Gueguen Ronan et Hadji Hanane

CYCLON

Inexpensive Membership Management for Unstructured P2P Overlays

Problem statement

With the growth of the Internet in both size and speed, a huge number of network applications and services have been deployed recently and while the centralized servers for large-scale tasks are expensive, dedicated and hard to administer, distributing the workload across participants in a peer-to-peer system can carry these tasks in a simple and generally scalable way.

For highly dynamic systems, overlays that are close to a random graph are preferable.

A random graph is a graph in which properties like the number of graph edges, graph vertices, and connections between them are determined in some random way. Random graph generally refer to probability distributions over graphs.

State-of-the-art

Peer-to-peer systems are separated in two categories, the structured P2P systems and the unstructured P2P systems. The first kind impose a linkage structure between nodes while the second kind peers are linked either randomly or based on the proximity between nodes.

Unstructured P2P systems exploit randomness to disseminate information in a large set of nodes.

Contribution

In this paper, Cyclon, the presented P2P system, is an unstructured system that uses randomness to disseminate information. It is based on the shuffling algorithm, another unstructured P2P system in which each node in graph periodically trades parts of its neighbors with another one, the other node sends back a list of its neighbors in exchange.

Cyclon has a better efficiency, management of node additions and removals, that can establish truly inexpensive membership management that does not disrupt the randomness of the overlay network.

On top of that, Cyclon adds an age to each neighbor a node has and forces all the nodes to shuffle with their oldest neighbor.

Cyclon exhibits properties of similar random graphs, such as the convergence of both the smallest average path length and clustering coefficient to a small value $(O(log(n)), \quad n$: size of the graph).

It also exhibits properties like the connectivity, which is guaranteed in a fail-free environment, and a balanced and uniform degree distribution.

To add nodes to the graph, Cyclon uses an external entry point that will perform several random walks in the graph to find random nodes and perform a shuffle with these nodes, the inserted node is then indistinguishable from another node. How the entry point is connected is out of the scope of this paper.

Cyclon is highly scalable, very robust, and completely decentralized, the resulting communication graphs share important properties with random graphs.

Future works

Cyclon is used in highly dynamic environments, self-monitoring clusters, possibly in the wide area, avoiding centralized architectures. Cyclon is used also for data aggregation in Newscast EM.

The next step that can be reached is to replace the periodic cache exchanges with a reactive exchange protocol, this will lead us to a better usage of network resources, and it will allow us to have a minimal costs when we will detect failed nodes.

Reference

S. Voulgaris, D. Gavidia, and M. van Steen, *Cyclon: Inexpensive Membership Management for Unstructured P2P Overlays*, Journal of Network and Systems Management, Vol. 13, No. 2, June 2005.