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MRAI optimization for BGP convergence time reduction without increasing the number of advertisement messages

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Abstract

The primary cause for the slowness of the Border Gateway Protocol (BGP) convergence delay is the Minimum Route Advertisement Interval (MRAI). The MRAI is a timer with a default value of 30 seconds, which forces the BGP routers to wait for at least that amount of time before sending an advertisement for the same prefix. This process can delay important BGP advertisements. To date, there has been no specific value used by all the networks around the Internet. This paper aims to find the optimum value for the MRAI timer that maximally reduces the convergence time without increasing the number of advertisement messages. The optimal MRAI value founded by this paper reduced the convergence time by minimum 45%.

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Keywords: BGP; Convergence Time; MRAI; Neuro Fuzzy Modelling

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1. Introduction

The Internet consists of numerous heterogeneous computer networks from all over the world [1]. Networks are typically referred to as domains or Autonomous Systems (AS), which are each controlled by single administrative entities. The Border Gateway Protocol (BGP) is the only routing protocol between different networks on the Internet [2]. However, more than one protocol exists within the boundary of each network or AS.

Convergence time is an important metric for routing protocols, such as the BGP. Convergence time is the period required by the BGP to reroute the packet after a routing change. Significant research on BGP convergence time using Internet measurements has revealed the problematic slowness BGP convergence [3]. One of the causes of the delay is a timer called the Minimum Route Advertisement Interval (MRAI). This timer was set to 30 seconds, forcing the BGP routers to wait at least 30 seconds before sending advertisement for the same prefixes [2].

In [4], the MRAI optimal value was dependent on a specific topology and could not be used as a general mechanism to reduce convergence time. However, [5] revealed that, while routing systems with homogeneous MRAI timer values have linear convergence times, diverse MRAI values can cause significant increases in both the convergence time and number of advertisement messages. In [6], the researchers proposed the ghost flushing technique, which reduces convergence times but does not eliminate all cases of unnecessary MRAI timer messages.

Given that the current value for this timer causes significant convergence time delays, we propose an optimum value for the MRAI timer, which improves the convergence process and does not harm the scalability. We examined a number of networks with different topologies to identify the optimum value for the MRAI timer.

The rest of the paper is organized as follows. In Section II, an overview of the BGP is given. The impact of the MRAI on the BGP is explained in Section III. The steps for finding the optimum value for the MRAI are presented in Section IV. Section V discusses the results, and Section VI presents the conclusion and outlines future work.

2. BGP Overview

BGP is based on the path vector routing mechanism. It involves exchanges of network reachability information between the BGP systems to find the most efficient path [7]. Before any information can be exchanged, a BGP session must be established between two BGP routers. The connection is reliable, as the session is supported by the TCP connection. The BGP routers through this connection exchange four different messages [2]:

- OPEN to start the session between any two peers
- UPDATE or advertisement to withdraw an unfeasible route or advertise a new feasible route
- NOTIFICATION to shut down the session whenever an error condition is detected
- KEEPALIVE to verify that the BGP peer is still available; this message must be periodically exchanged

First, a BGP router establishes connection with its neighbours (the other BGP routers) that directly communicate with it. It then downloads the entire routing table of each neighbouring router, finds the best path for each destination and saves that path in the routing table. If there was a routing change for any reason, the BGP router detects it. As a result, the BGP router sends updated messages, which either announces a new path or signifies the withdrawal of a path that no longer exists. As mentioned, convergence time is the time required to reroute packets after a routing change. The current convergence delay could stretch into more than hundreds of seconds, which could lead to high packet drop rates [8].

3. MRAI impact on the BGP

One primary cause of delayed BGP convergence is the MRAI, which is a timer with a default value of 30 seconds [9]. This timer forces the BGP router to wait for at least that amount of time before sending an advertisement for the same prefix. Though this avoids the storm of BGP advertisements, according to [10], it may unnecessarily delay important BGP advertisements.

Thirty seconds is not the optimal value for every network topology, as this time varies from network to network. Previous studies [11-13] have agreed on the significant influence of the MRAI on BGP convergence time, observing