OSPF Efficient LSA Refreshment Function in SDL*

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Abstract. An 11-router Internet Protocol network model based on the Open Shortest Path First (OSPF) routing protocol and Link State Advertisement (LSA) is expressed in the Specification and Description Language (SDL). The corresponding simulation data to verify the performance of a proposed more efficient OSPF LSA refreshment function is presented. Network traffic generated by the routing table refreshment activity using the new function is compared to the traffic generated in the Internet today when using the existing LSA refreshment function. The relative performance characteristics were found to depend on the number of LSA packets per router and the router startup sequence. Such dependencies when using protocol standards in natural language are not always visible until a number of implementations of the standard become available and tested in the field. SDL and tools provide an inexpensive but reliable way of verifying protocols under development in advance of implementation and final agreement.

1 Introduction

The Internet is an interconnection of computers called routers. Routers are responsible for routing of information packets through one or more interconnected Internet Protocol (IP) networks for delivery to specified destinations. If a router fails, the remaining routers must re-route the packets and ensure the correct delivery. This is a very complex task in a dynamic environment. For this purpose, the Internet Engineering Task Force (IETF) has defined a routing protocol called Open Shortest Path First (OSPF) protocol [1,2]. The operation of the OSPF protocol depends on link-state databases that are maintained by each router in the network and used in calculating shortest routes to the destination. Such databases need to be continually updated by having each router originate one or more LSA database entries containing information about each link connected

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to the router. The LSA exchanges lead to additional traffic on the Internet that could cause router outages if the traffic is not managed properly. Manufacturers strive to design OSPF routers that have average downtimes no greater than a few seconds per year.

1.1 Flooding Function Performance

An important property of an OSPF router is its ability to reconfigure dynamically when new routers are added or removed. If the topology of the network changes, each router must adapt quickly without losing information packets or disrupting the end user. To do this, OSPF routers communicate with one another over the network and generate additional traffic overhead. For example, routing tables maintained by every router are updated every 30 minutes by flooding the network with LSA packets from each router. According to Alex Zinin [3], Area Border Routers currently used may generate OSPF traffic on the network in bursts that may cause network exhaustion for several seconds. Depending on the router implementation, such bursts can cause routers to crash, bringing the area network down and requiring operator intervention. As a solution, Zinin proposed a method for dispersing this traffic over the entire 30-minute interval between floods. This proposal was contributed to IETF as an Internet Draft for a more efficient LSA refreshment function [3].

This paper presents the results of the work carried out to verify the operation of the new flooding function and to evaluate the SDL-based design process used in terms of a number of business values. An SDL [4] model of an 11-router OSPF network was developed and simulation data generated to verify the proposed refreshment function performance. Numerical data for the routing table refreshment traffic using the new function is presented based on SDL simulations and the data is compared to that for the currently used LSA refreshment function. Performance characteristics were found to depend on the number of LSAs per router and the router startup sequence.

1.2 Improving RFC Quality

Some important aspects of the refreshment function behaviour are not evident form the natural language specification and normally would require expensive implementation for their determination. SDL (in conjunction with commercial tools) provides an inexpensive approach for such evaluation during the standards development process. At the same time, the results obtained are reliable and have been supported by the individual experts in the field.

Traditionally, IETF Requests for Comment (RFCs) have been specified in ASCII format to permit reading of the content without special tools. However, verification of the RFCs cannot be carried out until a number of implementations enter into operation in the network. Implementation of new protocols are often delayed or not considered due to a lack of confidence in a proposal.

There is value in introducing a greater degree of precision and better documentation capability when specifying RFC content in IETF protocol work. Past