Transmission Duration Per Bit Cost Metric
draft-perkins-manet-tdpb-00.txt

Abstract

The Transmission Duration Per Bit metric is a simple cost metric that enables selection of a route with the highest end-to-end bandwidth.

Table of Contents

1. Introduction

It is often desirable to identify which of several available routes offers the highest bandwidth for data transmission, regardless of other considerations such as number of hops. However, bandwidth is in certain ways less suitable for use as a routing metric; in particular, the bandwidth of a path with several hops is not as easy to calculate as cost metrics such as hop count.

Instead of bandwidth, we specify the transmission duration as a cost metric. The route with the lowest total transmission duration per bit is the same as the route with the highest bandwidth, and yet the end-to-end transmission duration per bit is simple to calculate. The total transmission duration per bit for a route is the sum of the transmission durations at each hop, so that the TDPB cost metric is additive, monotonic, and easy to calculate.

2. Total Transmission Duration Per Bit

The bandwidth between two neighboring nodes determines the transmission duration per bit (TDPB) between those two nodes. If bandwidth = B bits/second, then we define TDPB = 1 / bandwidth.

For a route R as follows composed of links between nodes N_1 ... N_k:

```
N_1 <--> N_2 <--> N_3 <--> .... <--> N_k
```

denote the link between N_{i} and N_{i+1} by L_{i,i+1} and the bandwidth over link L_{i,i+1} by B_{i,i+1}. Then the TDPB over link L_{i,i+1} is 1 / B_{i,i+1}, which we denote as TDPB(L_{i,i+1}). The TDPB cost for route R is the sum of the TDPB costs for each link, or in other words TDPB(R) = SUM TDPB(L_{i,i+1}) [i == 1..k-1].

3. Cost() and Loop_Free() functions for the TDPB metric

To be useful with AODVv2 [I-D.ietf-manet-aodvv2], it is helpful to define functions Cost() and Loop_Free() for the TDPB metric.

The definition of the Cost() function for TDPB is exactly the same as the TDPB itself. In other words, using TDPB, Cost(L) = TDPB(L) and Cost(R) = TDPB(R) for a link L and a route R.

For routes R1 and R2, Loop_Free(R1, R2) for TDPB is defined as follows:

```
LoopFree(R1,R2) := TDPB(R1) < TDPB(R2)
```

or, in other words, LoopFree(R1,R2) returns TRUE if the cost of R1 is less than the cost of R2 (cost as measured by the TDPB metric).

4. Units for TDPB metric

Transmission times per bit for modern wireless media are tiny. For a slow link operating at only 1 Mb/sec, the transmission time for a single bit is 1 microsecond. Faster links commercially available today for personal computers are able to transmit one bit in less than 1 nanosecond. Already, terabit wireless transmission is available, for instance with satellite communications. In order to lengthen the time for which the TDPB metric may be useful for route selection in wireless networks, it is necessary to pick an extremely unit of measurement.

For the purposes of this initial draft, it is proposed to use units of 0.001 picosecond, and for the value of metric to be 16 bits long, with substructure as follows.

```
 0                   1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Exponent | Significant Digits  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Structure of Value Field for TDBP metric

From the figure, it is seen that the range of values for the TDBP metric will be 2^31 * [0..2^11]. This will enable measurements of TDBP for links as slow as 4 milliseconds, with accuracy of better than one part in a thousand. For routes of length up to 64 hops, the average link speed would need to be faster, perhaps no worse than 64 microseconds/bit; this enables route selection in foreseeable networks with that many hops.

However, should this be insufficient, either more bits of resolution could be added (i.e., metric value of 24 bits instead of 16), or the exponent field could be made into 6 bits or longer. Also see RFC 7185 [RFC7185] for related discussion.

5. Security Considerations

This document does not introduce any security mechanisms, and does not have any impact on existing security mechanisms.

6. IANA Considerations

The routing metric defined in the document should be assigned a value from the "Routing Metric/Constraint Type" registry [RFC6551].

7. References

7.1. Normative References

[RFC6551] Vasseur, JP., Ed., Kim, M., Ed., Pister, K., Dejean, N., and D. Barthel, "Routing Metrics Used for Path Calculation in Low-Power and Lossy Networks", RFC 6551, DOI 10.17487/RFC6551, March 2012, <http://www.rfc-editor.org/info/rfc6551>.

7.2. Informative References

[I-D.ietf-manet-aodvv2] Perkins, C., Ratliff, S., Dowdell, J., Steenbrink, L., and V. Mercieca, "Ad Hoc On-demand Distance Vector (AODVv2) Routing", draft-ietf-manet-aodvv2-11 (work in progress), July 2015.

[RFC7185] Dearlove, C., Clausen, T., and P. Jacquet, "Link Metrics for the Mobile Ad Hoc Network (MANET) Routing Protocol OLSRv2 - Rationale", RFC 7185, DOI 10.17487/RFC7185, April 2014, <http://www.rfc-editor.org/info/rfc7185>.

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