Gossip-based Aggregation blah

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Abstract

Motivated by increase of peer-to-peer network and *ad hoc* sensor networks, we study distributed algorithm, also known as gossip algorithm, which is for exchanging information and message dissemination. As aggregating network information and enabling local access to this information are crucial to manage a large scale networks, gossip-based aggregation facilitates management of networks in a completely decentralized manner. This study focuses on the extracting the relation between convergence speed and connectivity of graph, addressing several real network topologies.

Keywords
Gossip-based aggregation, performance

[10]

Contents

1 Introduction

1.1 Background

Large scale computer networks have been an uptrend in these years and will require a more scalable and reliable solution.
Traditionally, with periodically poll and centralized management system, some variables of the network, such as throughput, workload and bandwidth, are gathered through the whole network. Apart from several apparent drawbacks such as single point failure and performance bottleneck, centralized management approach usually cannot fulfill the need of mission-critical business processes, which will often need to deal with load changes and failure [11]. Distributed algorithms are utilized to tackle these problems by propagating messages through the whole network in completely decentralized manner. Another advantage along with the solution is the local accessibility of global information [3].
Gossip-based algorithms, also known as epidemic-style techniques [2], are used to deal with drawback of deterministic algorithms in exchange of certainties. On another hand, they are structureless algorithms, comparing to some other distributed protocols such as Echo algorithm proposed by Segell [9]. Although, gossip-based algorithms could be combined with tree-based algorithms to reach an optimization for certain topologies [6]. Utilizing this algorithm, aggregation could be performed to collect data through the whole network and compute global information on every node. Underlying topology has been proved by many works to have a strong impact on the performance of gossip-based algorithm [7] [3], although little works exist regarding running gossip-based aggregation algorithm in real network topologies. This study would focus on investigating the divergence of performance in different real network topologies, namely Reuna, BREN, Geant, Iij [5].

2 Chapter 2

2.1 Related work

Motivated by peer-to-peer and *ad hoc* networks, a considerable number of studies have been done regarding gossip-based algorithms. Convergence and upper bound consensus time have been proved by J.Lavaei and R.Murray in [7]. Analytical methods and simulations have been utilized to discuss the relations between performance of gossip protocols and topology of network, namely randomness, connectivity etc. As a subcategory of distributed algorithm, different models, such as synchronous and asynchronous models, with or without churn, are discussed in [8]. The optimization of parameters of an asynchronous randomized gossip algorithm for fasted convergence is proved to be semi-definite problem [1].
This study is mainly based on the work of M.Jelasity, A.Montresor and O.Babaoglu [3], focusing on existing static networks of different topologies [5]

2.2 Gossip-based aggregation

A simple implementation of synchronous gossip-based aggregation algorithm, inspired by [3] can be illustrated by following pseudo code,

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hello, world!%TODO: pseudo code
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For better understanding of aggregation mechanism, we assume a graph as in Figure

Although convergence is proved and expected convergence time can be estimated by probability density function for a certain topology [7], a drawback of probabilistic algorithm comparing to deterministic algorithm is reliability [8]. The value can only be considered as true result at a certain probability. To put this protocol into practice, some extra procedures need to be added. In this study, we leave out the test of correctness inside implementation but try to obtain a empirical criteria according to the result of experiments.

2.3 Impact of topology toward the performance of aggregation

A plenty of methods exist to describe overlay topologies of a network, and different representations are used to describe properties of a topology. On the other hand, the performance of gossip-based aggregation is also abstracted differently for specific purpose. In this study, we focus on extracting proper parameters representing a unweighted undirected connected graph through applying the definition of entropy presented by [4] and [10].

In [3], convergence factor $E(2^{-\phi})$ is used to determine convergence time, smaller convergence factor results in faster convergence. The Watts-Strogatz is used to model the topology of overlay network, indicating randomness as an independent variable [12]. Thus, a function is derived, with randomness parameter β as input and convergence factor $E(2^{-\phi})$ as output.

2.4 Applying to real network

In order to apply control variable experiment method, we based our experiment on 4 real network topologies with same number of nodes (37) and different number of links, as showed in Table 2.4. Entropies are also calculated by applying methods presented by [4] (referred in the table as Entropy1) [10] (referred in the table as Entropy2).

Name of Network	Year	Country	# of Links	Entropy1	Entropy2
Reuna	2010	Chile	36	202.0476	0.5164084
BREN	2010	Bulgaria	38	210.2229	0.6214745
Geant	2010	Europe	58	277.3282	1.530375
Iij	2010	Japen, USA	66	307.2482	1.553654

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