

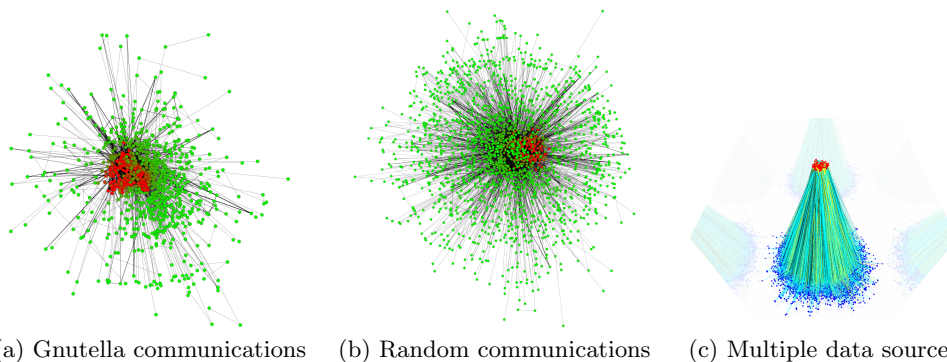
# Analytic Visualizations and their Applications for the Autonomous System Graph\*

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## Abstract

The graph of the Autonomous Systems, i. e., collection of computer devices under the same administrative authority that establishes global connection in the Internet, is an instance of a complex system. Out of the vast range of issues that have been addressed in the context of this network, we focus on revealing structural information via visualization.

In the following, we present several examples: excerpts from the temporal evolution of the AS graph between 2001 and now, overlay networks, i.e., comparing Gnutella communication and AS peering relations, and the comparison of different sources for AS path.



We used the technique of [2] as the basis of our analytic visualizations. In Figure (a) and (b), the induced communication network of Gnutella and of a random overlay network, respectively, are shown. Although, both the Gnutella network and the random network (uniformly drawn from the IP space) are non-correlated with the underlying AS graph [1], the two networks significantly differ in certain characteristics. This fact is apparent from the visualizations.

The two data sets obtained from the DIMES project and Oregon Routeview mapping the AS graph share more than 40% of their edges. However, combining both sets yields a more representative picture. The hierarchical layout of this combined set (Figure (c)) is used to study the differences between the two sets. A surprising result is the fact, that both sets equally influence the global shape. These examples show that the technique of [2] has promising potential to analyse various different aspects of the AS graph.

## References

- [1] Vinay Aggarwal, Stefan Bender, Anja Feldmann, and Arne Wichmann. Methodology for estimating network distances of gnutella neighbors. In *GI Jahrestagung*, volume 2, 2004.
- [2] Michael Baur, Ulrik Brandes, Marco Gaertler, and Dorothea Wagner. Drawing the as graph in 2.5 dimensions. In *Proceedings of the 12th International Symposium on Graph Drawing (GD'04)*, volume 3383 of *Lecture Notes in Computer Science*, pages 43–48, 2005.

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