HUGHES
An EchoStar Company

JUPITER™ System and Multiprotocol Label Switching (MPLS)

To meet the increasing demand for speeding up and shaping network traffic flows, next-generation platforms for VSAT networks must have the ability to be easily integrated with Multiprotocol Label Switching (MPLS) protocol. The Hughes JUPITER System, the most advanced and most widely deployed VSAT system, offers seamless integration with MPLS, making it simple for any operator who uses JUPITER to shape and speed up network traffic flows.

There are a variety of ways in which the JUPITER System can interact with MPLS. The JUPITER System can be an extension of an MPLS network, a backup to an MPLS network, or part of an MPLS network. Since MPLS is a sub-IP layer method for handling Quality of Service, Routing, and multiple customers' IP address spaces, it is an alternate sub-IP layer to those used in other transport networks, such as those provided by JUPITER. Traffic traversing the JUPITER System transports is not required to carry MPLS tags, since it has existing sub-IP layer and IP layer mechanisms that are equivalent to those provided by MPLS.

Introduction to MPLS

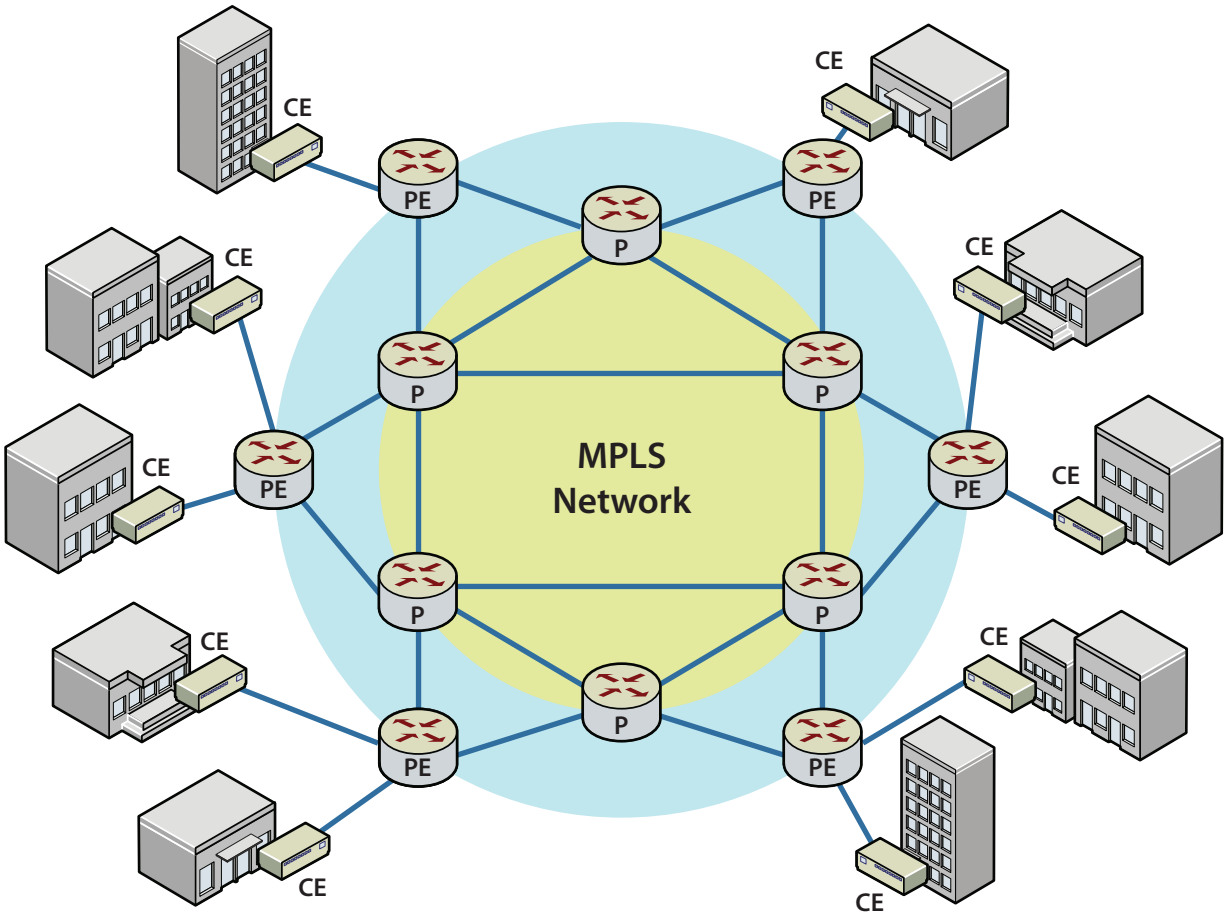

Figure 1. Router Types in an MPLS Network

An MPLS backbone network is a set of Provider Edge (PE) and Provider (P) routers that are interconnected and administered by the same Service Provider, carrying MPLS labels on traffic between them, and using the labels for the purposes of switching and providing differentiated service to traffic flows over the backbone. Traffic between PE and P routers is label switched according to MPLS, and the PE and P routers do not need to access the IP/TCP/UDP headers of the traffic to make a classification or forwarding decision. Because P routers are not edge routers, they do not require a routing protocol that contains customer IP subnet information. They may run an internal routing protocol between themselves and PEs, to determine reachability within the backbone.

PE routers are the edge routers of the service provider network. They may need to look into the IP packet for packets ingressing and egressing to Customer Edge (CE) routers, but not for packets on interfaces to other PE routers or P routers. PEs contain multiple virtual routers or VRFs, one for each virtual private network that it directly serves. A PE router is said to serve a virtual private network if it is directly connected to a CE that is a member of that virtual private network. A PE does not contain virtual routers if it does not have a directly connected CE that is a member of that domain and does not exchange routing information regarding a virtual private network if it has no directly connected CE in that domain.

The CE is at the customer premise. A CE may be a member of multiple virtual private networks, but for simplicity, this brief MPLS introduction discusses the case of a CE belonging to a single virtual private network. The CE may or may not participate in a routing protocol with the PE router as described above. The CE may or may not participate in a routing protocol with the local site network for which it provides access to the MPLS network. If the CE performs a routing protocol with the local site, the routing protocol that it uses may or may not be same as the routing protocol it uses to the PE.

JUPITER as an extension of an MPLS network

In a scenario where some number of sites associated with an enterprise cannot or do not receive MPLS last mile connectivity, JUPITER can be used as an extension (Figure 2). Traffic from one or more IP Transport Remote Terminations is aggregated onto an MPLS connection with connectivity to the other enterprise sites on the MPLS network including data centers Further, there may be a connection to the MPLS network dedicated to a single customer, or, where the Hub CE supports multiple VRF, there may be an aggregated connection to the MPLS network serving multiple customers.

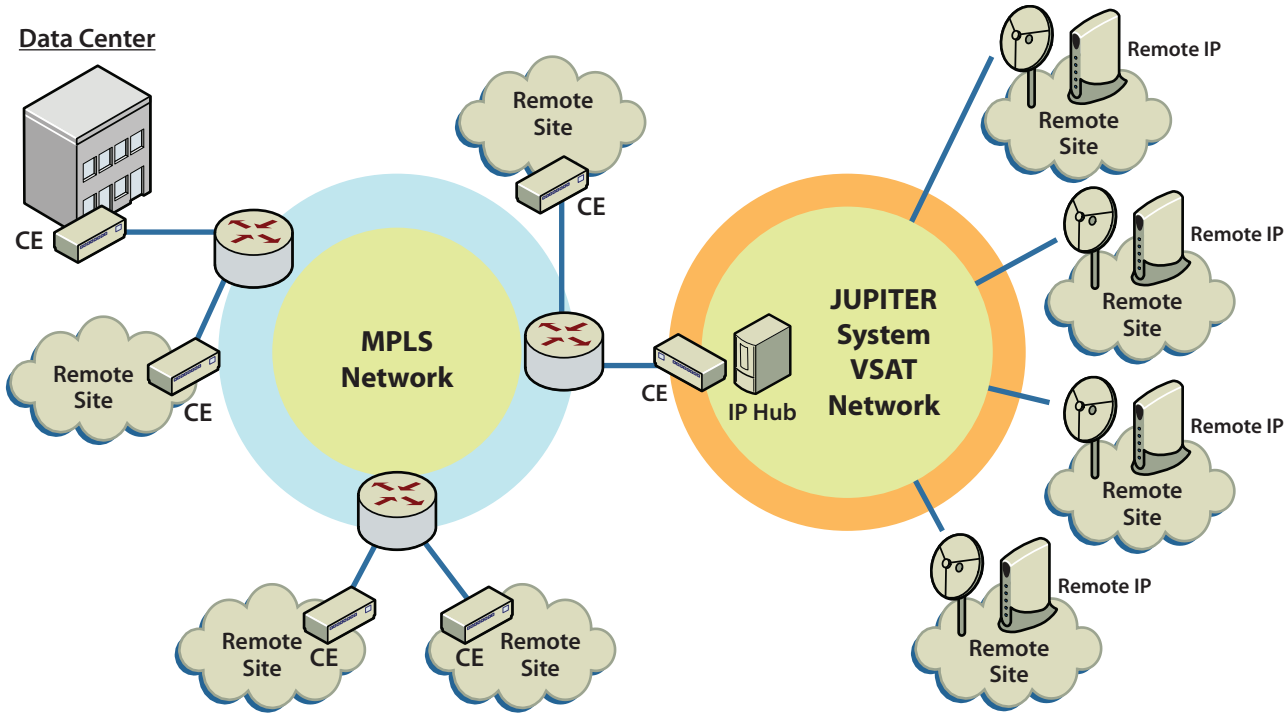

Figure 2. JUPITER as an extension to MPLS

Routing for Access Continuity

1. **Static Routing** – This would be used when the remote site has no additional routers and/or static routing is to be configured for the routers at the remote location. VRRP is used between the CE and the JUPITER remote terminal to determine the current primary default route for the customer's remote network. For the return traffic, either routing protocols are used between the Interface Router and both Hub CE and the JUPITER hub (with the IP gateway using up/down status of the JUPITER remote to determine its routes), or a static route is used at the Interface Router to the JUPITER hub with a higher metric with the Hub CE reporting reachability with a routing protocol.

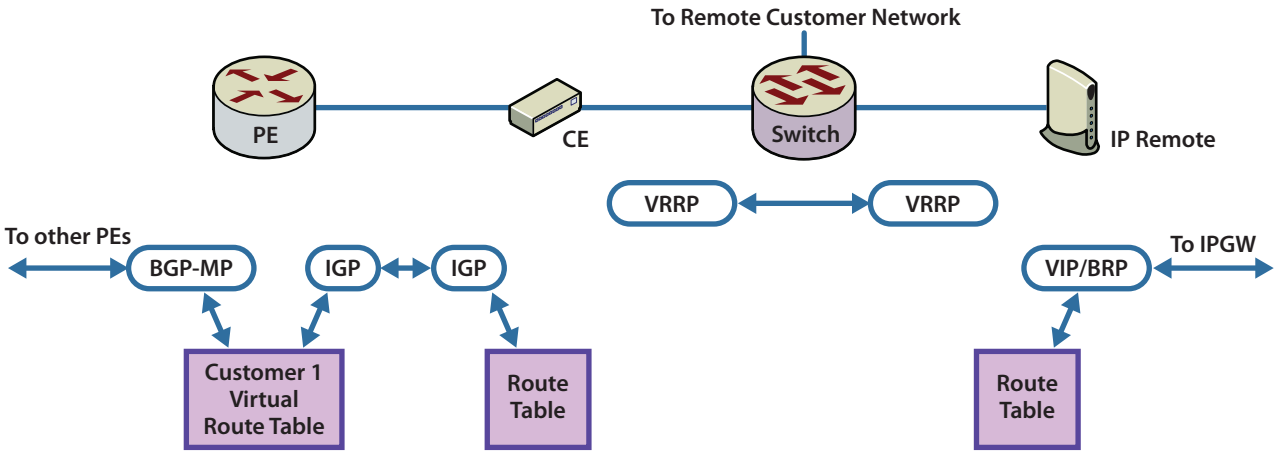

Figure 3

2. **RIP** – The figure below illustrates use of RIP between JUPITER hub and CE. VRRP is used between CE and JUPITER remote terminal to determine the default route for customer remote network.

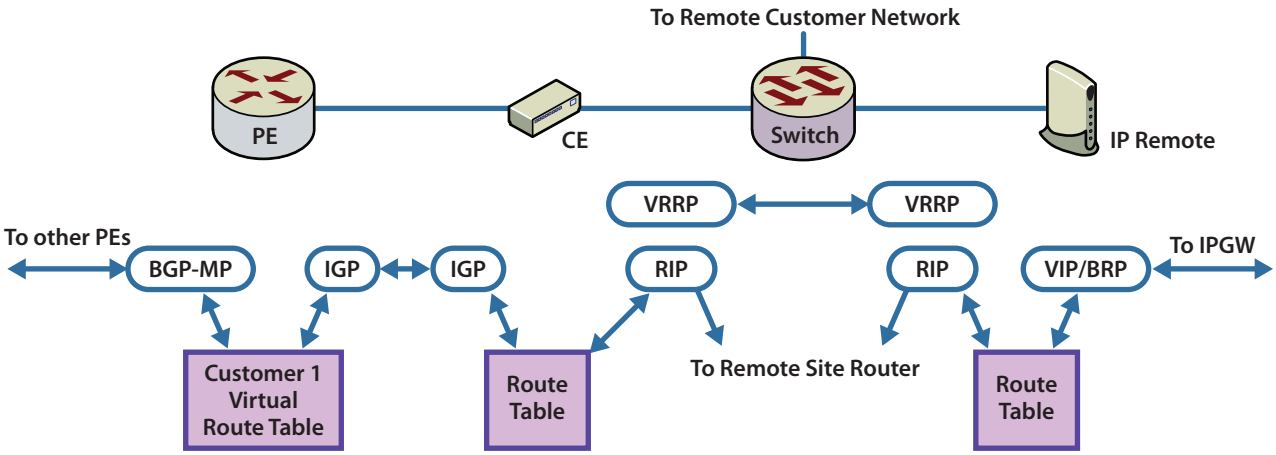

Figure 4

3. Other routing protocol at remote site – Interface routers may be used to support other routing protocols as illustrated in Figure 5.

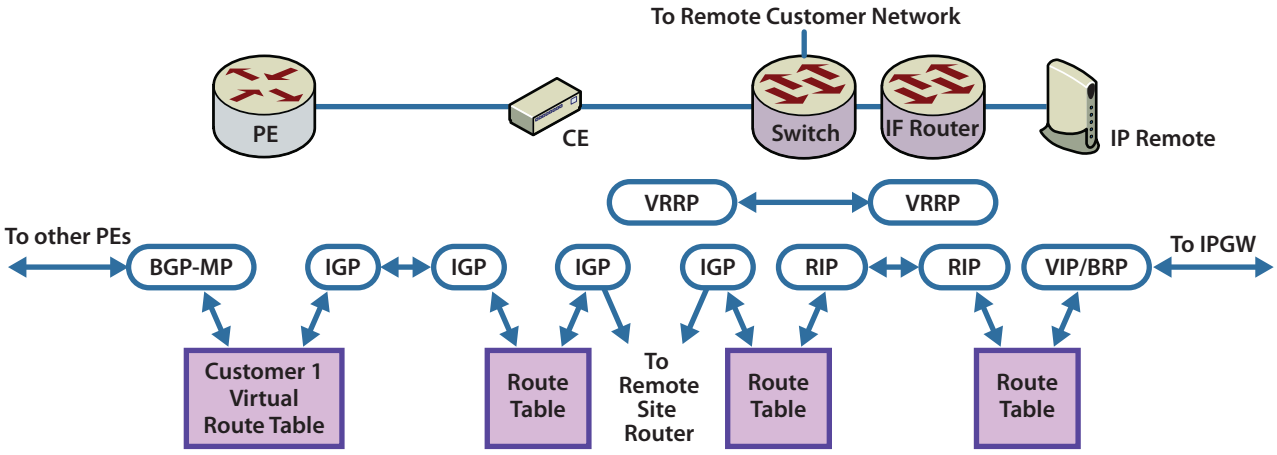

Figure 5

JUPITER as backup of an MPLS network

The JUPITER System can be used as an integrated backup to an existing MPLS network (Figure 6). In this scenario, JUPITER is desired to ensure that any failure of the MPLS access can be mitigated. This can be combined with the aforementioned item 2 to allow for the use of both paths when available and the consolidation to one path for at least some traffic if the other path is currently unavailable.

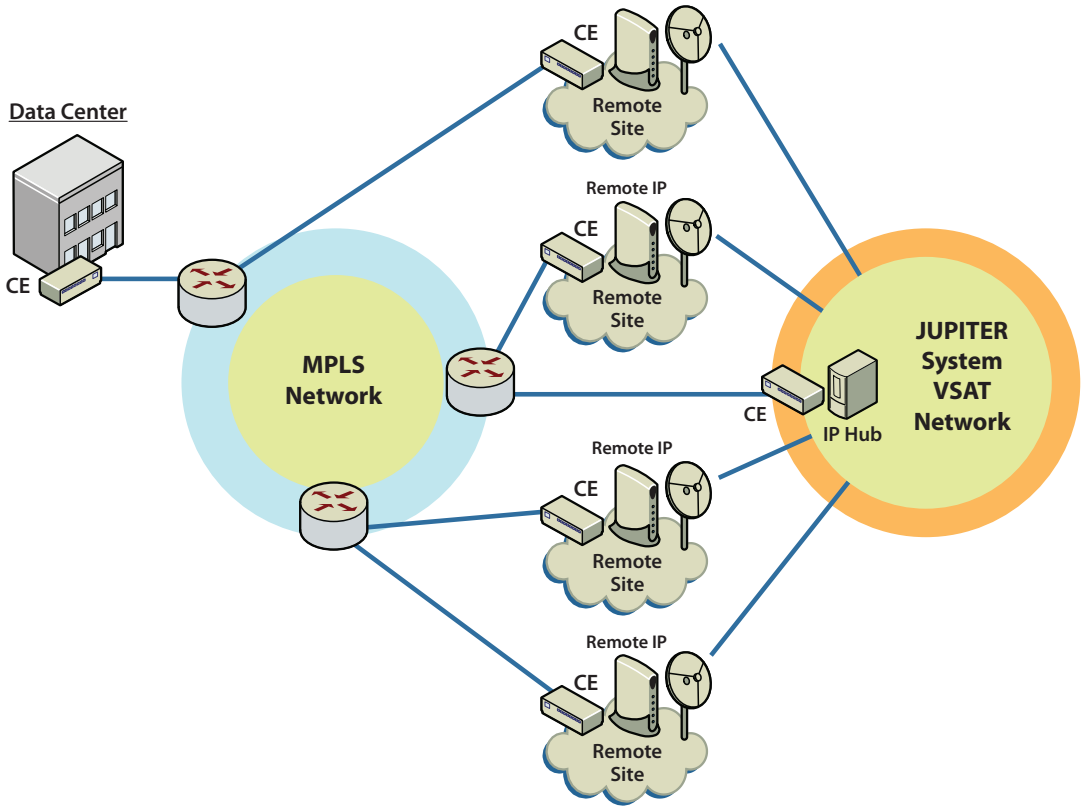

Figure 6. JUPITER as backup of MPLS network

Routing in JUPITER as backup of MPLS network

Routing is a critical aspect of every network. The JUPITER System supports a variety of routing protocols between the hub and CE as follows:

1. Static Routes

In this case no routing protocol is run between the CE and the JUPITER hub (shown as IP GW in the diagram). Static routes are used at the CE and the JUPITER hub.

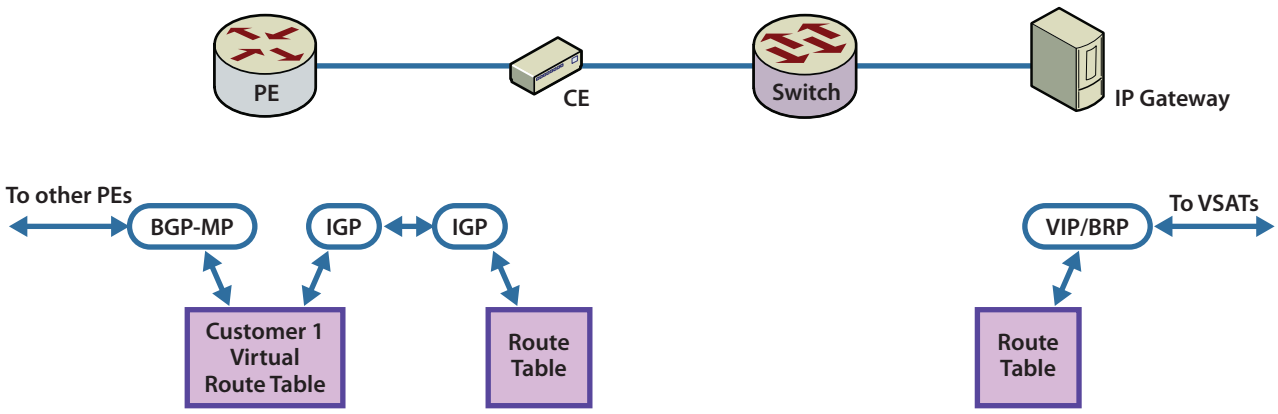

Figure 7

2. RIP to CE

In this case, the CE and the JUPITER hub (shown as IP GW in the diagram) are configured to exchange RIP. The CE may be configured to use a different routing protocol with the PE. The JUPITER hub and remotes may or may not be configured to use Dynamic Routing.

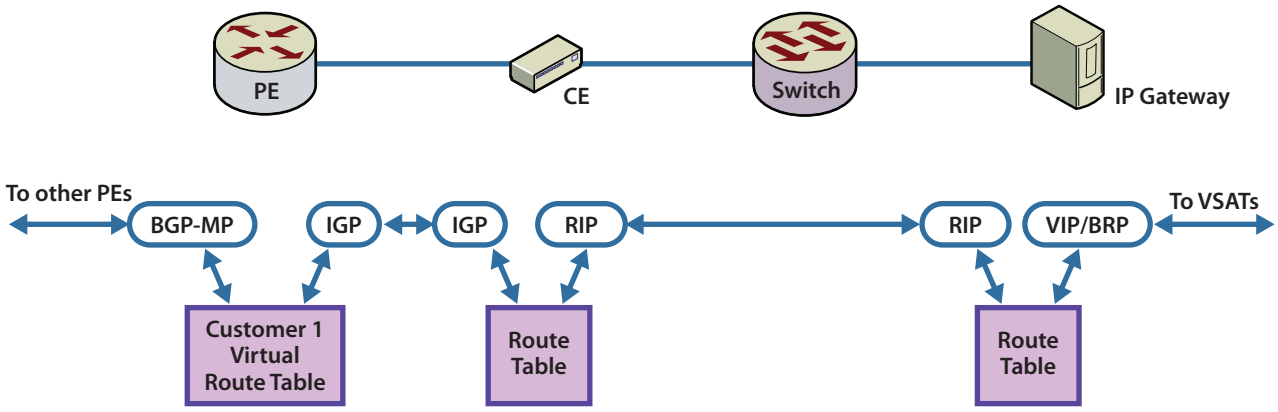

Figure 8

3. BGP to CE

In this case, the CE and the IPGW in the JUPITER hub are configured to exchange BGP. The CE may be configured to use a different routing protocol with the PE. The JUPITER hub and remotes may or may not be configured to use Dynamic Routing.

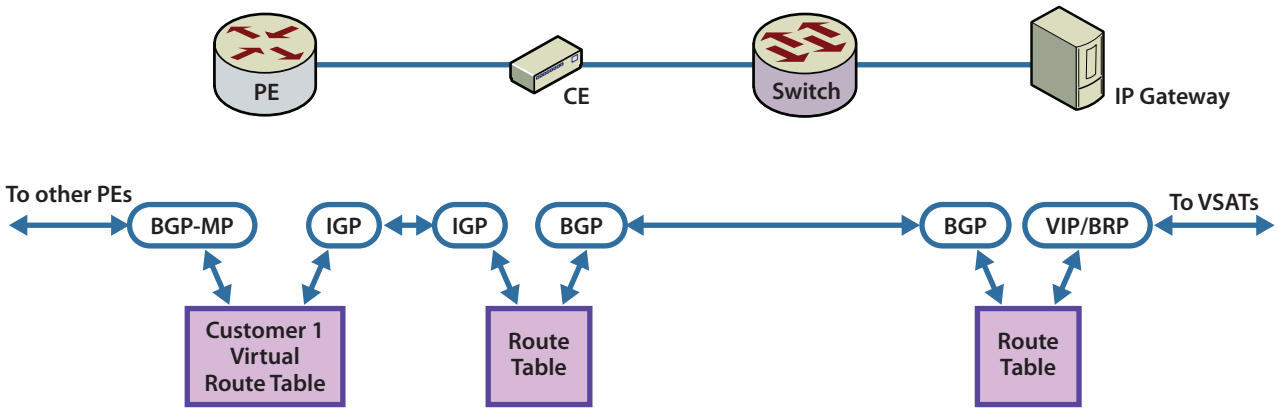

Figure 9

4. Other routing protocols to CE

In order to support routing protocols other than RIP and BGP, another router may be used for cases where the CE is not configured to support either RIP or BGP.

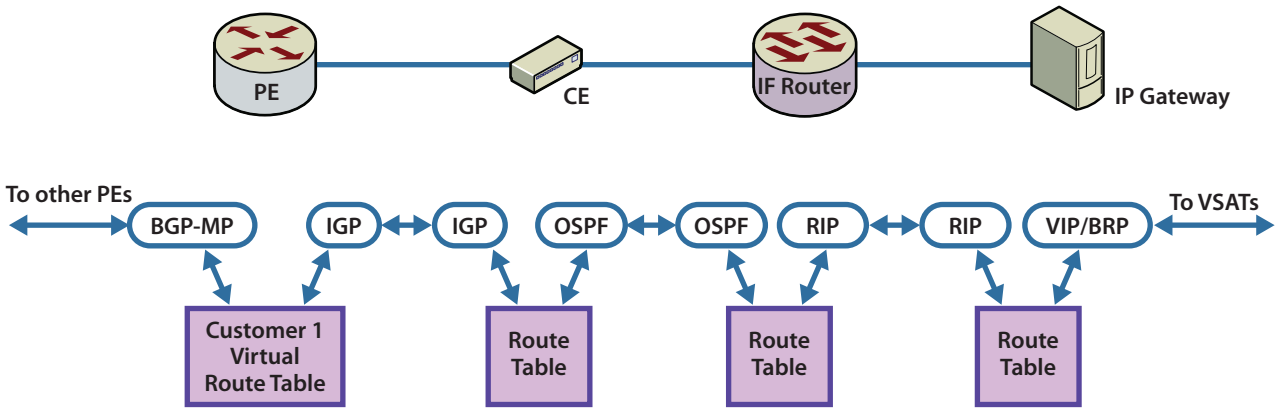

Figure 10

JUPITER for multicast

To understand the use of JUPITER System in Multicast MPLS network, we assume that Protocol Independent Multicast – Sparse-Dense Mode (PIM-SDM) is the protocol used in the MPLS network. PIM-SDM is a protocol used between routers to set up distribution trees based on which routers have ports where a host or another router is requesting multicast data for a specific multicast address. Sparse mode and sparse-dense modes are methods for how the multicast distribution tree is created and pruned back as a function of membership. The PIM-SDM protocol runs between PEs and P routers and the backbone multicast tables are not shown in the figures provided. The multicast configurations supported by JUPITER include:

1. Static Multicast Configuration

The implication is that the multicast traffic is always sent to the CE at the JUPITER hub.

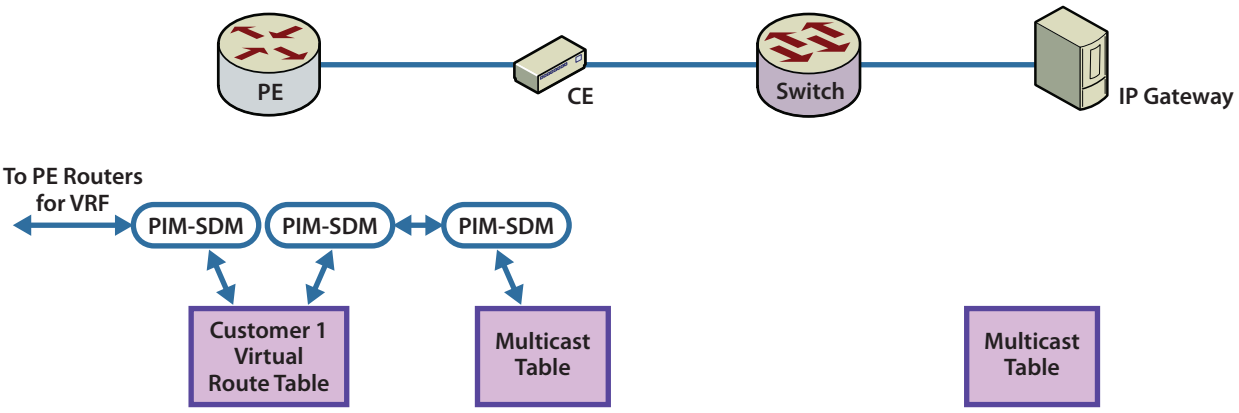

Figure 11

2. Dynamic protocols at Hub

If the multicast is not dynamically joined by JUPITER, then there needs to be enough bandwidth to support all the multicasts coming into the JUPITER hub CE at all times.

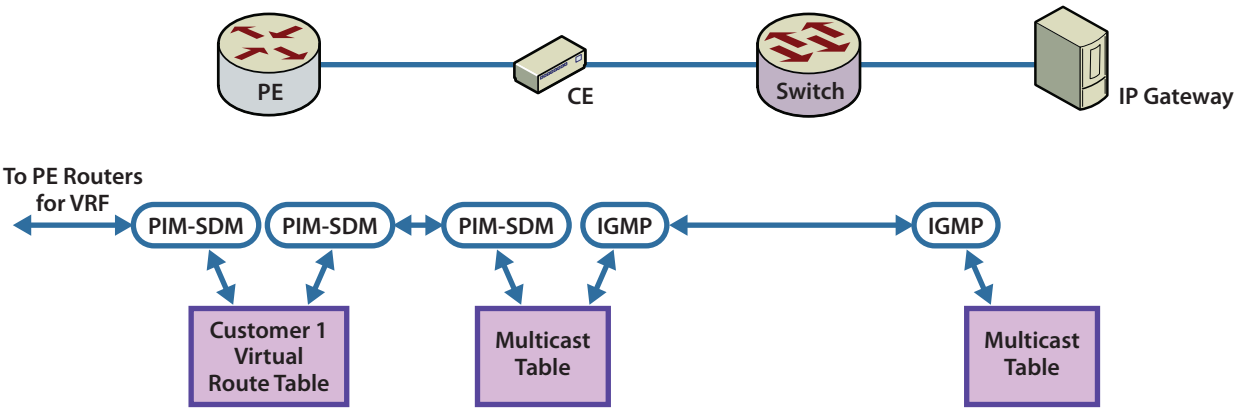

Figure 12

Full set of features for every MPLS configuration

In order to seamlessly support the above three configurations, Hughes has developed the following feature capabilities within the JUPITER System:

- Differentiated traffic handling of up to 4 Classes of Service.
- Class of Service indicators (i.e., DSCP) through the VSAT network end-to-end.
- Service can be configured to pass or not pass multicast traffic from its edge towards external routers.
- Ability to provide separation of multiple customers with potentially overlapping IP address space at its IP Transport Hub Terminations.
- Ability to configure with classification rules that allow it to set Class of Service indicators (i.e., DSCP) to external routers as a function of multifield classification on source/destination IP address, source/destination port, and protocol.

Furthermore, JUPITER System can provide QoS in both directions between the MPLS network and the VSAT network. In every situation of whether or not the MPLS network or Customer remotes provide DSCP, the JUPITER System can be configured to deliver the desired class of service.

Conclusion

In conclusion, the JUPITER System can be seamlessly integrated with an MPLS network in a variety of ways including:

- As a backup to an MPLS network
- As an extension of an MPLS network
- For Multicast in an MPLS network

In addition, the JUPITER System supports a full stack of features required for an extensive MPLS network ranging from multicast to QoS to routing, allowing any operator who uses JUPITER to use MPLS.

Proprietary Statement