Extracting Intra-domain Topology from mrinfo Probing

Jean-Jacques Pansiot$^1$, Pascal Méridol$^2$, Benoit Donnet$^2$, and Olivier Bonaventure$^2$,*

$^1$ Université de Strasbourg, Strasbourg, France
$^2$ Université catholique de Louvain, Louvain-la-Neuve, Belgium

Abstract. Active and passive measurements for topology discovery have known an impressive growth during the last decade. If a lot of work has been done regarding inter-domain topology discovery and modeling, only a few papers raise the question of how to extract intra-domain topologies from measurements results.

In this paper, based on a large dataset collected with mrinfo, a multicast tool that silently discovers all interfaces of a router, we provide a mechanism for retrieving intra-domain topologies. The main challenge is to assign an AS number to a border router whose IP addresses are not mapped to the same AS. Our algorithm is based on probabilistic and empirical IP allocation rules. The goal of our pool of rules is to converge to a consistent router to AS mapping. We show that our router-to-AS algorithm results in a mapping in more than 99% of the cases. Furthermore, with mrinfo, point-to-point links between routers can be distinguished from multiple links attached to a switch, providing an accurate view of the collected topologies. Finally, we provide a set of large intra-domain topologies in various formats.

1 Introduction

The Internet topology discovery has been an extensive subject of research during the past decade [1]. While topological information can be retrieved from passive monitoring (using, for instance, BGP dumps in the case of AS level topology), router level topology is usually obtained from active measurements based on traceroute.

Nevertheless, if traceroute has been largely deployed in the last few years, it comes with some important drawbacks. Traceroute provides a partial view of the network as it is routing dependent. For instance, backup links (high IGP weighted links for intra-domain and low BGP local preference links for inter-domain) are rarely captured by traceroute. Furthermore, the alias resolution problem is a complex issue to fix [2]. This leads thus to an incomplete and biased view of the

* This work is partially funded by the European Commission funded Trilogy ICT-216372 project. B. Donnet’s work is supported by the FNRS/FRS (Fonds National de la Recherche Scientifique, rue d’Egmont 5 – 1000 Bruxelles, Belgium.).
network. Obtaining complete intra-domain topologies is further a daunting task, requiring extensive probing campaigns \[3\].

Recently, we used mrinfo \([4]\), a management multicast tool, in order to collect topology information \([5]\). mrinfo has the advantage of sweeping out many of traceroute’s limitations as it is able to silently discover all interfaces of a router. However, it requires multicast being enable within ISPs’ networks and no filtering policies, limiting so its applicability range. Indeed, only IPv4 multicast enabled routers reply to mrinfo. Also, some ISPs filter the IGMP messages used by mrinfo (i.e., they do not propagate them).

In this paper, we take advantage of the mrinfo dataset \([6]\) for extracting intra-domain router level topologies. Obtaining real data concerning intra-domain topologies is of the highest importance. Indeed, it allows one to study actual network characteristics (e.g., degree distribution, network connectivity, ...) and to obtain insights on the way operators build their network. Furthermore, real topologies are crucial inputs for network simulations in order to consider complex and realistic scenarios. By modeling the collected topologies characteristics, it can also contribute to building better topology generators.

The contributions of this paper are twofold. We first describe how to extract intra-domain topologies from raw mrinfo data. While it is pretty easy to map IP addresses to an autonomous system number (ASN), the challenge is to mark the boundary of a given autonomous system (AS). Then, it is necessary to assign the right ASN to an AS border router (ASBR) whose IP addresses are not mapped to a single AS. In this paper, we provide an efficient algorithm, called router-to-AS mapping, for fixing this issue. We evaluate our algorithm and show that it provides a consistent mapping in more than 99.5% of the cases. In addition, an interesting feature of mrinfo is that point-to-point links between routers may be distinguished from multiple links attached to a switch. On average, we discover that roughly 11% of the nodes, in probed networks, are actually switches. As depicted in Sec. \[3\] this is a fundamental issue to correctly analyze network characteristics. Second, based on our router-to-AS mapping, we provide a set of intra-domain topologies under various formats. Our set of topologies is composed of three kind of networks: Tier-1 (such as Sprint), Transit networks (such as TDC), and Stub networks (such as UNINETT)\[1\]. An extended version of this paper provides more results and discussions \([7]\).

The remainder of this paper is organized as follows: Sec. \[2\] discusses how we collected topology data using mrinfo; Sec. \[3\] explains and evaluates our router-to-AS algorithm; Sec. \[4\] positions our work regarding the state of the art; Finally, Sec. \[5\] concludes this paper by summarizing its main achievements and discussing further works.

2 Collection Methodology and Dataset

mrinfo messages use the Internet Group Management Protocol (IGMP \([8]\)). IGMP was initially designed to allow hosts to report their active multicast groups

---

\[1\] See [http://inl.info.ucl.ac.be/content/mrinfo](http://inl.info.ucl.ac.be/content/mrinfo)