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INTERIOR GATEWAY PROTOCOL PATH COMPUTATION BASED ON THE MAXIMUM TRANSMISSION UNIT FOR A LINK

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ABSTRACT

Fragmentation or packet drops can occur for data packets at any node in the path of packets based on the maximum transmission unit (MTU) of the links that constitute the path. This path can be a tunneled path, which is formed over multiple nodes based on the constraints advertised by Interior Gateway Protocol (IGP) of those nodes. There are certain flows over a tunneled path where fragmentation and dropped packets can cause multiple issues. Provided herein is a proposal to extend the IGP extended link Type-Length-Value (TLV) object to carry information identifying the MTU of a link, which can be used via various applications, such as Traffic Engineering (TE) applications, as a network constraint for path computation. Additionally, techniques herein propose a variant of Constrained Shortest Path First (CSFP) to include link MTU as a constraint for computing candidate route paths for a given destination.

DETAILED DESCRIPTION

Traffic Engineering (TE) is a tunneling technology, which utilizes Interior Gateway Protocol (IGP) as a control protocol. TE-tunnels in a network may be used to facilitate Quality of Service (QoS) flows, optimized bandwidth utilization, redundancy, and/or improved/faster routing. A candidate path (e.g., determined via Segment Routing Traffic Engineering (SR-TE) functionality or any such equivalent path that may be determined based on network constraints) that is created at a headend or Path Computation Element (PCE) typically does not consider the maximum transmission unit (MTU) of the links that constitutes the path. As a result, there is possibility that data packets flowing through the tunneled path can get fragmented. However, for certain flows it may be necessary that data is transferred end-to-end without fragmentation.

Provided herein is a proposal to extend the IGP extended link Type-Length-Value (TLV) object to carry information identifying the MTU of a link, which can be used via various applications, such as TE applications, as a network constraint for path computation. Current techniques involving IGP constraints do not include link MTU as a path computation constraint.

In accordance with this proposal, a new sub-TLV can be included in the extended link TLV object in order to advertise the MTU for a given link such that path computation can be performed based on the link MTU constraint.

Consider an operational example, as illustrate via the example architecture shown in Figure 1, in which an operator can provide a minimum MTU as one of the constraints that can be utilized to set a tunneled path (e.g., SR-TE path) across a single domain or multi-domain network, which will allow routing decisions to be made in conjunction with conventional algorithms enhanced to consider the new parameter of link MTU. In some instance, link MTU can also be used by IGP for path computation using the Flex algorithm.

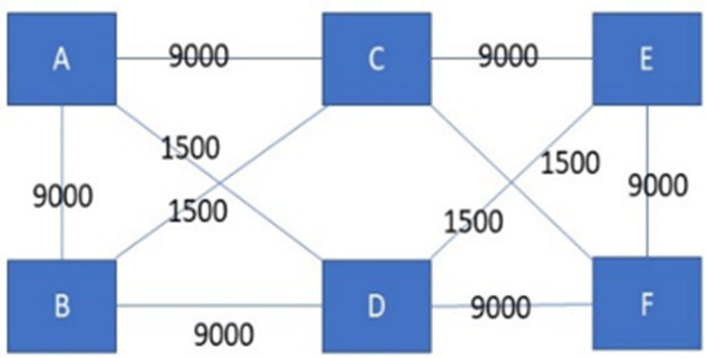

Figure 1: Example Operational Architecture

For the example architecture illustrated in Figure 1, if the link cost is 10 (for all the links), then best path to reach Node F from Node A involves Nodes A, D, and F or Nodes A, C, and F (with a minimum metric of 20). However, due to link MTU constraints, this path may involve the fragmentation of packets that are more than 1500 bytes under an assumption that the smallest MTU in the path involving Nodes A, D, and F or Nodes A, C, and F is 1500 bytes.

However, in accordance with techniques proposed herein, if IGP advertises the link MTU and the link MTU is used as one of the constraints to build the traffic path at Node

A, then a policy can be defined at Node A to build the best path with a constraint of an MTU of, say, 7000 bytes. Thus, Node A can run CSPF path computation operations, considering the link MTU parameter, and calculate a path in which the minimum MTU is more than defined constraint value of 7000 bytes. In this example, such a path may include Nodes A, B, D, and F or Nodes A, C, E, and F, which may provide paths that do not include fragmentation of packets and, thus, offering improvements over current path computation techniques.

Advantageously, realizing path computation improvements utilizing techniques of this proposal does not involve any new operations for path computation but rather involve the use of an additional constraint, link MTU, which can be utilized for path computation operations. Similarly, there is no change suggested for the shortest path first algorithm. Regarding interoperability, a router not supporting the link-attribute sub-TLV can silently ignore the sub-TLV.

If there is more than one path available for a given network topology, the link MTU sub-TLV, as proposed herein, can optionally be added as an attribute that can be used improve decision making capabilities for determining an optimal path. In one example, a topology database can include link MTU information advertised via the IGP extended link TLV such that a computation engine can use this information to determine an optimal path.

Thus, the link MTU, which can be provided as an optional sub-TLV that contains the maximum link MTU, can be used on a link in the direction from a system originating a label-switched path (LSP) to its neighbors, which can be useful for a variety of TE-based solutions.