                         OSPF Two-part Metric
                 draft-ietf-ospf-two-part-metric-00.txt

Abstract

   This document specifies an optional extension to the OSPF protocol,
   to represent the metric on a multi-access network as two parts: the
   metric from a router to the network, and the metric from the network
   to the router. The router to router metric would be the sum of the
   two.

Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC2119.

Copyright Notice

Table of Contents

1. Introduction

   For a broadcast network, a Network-LSA is advertised to list all
   routers on the network, and each router on the network includes a
   link in its Router-LSA to describe its connection to the network.
   The link in the Router-LSA includes a metric but the listed routers
   in the Network LSA do not include a metric. This is based on the
   assumption that from a particular router, all others on the same
   network can be reached with the same metric.

   With some broadcast networks, different routers can be reached with
   different metrics. RFC 6845 extends the OSPF protocol with a hybrid
   interface type for that kind of broadcast network, where no Network
   LSA is advertised and Router-LSAs simply include p2p links to all
   routers on the same network with individual metrics. Broadcast

capability is still utilized to optimize database synchronization and
adjacency maintenance.

That works well for broadcast networks where the metric between
different pair of routers are really independent. For example, VPLS
networks.

With certain types of broadcast networks, further optimization can be
made to reduce the size of the Router-LSAs and number of updates.

Consider a satellite radio network with fixed and mobile ground
terminals. All communication goes through the satellite. When the
mobile terminals move about, their communication capability may
change. When OSPF runs over the radio network (routers being or in
tandem with the terminals), RFC 6845 hybrid interface can be used,
but with the following drawbacks.

Consider that one terminal/router moves into an area where its
communication capability degrades significantly. Through the radio
control protocol, all other routers determine that the metric to this
particular router changed and they all need to update their Router-
LSAs accordingly. The router in question also determines that its
metric to reach all others also changed and it also needs to update
its Router-LSA. Consider that there could be many terminals and many
of them can be moving fast and frequently, the number/frequency of
updates of those large Router-LSAs could inhibit network scaling.

2. Proposed Enhancement

Notice that in the above scenario, when one terminal's communication
capability changes, its metric to all other terminals and the metric
from all other terminals to it will all change in a similar fashion.
Given this, the above problem can be easily addressed by breaking the
metric into two parts: the metric to the satellite and the metric
from the satellite. The metric from terminal R1 to R2 would be the
sum of the metric from R1 to the satellite and the metric from the
satellite to R2.

Now instead of using the RFC 6845 hybrid interface type, the network
is just treated as a regular broadcast network. A router on the
network no longer lists individual metrics to each neighbor in its
Router-LSA. Instead, each router advertises the metric from the
network to itself in addition to the normal metric for the network.
With the normal Router-to-Network and additional Network-to-Router
metrics advertised for each router, individual router-to-router
metric can be calculated.

With the proposed enhancement, the size of Router-LSA will be
significantly reduced. In addition, when a router's communication
capability changes, only that router needs to update its Router-LSA.

Note that while the example uses the satellite as the relay point at
the radio level (layer-2), at layer-3, the satellite does not
participate in packet forwarding. In fact, the satellite does not
need to be running any layer-3 protocol. Therefore for generality,
the metric is abstracted as to/from the "network" rather that
specifically to/from the "satellite".

3. Speficications

The following protocol specifications are added to or modified from
the base OSPF protocol. If an area contains one or more two-part
metric networks, then all routers in the area must support the
extensions specified herein. This is ensured by procedures described
in Section 3.5.

3.1. Router Interface Parameters

The "Router interface parameters" have the following additions:

o Two-part metric: TRUE if the interface connects to a multi-access
   network that uses two-part metric. All routers connected to the
   same network SHOULD have the same configuration for their
   corresponding interfaces.

o Interface input cost: Link state metric from the two-part-metric
   network to this router. Defaulted to "Interface output cost" but
   not valid for normal networks using a single metric. May be
   configured or dynamically adjusted to a value different from the
   "Interface output cost".

3.2. Advertising Network-to-Router metric in OSPFv2

For OSPFv2, the Network-to-Router metric is encoded in an OSPF
Extended Link TLV Sub-TLV [ietf-ospf-lsa-extend], defined in this
document as the Network-to-Router Metric Sub-TLV. The type of the
Sub-TLV is TBD. The length of the Sub-TLV is 4 (for the value part
only). The value part of the Sub-TLV is defined as follows:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |      MT       |       0       |          MT   metric          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Multiple such Sub-TLVs can exist in a single OSPF Extended Link TLV,
one for each topology. The OSPF Extended Link TLV identifies the
transit link to the network, and is part of an OSPFv2 Extended-Link
Opaque LSA. The Sub-TLV MUST ONLY appear in Extended-Link TLVs for
Link Type 2 (link to transit network), and MUST be ignored if
received for other link types.

3.3. Advertising Network-to-Router metric in OSPFv3

For OSPFv3, the same Network-to-Router Metric Sub-TLV definition is
used, though it is part of the Router-Link TLV of E-Router-LSA [ietf-
ospf-ospfv3-lsa-extend]. Currently OSPFv3 Multi-Toplogy is not
defined so the only valid value for the MT field is 0 and only one
such Sub-TLV SHOULD be included in the Router-Link TLV. Received
Sub-TLVs with non-zero MT field MUST be ignored.

Similarly, the Sub-TLV MUST ONLY appear in Router-Link TLVs for Link
Type 2 (connection to a transit network) and MUST be ignored if
received for other link types.

3.4. SPF Calculation

During the first stage of shortest-path tree calculation for an area,
when a vertex V corresponding to a Network-LSA is added to the
shortest-path tree and its adjacent vertex W (joined by a link in V's
corresponding Network LSA), the cost from V to W, which is W's
network-to-router cost, is determined as follows:

o For OSPFv2, if vertex W has a corresponding Extended-Link Opaque
   LSA with an Extended Link TLV for the link from W to V, and the
   Extended Link TLV has a Network-to-Router Metric Sub-TLV for the
   corresponding topology, then the cost from V to W is the metric in
   the Sub-TLV. Otherwise, the cost is 0.

o For OSPFv3, if vertex W has a corresponding E-Router-LSA with a
   Router-Link TLV for the link from W to V, and the Router-Link TLV
   has a Network-to-Router Metric Sub-TLV, then the cost from V to W
   is the metric in the Sub-TLV. If not, the cost is 0.

3.5. Backward Compatibility

Due to the change of procedures in the SPF calculation, all routers
in an area that includes one or more two-part metric networks must
support the changes specified in this document. To ensure that, if
an area is provisioned to support two-part metric networks, all
routers supporting this capability must advertise a Router
Information (RI) LSA with a Router Functional Capabilities TLV [acee-

   ospf-rfc4970bis] that includes the following Router Functional
   Capability Bit:

                Bit   Capabilities

                0   OSPF Two-part Metric [TPM]

   Upon detecting the presence of a reachable Router-LSA without a
   companion RI LSA that has the bit set, all routers MUST disable the
   two-part metric functionalities and take the following actions:

   o If this router currently advertises network-to-router costs,
      remove the Network-to-Router Metric Sub-TLVs. This may lead to
      removal of parent TLVs and even withdrawal of the parent LSAs.

   o Recalculate routes w/o considering any network-to-router costs.

4. IANA Considerations

   This document requests IANA to assigna a new bit in the Router
   Functional Capabilities TLV to indicate the capability of supporting
   two-part metric, a new Sub-TLV in the OSPF Extended-Link TLV Sub-TLV
   Registry, and a new Sub-TLV in the The OSPFv3 Extend-LSA Sub-TLV
   registry.

5. Security Considerations

   This document does not introduce new security risks.

6. Acknowledgements

   The authors would like to thank Abhay Roy, Hannes Gredler, Peter
   Psenak and Eric Wu for their comments and suggestions.

7. References

7.1. Normative References

   [I-D.acee-ospf-rfc4970bis]
              Lindem, A., Shen, N., Vasseur, J., Aggarwal, R., and S.
              Shaffer, "Extensions to OSPF for Advertising Optional
              Router Capabilities", draft-acee-ospf-rfc4970bis-00 (work
              in progress), July 2014.

[I-D.ietf-ospf-lsa-extend]
          Psenak, P., Previdi, S., Filsfils, C., Gredler, H.,
          Shakir, R., Henderickx, W., Tantsura, J., and A. Lindem,
          "OSPFv2 LSA Extendibility", draft-ietf-ospf-lsa-extend-00
          (work in progress), August 2014.

[I-D.ietf-ospf-ospfv3-lsa-extend]
          Lindem, A., Mirtorabi, S., Roy, A., and F. Baker, "OSPFv3
          LSA Extendibility", draft-ietf-ospf-ospfv3-lsa-extend-05
          (work in progress), November 2014.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
          Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2328] Moy, J., "OSPF Version 2", STD 54, RFC 2328, April 1998.

[RFC4915] Psenak, P., Mirtorabi, S., Roy, A., Nguyen, L., and P.
          Pillay-Esnault, "Multi-Topology (MT) Routing in OSPF", RFC
          4915, June 2007.

[RFC5340] Coltun, R., Ferguson, D., Moy, J., and A. Lindem, "OSPF
          for IPv6", RFC 5340, July 2008.

[RFC5613] Zinin, A., Roy, A., Nguyen, L., Friedman, B., and D.
          Yeung, "OSPF Link-Local Signaling", RFC 5613, August 2009.

7.2. Informative References

[RFC6845] Sheth, N., Wang, L., and J. Zhang, "OSPF Hybrid Broadcast
          and Point-to-Multipoint Interface Type", RFC 6845, January
          2013.

Authors' Addresses

   Jeffrey Zhang
   Juniper Networks, Inc.
   10 Technology Park Drive
   Westford, MA 01886

   EMail: zzhang@juniper.net

   Lili Wang
   Juniper Networks, Inc.
   10 Technology Park Drive
   Westford, MA 01886

   EMail: liliw@juniper.net

    Acee Lindem
    Cisco Systems
    301 Midenhall Way
    Cary, NC 27513

    EMail: acee@cisco.com

    David Dubois
    General Dynamics C4S
    400 John Quincy Adams Road
    Taunton, MA 02780

    EMail: dave.dubois@gdc4s.com

    Vibhor Julka
    L3 Communications, Linkabit
    9890 Towne Centre Drive
    San Diego, CA 92121

    EMail: vibhor.julka@l-3Com.com

    Tom McMillan
    L3 Communications, Linkabit
    9890 Towne Centre Drive
    San Diego, CA 92121

    EMail: tom.mcmillan@l-3com.com