XRoads Networks - White Paper
BPR (Best Path Routing)

The purpose of this paper is to provide an understanding of XRoads Networks' patent-pending BPR technology that is built into its XRoads Edge product line.

Background

In large computer networks, such as the Internet, the entire network is actually made up of many smaller networks. Each of those smaller networks use their own methods to route traffic, some better than others. Due to various adoptions of practices, it is very difficult to provide guarantees in terms of packet loss, latency, etc to every network and every node on this large network. There are simply too many smaller networks using too many different routing technologies to ensure that the data sent from one end of a network connection to the other is handled and/or treated the same.

Many providers over the years have begun to implement standards within their own networks in an attempt to increase reliability and ensure that network traffic is handled the same from one end to the other.

The problem is that in most cases, the businesses that use the Internet have offices, and/or partners which do not use the same network provider and thus data traffic between these offices is not guaranteed.

This generally means that as the data leaves one office bound for a partners office, the data must be exchanged from one service provider to another. Even if the first provider has a particular SLA (Service Level Agreement) with the customer sending the traffic, there is generally no agreement with the second service provider, and thus the data is delivered with minimal, if any, SLAs.

With most web and email traffic this is not a major problem, however when it comes to critical latency sensitive data, such as VPNs, VoIP, and Point of Sale systems, SLAs and quality of the service becomes critical.

Summary

XRoads Networks BPR seeks to provide a novel method for optimizing network traffic by probing the critical remote networks via two or more diverse network paths, and then selecting the path that provides the overall best route, i.e. the lowest latency, lowest packet loss, and lowest calculated jitter. Using this method BPR effectively ensures that the network traffic stays on the same service provider as long as possible, in some cases from one side of the connection to the other.

BPR (Best Path Routing) network path selection is based on the continued measurement of a remote networks defined node via two or more diverse network paths to a larger external network, enabling the local network to also use the most optimal path for sending its data traffic.

In accord with the path selection by the BPR module a change to the XRoads Edge routing table is made such that all traffic bound for the associated remote network is sent through the appropriate network path.

Detailed Description

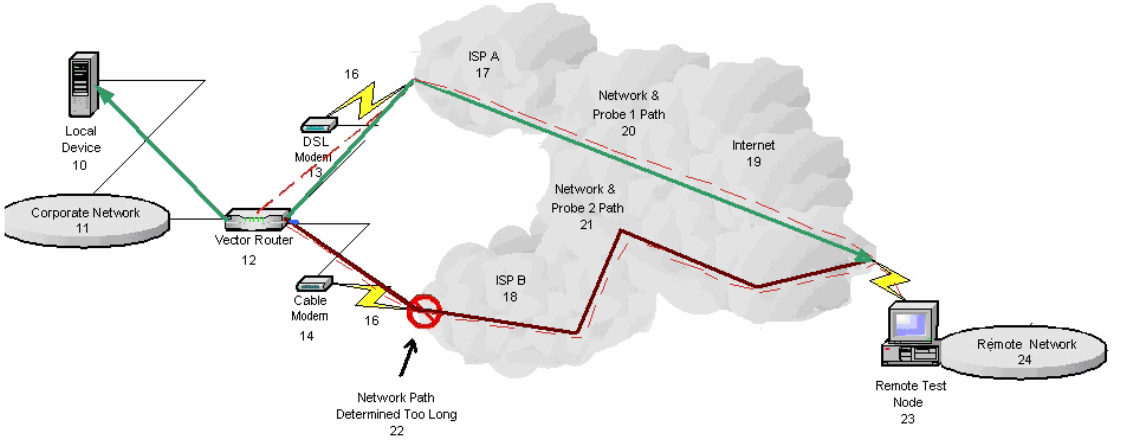
BPR works using a combination of techniques which are currently pending patent assignments from the USPTO. These techniques are described below:

- Critical Network Assignment
  - To initiate BPR the XRoads Edge administrator must first define a set of critical networks. These “critical networks” are remote networks which are heavily utilized by the local network, or carry other critical significance. The critical network is defined as:
    - Network Address
    - Network Subnet
    - Probe Address
- Thresholds Assignment
  - Upon configuration of a “critical network” several thresholds need to be configured which are used by the BPR module to determine the most suitable path, and when a path is to be determined as unacceptable. These thresholds include:
    - Packet Loss
    - Latency
    - Calculated Jitter
- Intelligent Probing
  - The BPR module uses a unique method of sending modified ICMP packets to the remote probe address. The responses obtained from those ICMP probes are then stored in the XRoads Edge memory for continuous examination by the BPR module.
- Smart Routing
  - The BPR module employs Smart Routing to determine which network path, when two or more are available, is “best” for delivering local network traffic to the remote critical network.
- SLA Reporting
  - Unique to the XRoads Edge product line and most of the “network load balancing” products on the market, is the BPR modules ability to perform detailed analysis on the probe responses in relation to the thresholds assigned by the administrator. This analysis is presented to the administrator in three forms.

- Graphical report generation – showing each paths current packet loss, and latency calculations.
- Web reports – showing how the TRUE network metrics compare to the SLA guarantees provided by the service providers.
- Emailed alerts – providing instant notification when an SLA threshold is outside the provided guarantee.

BPR (Best Path Routing)

FIG. 1



Reference is now made to FIG. 1 that provides the general flow of BPR (Best Path Routing). BPR in this diagram consists of two diverse network paths connected to a computing device which is running the BPR module (software code). The two network paths consist of broadband connection devices 13 and 14, logical broadband data connections 16, their associated networks 17 and 18 and the larger external network (in this case the Internet) 19. To ensure that the local network 11 is using the optimal path, the XRoads Edge 12 sends probe packets via a modified ICMP packet to an administratively defined remote node 23 to gather network measurements to determine which network path is providing the most optimal path of the local networks 11 data.

The modified ICMP packet consists of a standard ICMP packet with specific and predefined bits within the data portion of the packet which the BRP enabled apparatus looks for when determining which path is optimal. Others factors used when determining the best path include latency, packet loss, and calculated jitter. These measurements are then stored within the XRoads Edge for later comparison and manipulation by the BPR module to determine which diverse network path should be used for the associated remote network which has been defined by the administrator.

When the probe packets are sent out via the network paths 20 and 21 to remote node 23, the responses of those packets are used to determine which network path 20 or 21 will be used when sending data packets to the remote network 24. Once this determination has been made, the XRoads Edge routing table 12 is updated with route information associated with the optimal network path.

References Cited

Vector Routing White Paper, September 2001.
Vector Routing provisional patent filed June 2001.