Towards Network Resiliency with AI Driven Automated Load Sharing in Content Delivery Environments

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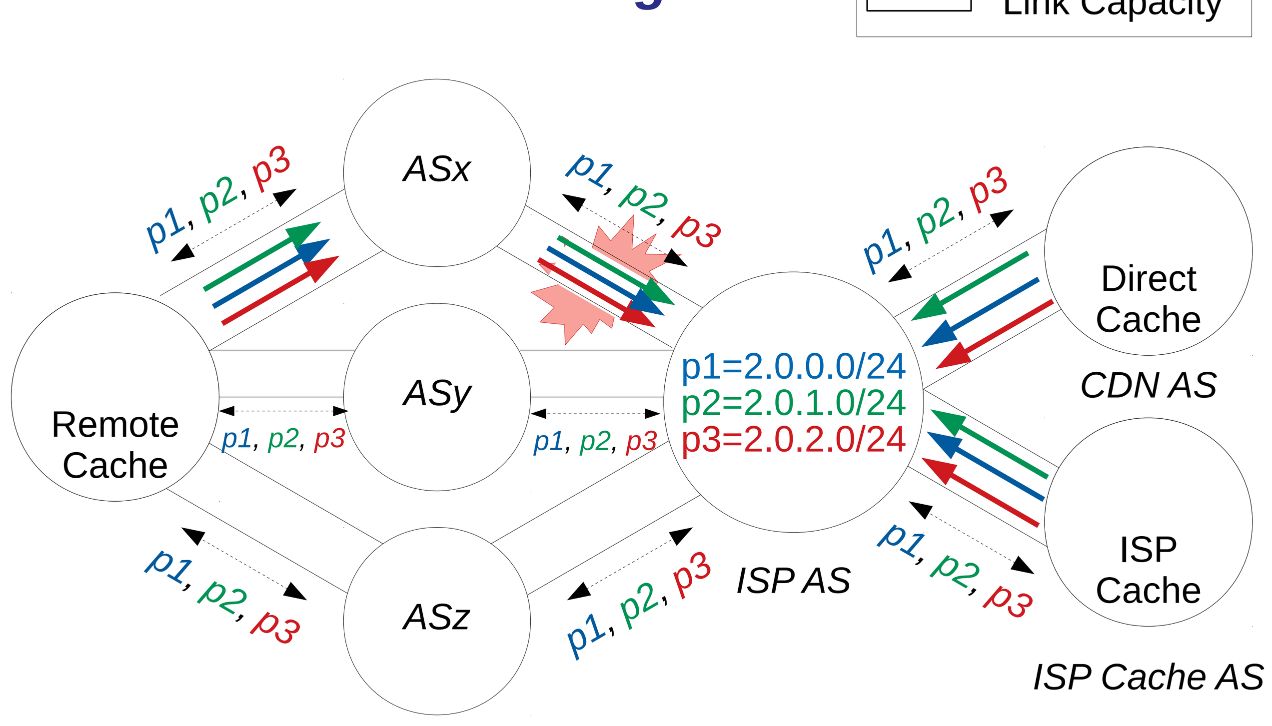
I. CONTEXT AND USE CASE

Content Delivery Networks' (CDNs) complex and dynamic delivery strategies expose Internet Service Providers (ISPs) to security issues (inter-domain sessions termination, for instance) that put at risk the good, working state of the network.

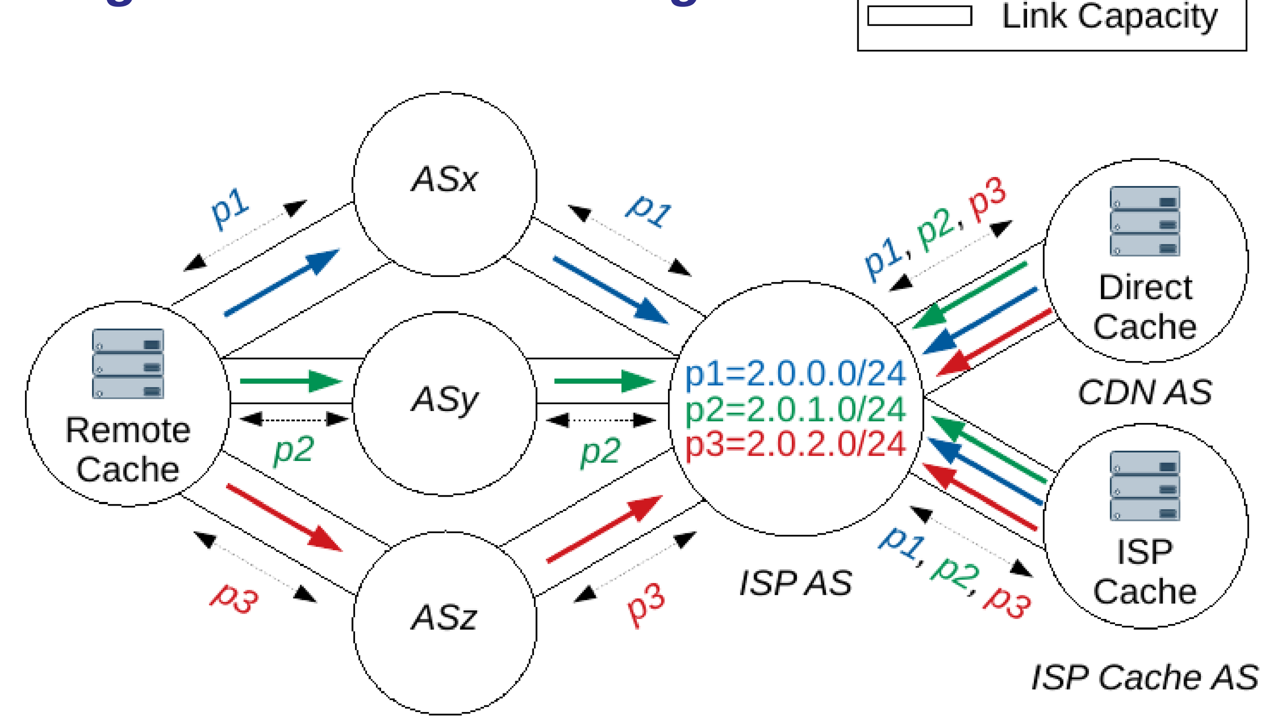
Delivery and Saturation with Prefix Load Balancing



1) ISP AS initially announces all its prefixes to ASx, ASy, ans ASz (load balancing).

2) A change of the cache server that delivers content causes saturation in the link between ISP AS and ASx.

Saturation avoidance through Prefix Load Sharing

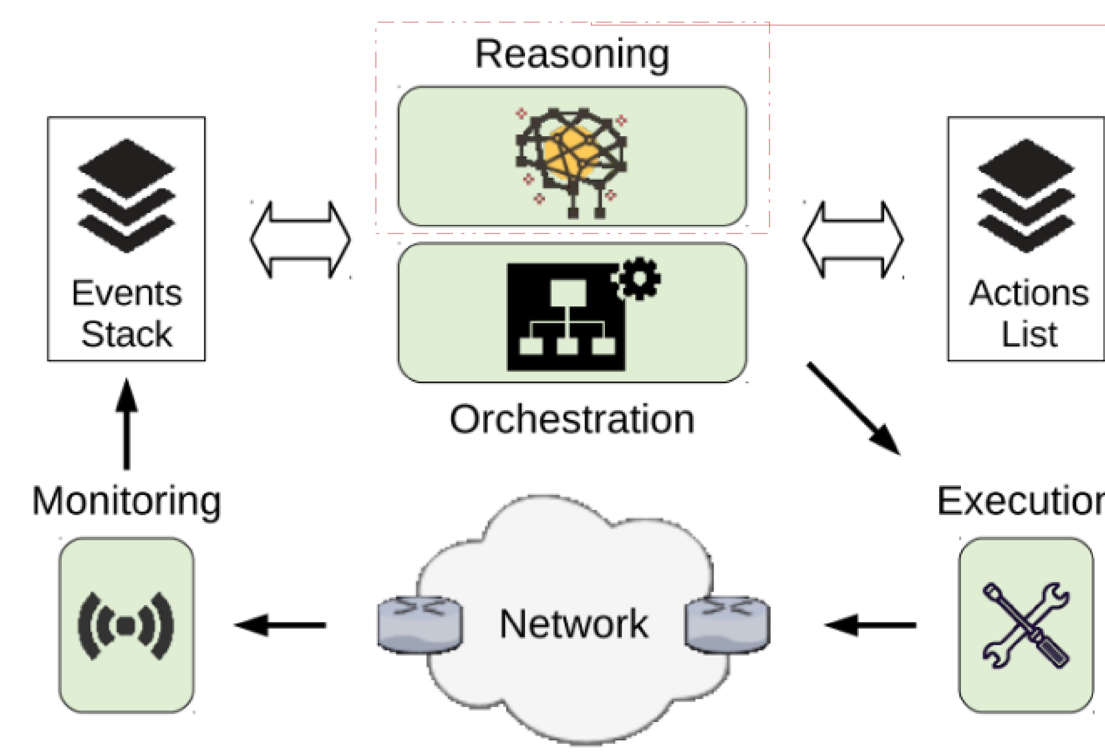


3) ISP AS changes its prefix distribution strategy, announcing one prefix per link (load sharing).

4) This new configuration makes the traffic, destined to each one of the prefixes, go through a specific link.

II. EDNA SOLUTION

In order to apply load sharing, we conceived an event-driven network automation solution (EDNA), capable of configuring routers in an automated and scalable way.



Reasoning block:
- Uses a *Deep Reinforcement Learning* (DRL) Algorithm.
- *Environment*: Max. traffic capacity, number of prefixes and traffic volume on each link.
- *Actions*: move one or more prefixes from one link to another.

III. ALGORITHMS

We compare the performance of four algorithms for automatically redistribute prefixes and share traffic load:

No-function (**NOF**) algorithm: At each time step, it does nothing. It represents today's situation when saturation arises.

Naive function (**NAIF**) algorithm: At each time step, it evaluates the state of saturation of any two links, and, if a link saturates, it moves one prefix from that link to a non-saturated one. It is therefore a basic straightforward automation of today's manual prefix load sharing.

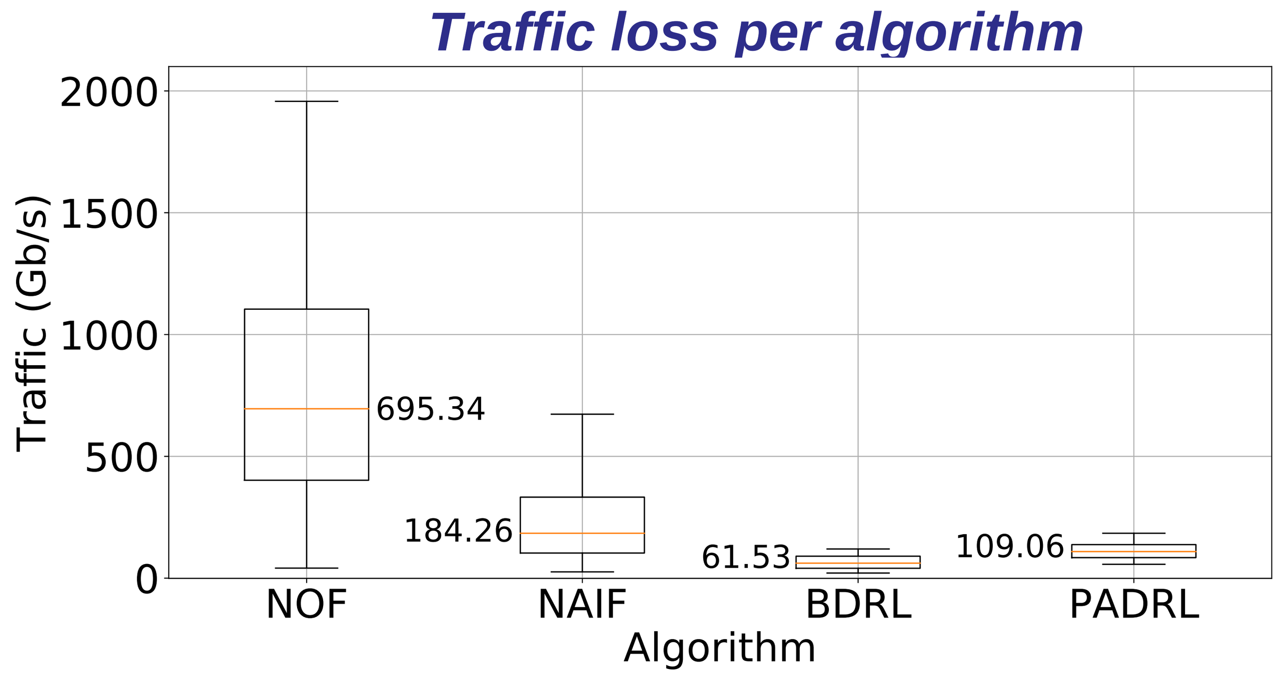
Balanced DRL (**BDRL**) algorithm: At each time step, it aims at maximizing the total reward. BDRL considers every link equally to redistribute prefixes.

Priority Aware DRL (**PADRL**) algorithm: At each time step, it aims at maximizing the total reward. PADRL prioritizes some links over others.

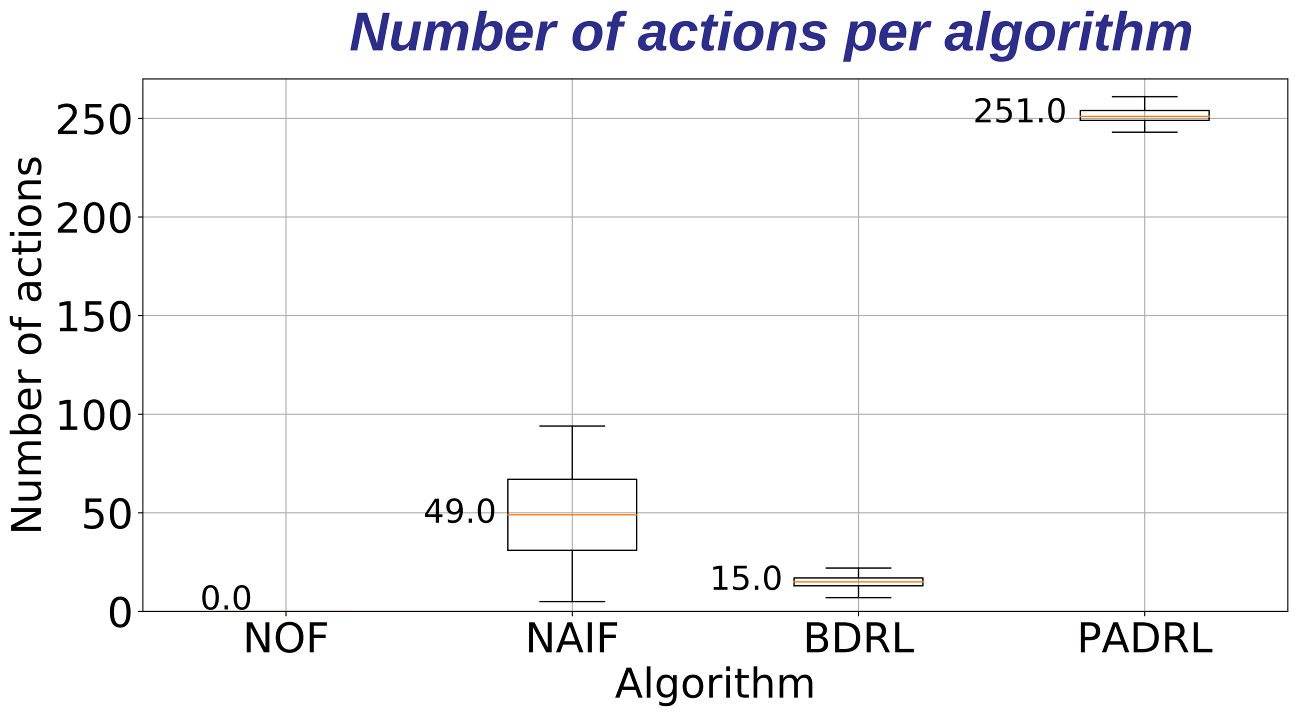
IV. RESULTS

The results show that BGP prefix announcement controlled by DRL reduces traffic loss in the network and the number of actions taken.

Traffic loss per algorithm

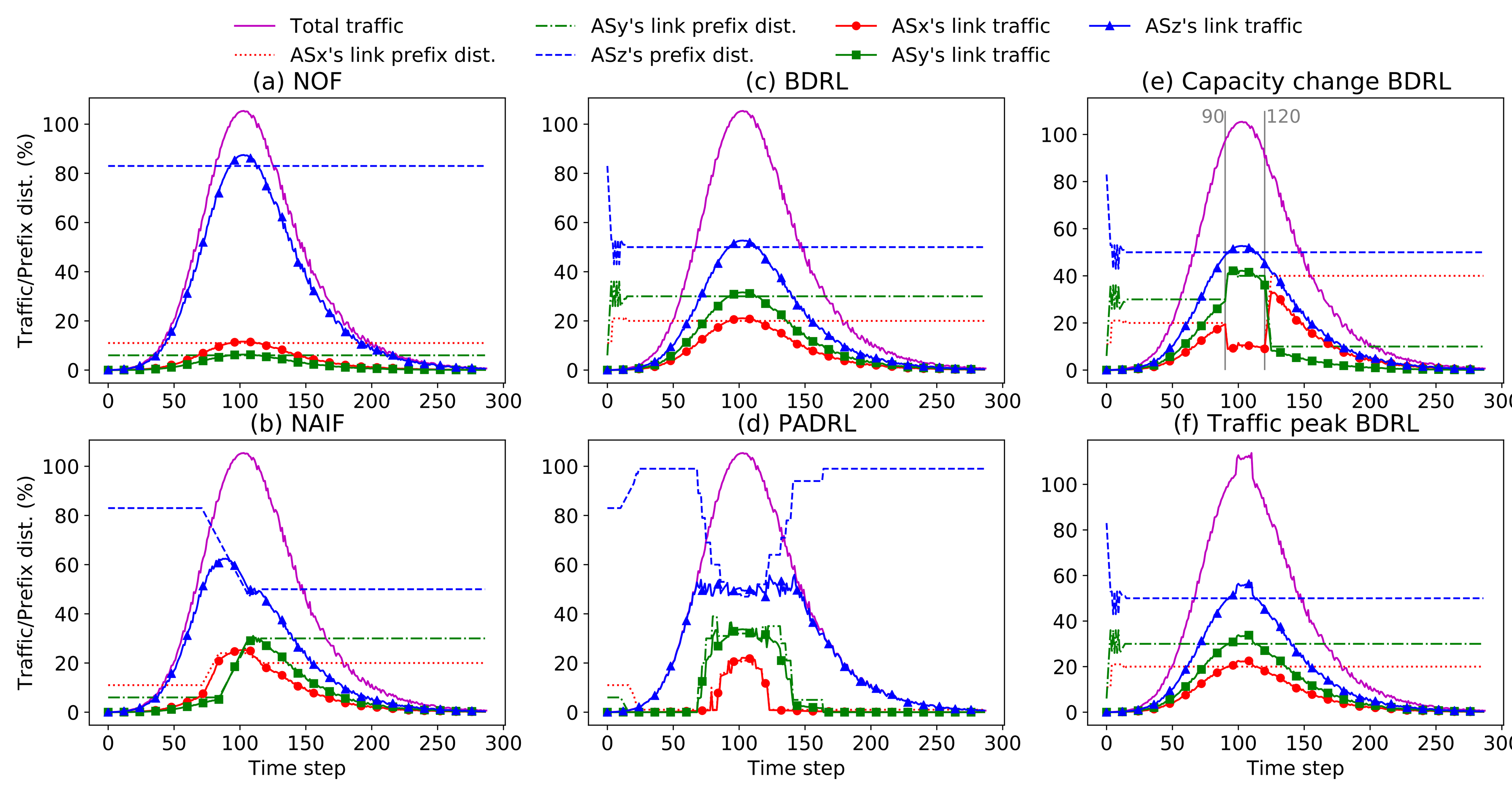


Number of actions per algorithm



Prefix and traffic distribution of NOF, NAIF, BDRL, and PADRL, Capacity change and Traffic peak of BDRL

A graphical representation of the algorithms' test shows an insight of the prefix announcement process. This analysis reveals undesired behaviors, such as instabilities, intended to be corrected in future work.



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