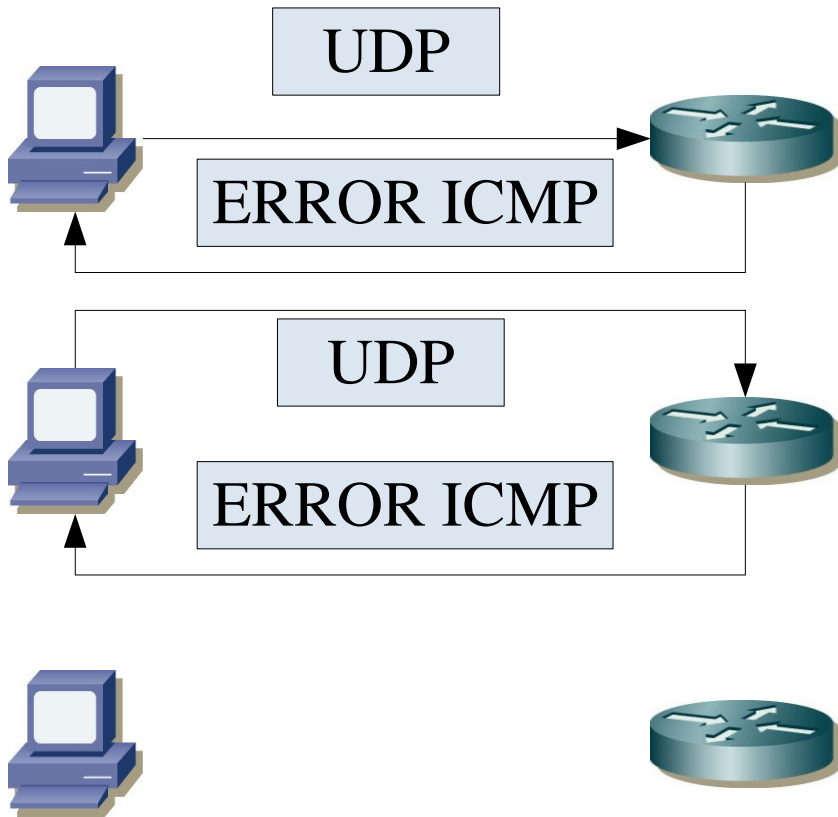
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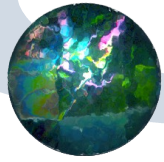




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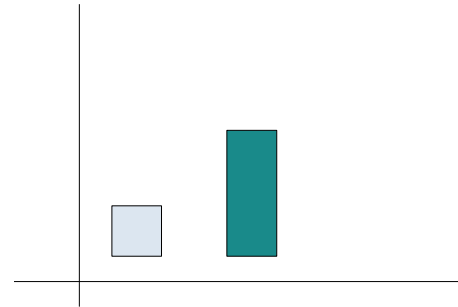
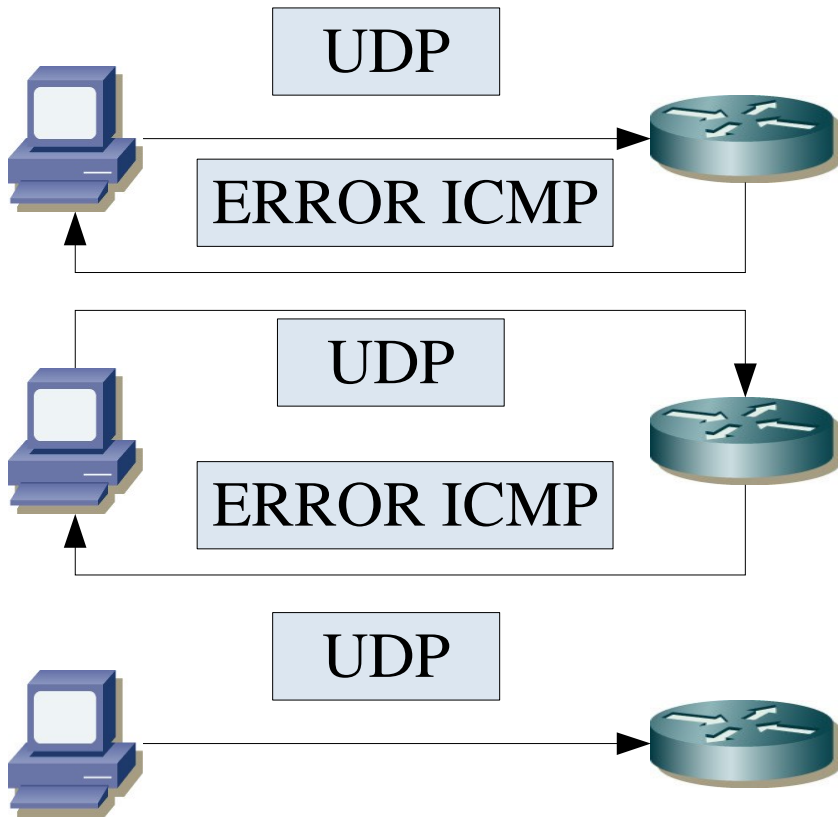
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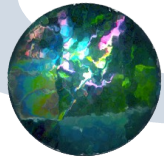




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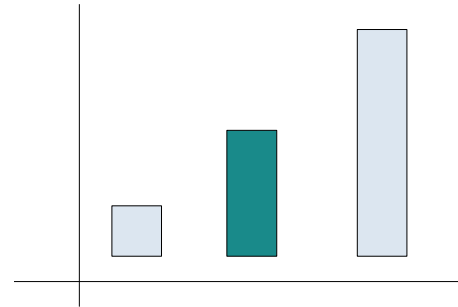
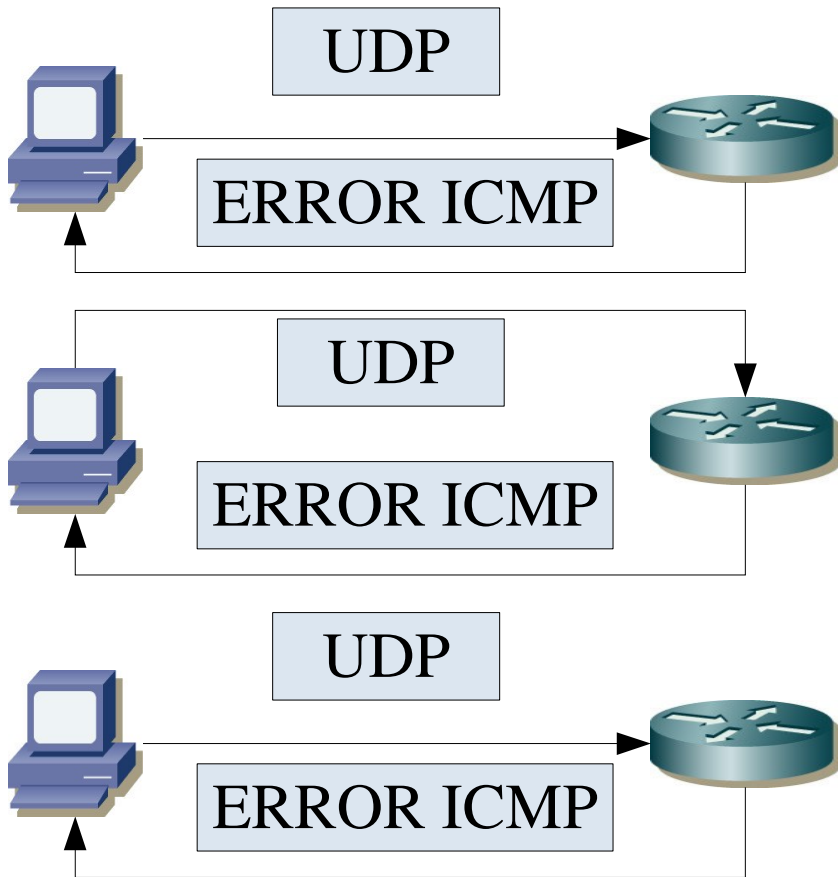
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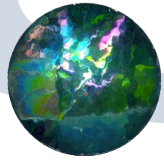




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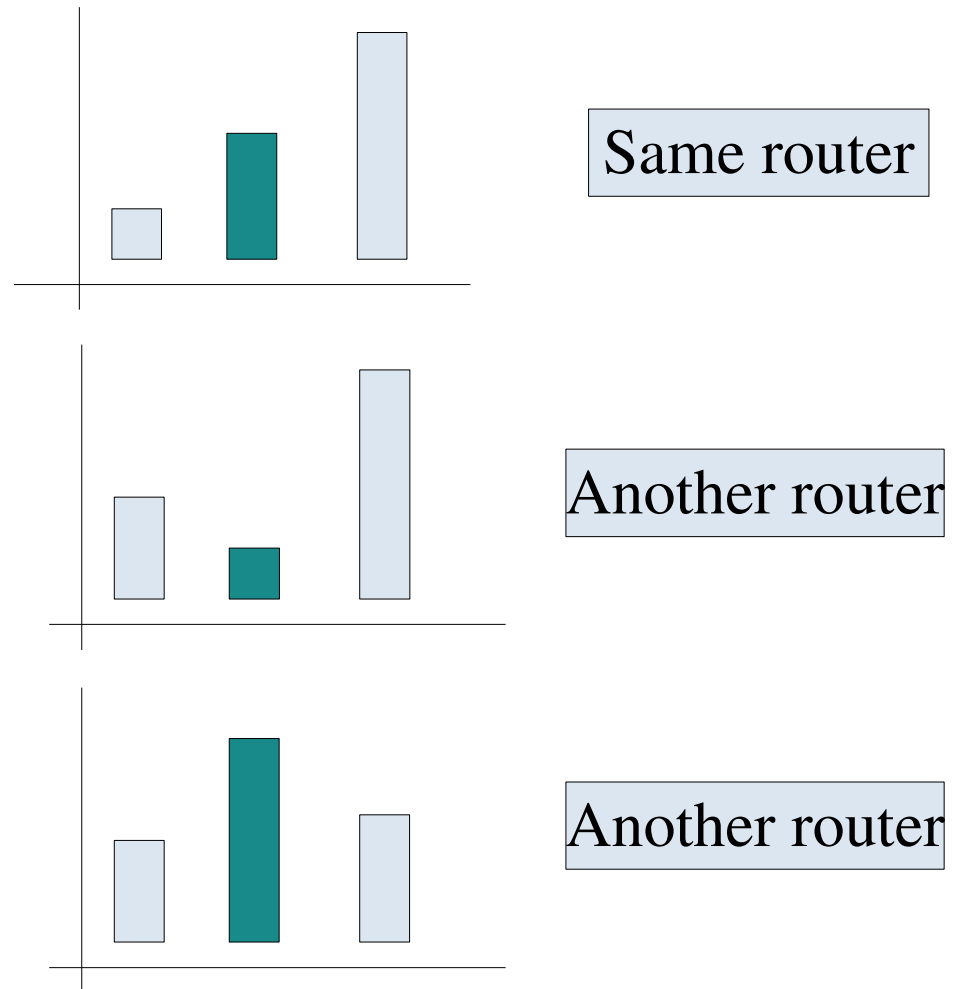
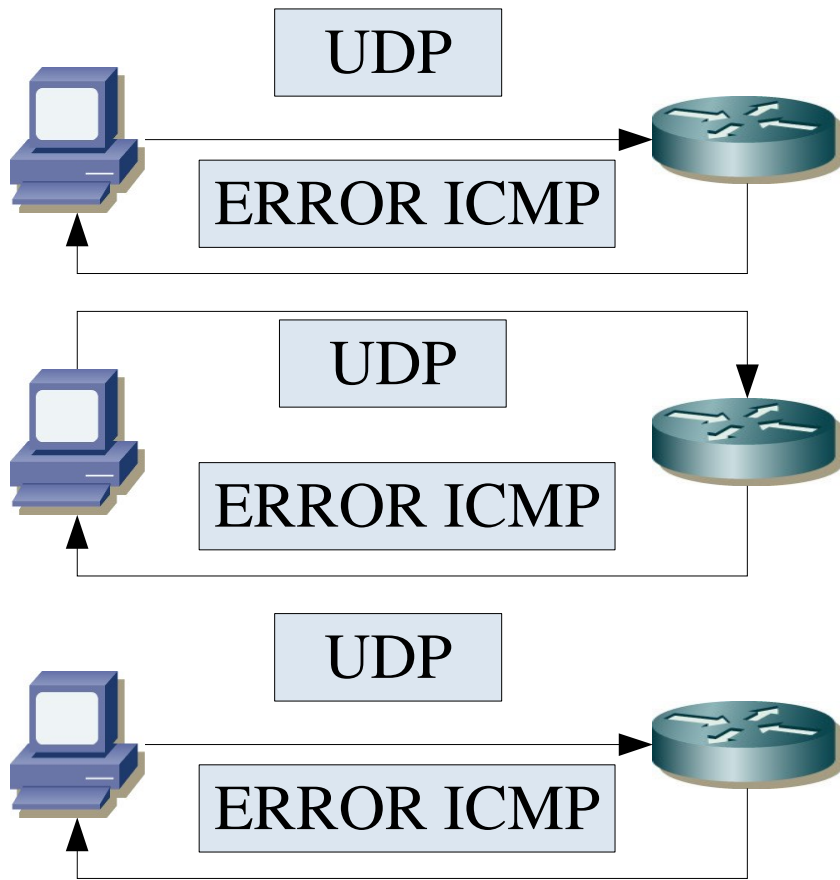
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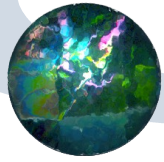




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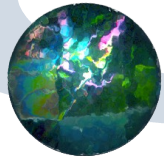
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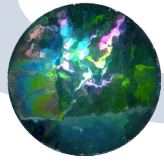
Existing techniques for alias resolution

- Ally
 - The two first packets are sent at the same time
 - To prevent in random behaviours false positives and to minimize the number of packets sent use an offset
 - The packets must be into a 200 IPIDs offsets to be test as true
 - If the second packet is higher than 200 the third packet is not been sent.



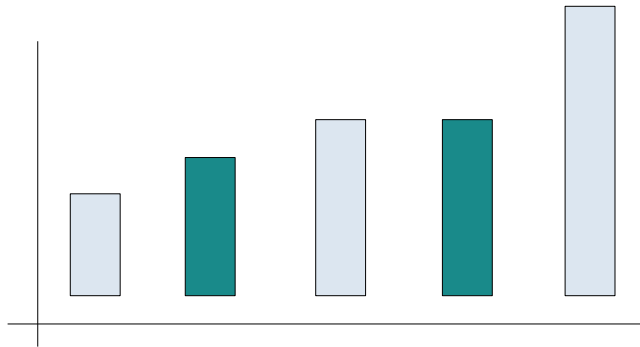
New techniques for alias resolution

- We propose some variation to make the techniques better in identification.
 - First we propose to vary the classic Ally implementation.
 - We propose to use timestamps to identify the aliases

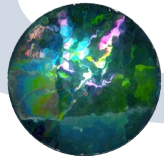


New techniques for alias resolution

- Variation of Ally are based on
 - With only three packets we can commit errors:



- This situation will be valuated as own to the same router



New techniques for alias resolution

- We have calculated the probability of error in Ally

- Random-random

- $P_{R.R} = \sum_{i=1}^{198} \left(\frac{i}{65536^2} \right) = 4,58 \cdot 10^{-6}$

- Random-Incremental

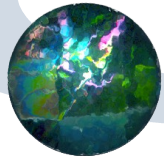
- $P_{R.I} = \sum_{i=1}^{198} \left(\frac{i}{65536^2} \right) = 4,58 \cdot 10^{-6}$

- Incremental-random

- $P_{I.R} = \frac{G}{65536^2}$

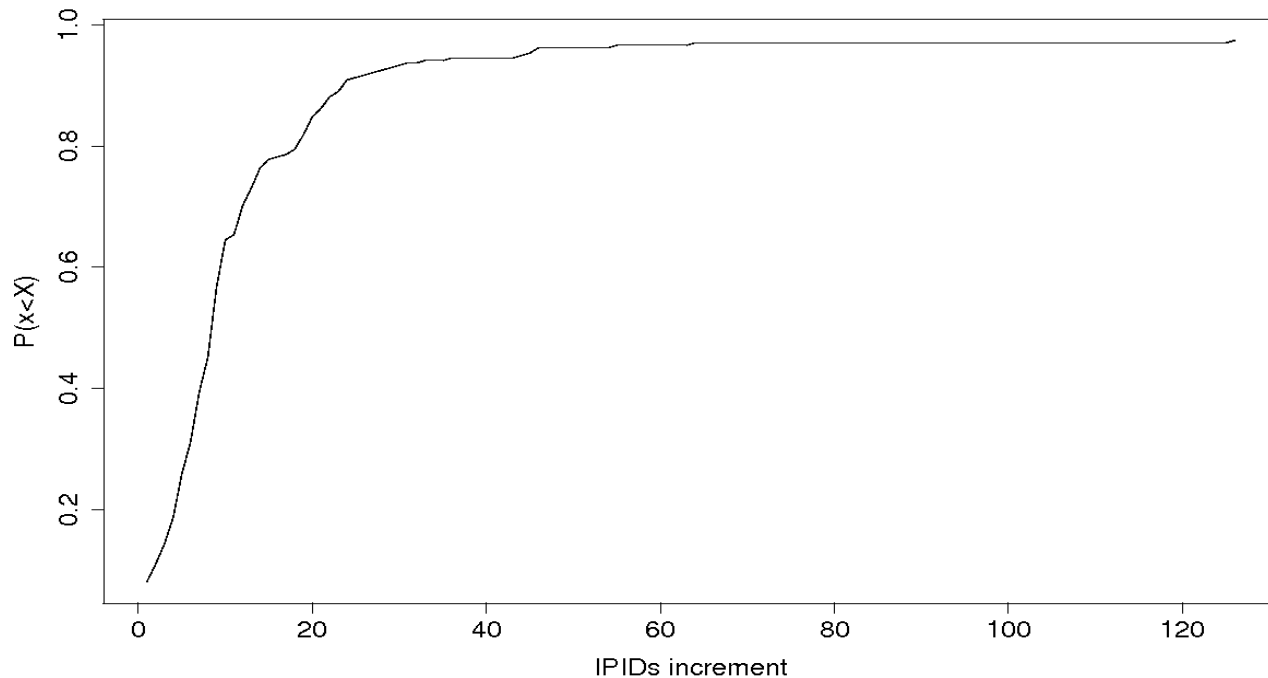
- Incremental-incremental

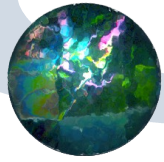
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New techniques for alias resolution

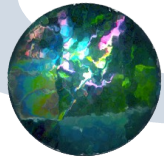
- The grow of IPID in 0'4 sec interval into incremental routers





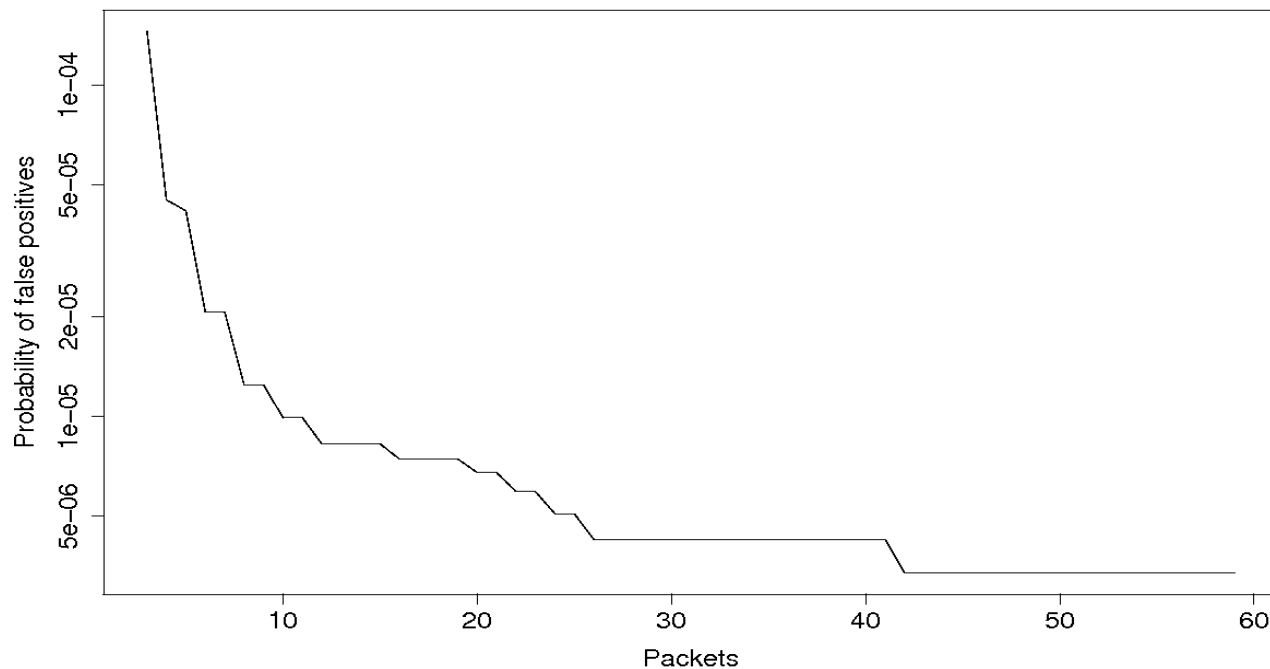
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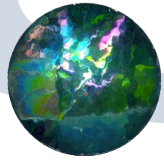
- We have calculated the probability of error in Ally
 - Random-random
 - $P_{R.R} = \sum_{i=1}^{198} \left(\frac{i}{65536^2} \right) = 4,58 \cdot 10^{-6}$
 - Random-Incremental
 - $P_{R.I} = \sum_{i=1}^{198} \left(\frac{i}{65536^2} \right) = 4,58 \cdot 10^{-6}$
 - Incremental-random
 - $P_{I.R} = \frac{22}{65536^2} = 2,7 \cdot 10^{-4}$
 - Incremental-incremental
 - $P_{I.I} = \frac{22}{65536^2} = 2,7 \cdot 10^{-4}$



New techniques for alias resolution

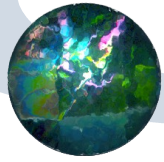
- We have made a simulation of probability of false positives with a number of packets sent





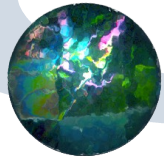
New techniques for alias resolution

- The variation of Ally method is to use another kind of packets too:
 - ICMP echo request, ICMP timestamp request and TCP
- To grow up the number of packets:
 - We have make the probes with 20 packets per IP. 40 Packets per probe.
- Vary the way to make the probes:
 - we use an static time offset between probes



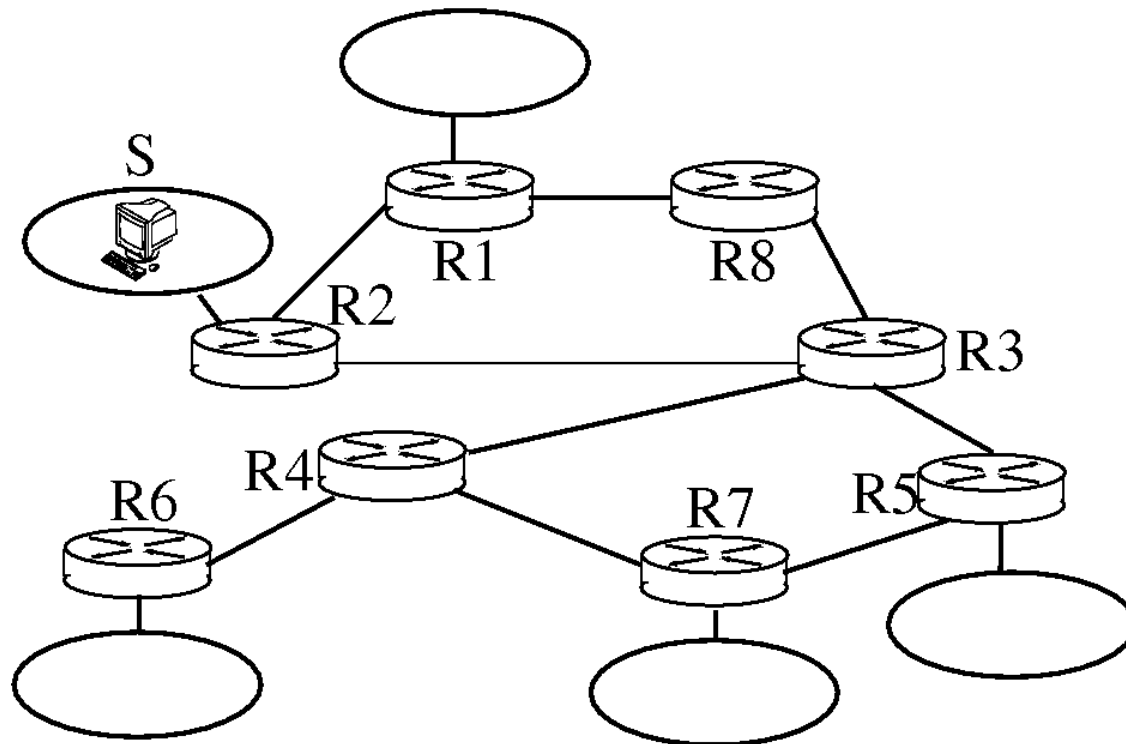
New techniques for alias resolution

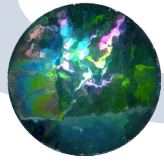
- We have include a new method:
 - We will use the timestamp of ICMP timestamp reply packets and the TCP reset packets too.
 - We will use a process similar to used in the ally modifications.



Evaluation in a controlled testbed

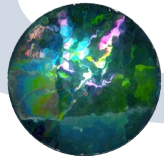
- To evaluate the probes we have use a controlled testbed.





Evaluation in a controlled testbed

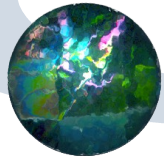
- We was able to take all routers with no problems using the probes proposed
- Using timestamp method with ICMP packets we obtain the 100% of identification. As in the Ally method and TCP method
- In the real world the timestamp method can not be apply due to NTP synchronization
- Others method have distinc success rates
- There was no errors in probes



Evaluation over the Internet

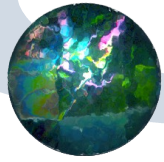
- We have test the probes in real world using ETOMIC





Evaluation over the Internet

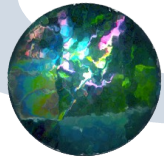
- We need a metric to know when we have finished
 - We use the total of pairs and all must be catalogated as true or false.
 - True the pair own to the same router
 - False the pair own to distinct router
- The total of trues are not a direct sum
- We can have error in probes, when the interaces do not respond
- We can have not conclusive probes, F.E. Two random interfaces



Evaluation over the Internet

- The aliasing result really vary a lot from Testbed:

Method	Positive	Negative	Not conclusive	Error	Nodes	Links	Total
Mercator	0,02	0	9,35	90,63	545	710	0,02
Ally	0,03	7,35	0	92,62	520	692	7,40
IPID UDP	0,06	7,77	0	92,17	506	685	11,79
IPID ECHO	0,21	54,81	19,12	25,86	440	588	62,03
IPID TCP	0,01	3,27	0,31	96,41	434	580	63,08
IPID TIME	0,06	12,52	7,91	79,51	434	580	63,17
TSTAMP TCP	0	0	0	100	434	580	63,17
TSTAMP TIME	0	0	7,22	92,78	434	580	63,17



Evaluation over the Internet

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Method

Mercator

Ally

IPID UDP

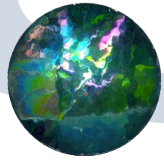
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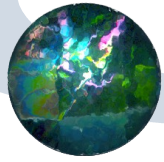
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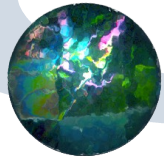
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0	0	0	100
0	0	7,22	92,78



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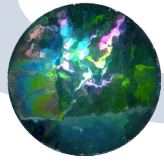
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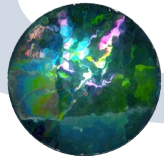
Positive	Negative
0,02	0
0,03	7,35
0,06	7,77
0,21	54,81
0,01	3,27
0,06	12,52
0	0
0	0



Evaluation over the Internet

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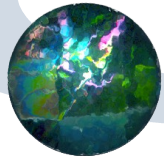
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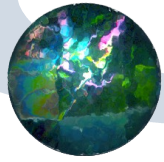
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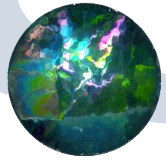
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Conclusions

- Using classic methods only have 7.4 % of the routers
- Using the modifications we have the 63.17 %
- We have improve a 55.77 % from the classic way to use the methods



Questions