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IGRP Metric

Introduction

Interior Gateway Routing Protocol (IGRP) calculates a metric by adding together weighted values of different characteristics of the link to the network in question. The link characteristics from which IGRP calculates its composite metric are bandwidth, delay, load, reliability, and maximum transmission unit (MTU). By default, IGRP chooses a route based on bandwidth and delay.

Prerequisites

Requirements

Readers of this document should be knowledgeable of the following:

- IGRP and its features

    Note: Refer to An Introduction to IGRP for more information.

Components Used

The information in this document is based on the software and hardware versions:

- Cisco IOS Software Release 12.2(10b)
- Cisco 2500 Series Routers

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

Finding the IGRP Metric

Let us take an example and find the metric when IGRP is the routing protocol.

Network Diagram

The diagram for the given scenario is below:

Here is the formula for calculating the composite metric for IGRP:

Metric = [K1 * Bandwidth + (K2 * Bandwidth)/(256–load) + K3*Delay] * [K5/(reliability + K4)]

The default constant values are K1 = K3 = 1 and K2 = K4 = K5 = 0.

If K5 = 0, the [K5/(reliability + K4)] term is not used. So, given the default values for K1 through K5, the composite metric calculation used by IGRP reduces to Metric = Bandwidth + Delay.

The K values in these formulas are constants that can be defined using the router configuration command, **metric weights tos k1 k2 k3 k4 k5**.

To find the bandwidth, find the smallest of all the bandwidths from outgoing interfaces and divide 10,000,000 by that number. (The bandwidth is scaled by 10,000,000 in kilobits per second.)

To find the delay, add all the delays from the outgoing interfaces and divide this number by 10. (The delay is in 10s of microseconds.)

Remember, the path with the smallest metric is the best path.

The various outputs of the show commands for both the routers are as below:

```
Venus# show interfaces ethernet 0
Ethernet0 is up, line protocol is up
Hardware is Lance, address is 0060.5cf4.a9a8 (bia 0060.5cf4.a9a8)
Internet address is 12.1.1.1/24
MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set

Venus# show interfaces serial 0
Serial0 is up, line protocol is up
Hardware is HD64570
Internet address is 172.16.10.2/24
MTU 1500 bytes, BW 784 Kbit, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation FRAME–RELAY, loopback not set
Keepalive set (10 sec)
LMI enq sent 981, LMI stat recvd 330, LMI upd recvd 0, DTE LMI up
LMI enq recvd 340, LMI stat sent 0, LMI upd sent 0
```

```
                    LMI DLCI 1023 LMI type is CISCO frame relay DTE

            Saturn# show interfaces serial 0
            Serial0 is up, line protocol is up
            Hardware is HD64570
            Internet address is 172.16.10.1/24
            MTU 1500 bytes, BW 224 Kbit, DLY 20000 usec,
            reliability 255/255, txload 1/255, rxload 1/255
            Encapsulation FRAME-RELAY, loopback not set
            Keepalive set (10 sec)
            LMI enq sent 167, LMI stat recvd 168, LMI upd recvd 0, DTE LMI up
            LMI enq recvd 0, LMI stat sent 0, LMI upd sent 0
            LMI DLCI 1023 LMI type is CISCO frame relay DTE

            Saturn# show interfaces ethernet 0
            Ethernet0 is up, line protocol is up
            Hardware is Lance, address is 0060.5cf4.a955 (bia 0060.5cf4.a955)
            Internet address is 172.17.10.1/16
            MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
            reliability 255/255, txload 1/255, rxload 1/255
            Encapsulation ARPA, loopback not set
```

The metric values calculated by IGRP can be viewed with the **show ip route** command.

```
            Venus# show ip route 172.17.1.1
            Routing entry for 172.17.0.0/16
            Known via "igrp 100", distance 100, metric 14855
            Redistributing via igrp 100
```

The corresponding calculations are:

Metric = Bandwidth + Delay = 10000000/784 + (20000 + 1000)/10 = **14855**

```
            Saturn# show ip route 12.1.1.1
            Routing entry for 12.0.0.0/8
            Known via "igrp 100", distance 100, metric 46742
            Redistributing via igrp 100
```

The corresponding calculations are:

Metric = Bandwidth + Delay = 10000000/224 + (20000 + 1000)/10 = **46742**

How Often Is Load Calculated?

The constant K2 defaults to zero. If K2 is set to 1, load becomes a variable used in routing. The problem would seem to be if the load jumps. For instance, at the start of an FTP session, the metric cost would jump, possibly making the route go into holddown due to the increase. How often is load calculated?

The load is a five minute exponentially weighted average that is updated every five seconds.

How Fast Can the Load Value Rise?

Is it possible for the load value to rise fast enough to make the route unstable?

Yes, it is. And worse, when the load falls, the metric will decrease, which causes a Flash update. We strongly suggest that you do not change the default K parameters.

Can IGRP Be Configured to Use the Fastest Path through the Network Cloud?

Since the composite metric cost to a given site is determined by the slowest link in the path and the slowest link is normally the access line into the cloud, how can IGRP be configured to use the fastest path through the network cloud?

Once the slowest link has been determined, the rest of the routing is done on hops (delay) without regard for hop link speeds. With the large gaps in the bandwidth values, it doesn't seem practical to try and use delay to bias network cloud routing. One obvious solution would be to configure the **bandwidth** command on the access lines to be faster than any network cloud backbone line.

Another solution is to configure the delay on the WAN links to be an accurate measurement of the delay for that particular link. You should not have to tweak the delays at all, and it should give you good routing.

Changing the bandwidths on the access line is certainly something that is worthwhile if you have radically different bandwidths within your WAN.

What Metric Should Be Used When Redistributing Routes into IGRP?

Use the **default−metric** statement to set the metric for the redistributed routes. The following statement is appropriate for most cases:

```
Venus(config)# router igrp 100
  Venus(config-router)# default-metric 10000 100 255 1 1500
```

Where 10000 = Bandwidth, 100 = Delay, 255 = Reliability, 1 = Loading, and 1500 = MTU.

Related Information

- **IGRP Support Page**
- **Technical Support − Cisco Systems**