

Network Connectivity on SPACEWAY

SPACEWAY's ability to enable mesh and QoS allows for a flexible and robust architecture to uniquely support a vast array of applications.

S P A C E W A Y TM

Network Connectivity on SPACEWAY

Introduction

SPACEWAY (throughout the document, SPACEWAY refers to SPACEWAY 3), is the world's first commercial satellite system to employ on-board traffic switching and routing. Developed, owned and operated by Hughes, SPACEWAY operates in the Ka band and encompasses numerous satellite technology advances, such as on-board fast packet switching, a phased array antenna and dynamic beam forming. With a gross traffic capacity of 10 Gbps, unprecedented in the industry, and incorporating bandwidth-on-demand functionality, SPACEWAY is delivering an ever-expanding range of HughesNet® broadband services over North America. These include high-speed Internet access of up to 5 Mbps per site; single-hop, mesh IP networking between sites; and high-availability, QoS solutions among many sites, all utilizing compact and cost-efficient broadband routers and terminals manufactured by Hughes.

This white paper describes the mesh connectivity and the QoS functionality available using SPACEWAY.

Mesh Connectivity

Unlike conventional “bent-pipe” satellite systems in which a Network Operations Center (NOC) is required to manage all traffic routing and switching among terminals in a double-hop process, SPACEWAY employs an on-board demodulator and a fast packet switch, allowing direct site-to-site connectivity between terminals. This mesh capability means enterprises have the flexibility to configure virtually any connectivity requirements using SPACEWAY, yet the system does not compromise on overall network security. As described in the following, it tightly controls the definition and management of traffic among sites in order to ensure secure private networking.

A central concept in SPACEWAY networking is the End User Group (EUG). An EUG is a group of sites that have the same connectivity characteristics, with each site having defined site(s) with which it can communicate. An EUG is set up so that any of its sites can be enabled to communicate with each other or not. For example, all stores in a retail network can be placed into a single EUG, but disabling intra-EUG connectivity will prevent any store-to-store communications. Two EUGs can be set up to communicate with each other so that all sites within each EUG can communicate with each

other. Continuing the example above, the data center(s) can be placed in another EUG, and the store EUG can be enabled to communicate with the data center EUG. Figure 1 shows this simple EUG scenario. An EUG can have as few as one site or thousands of sites.

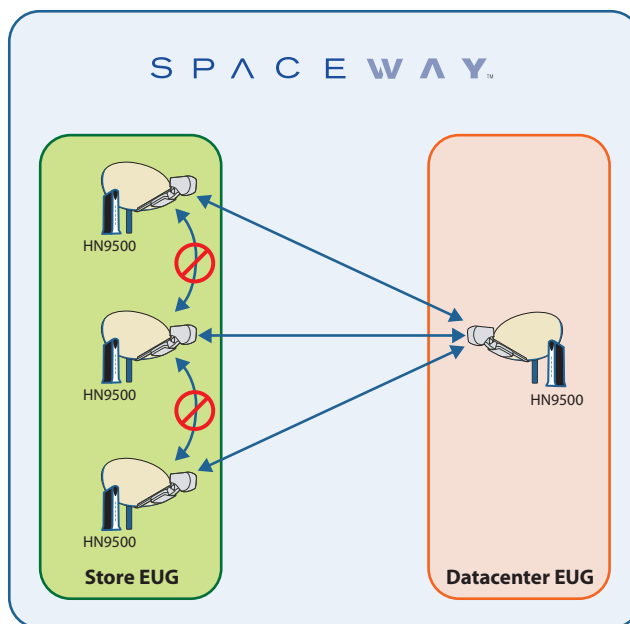


Figure 1. Example of Simple EUG Connectivity

EUGs are provisioned and maintained by the Hughes Network Operations Center (NOC). They can be set up and modified only by the NOC, for example, allowing new sites into the EUG, removing sites from the EUG, or changing any of the connectivity rules. The EUG site association is controlled by MAC address resolution in the SPACEWAY system. The NOC resolves the MAC address of the sites with whom a site has been allowed to communicate. If a site attempts to communicate with a destination site not enabled by EUG connectivity rules and the MAC address is not resolved, then connectivity cannot occur.

Each customer network (regardless of the EUG structure) is defined as a domain. Within the customer network, one of the SPACEWAY customer premise routers (HN9500) is designated as a “route server.” The remote site learns of the route to the desired destination via this route server. This information is used to populate the HN9500's route table

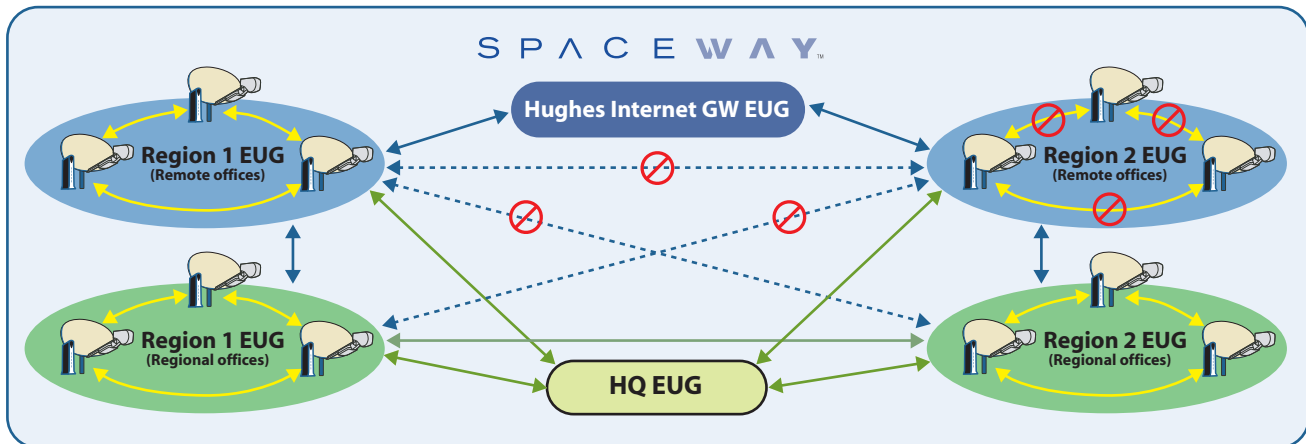


Figure 2. Example of Advanced EUG Connectivity

for subsequent communications. The route table also may be statically populated, if desired.

Figure 2 is an example of an enterprise network and associated EUG structure. Each bubble in the diagram represents an EUG. In this example, remote sites are in two regions: Region 1 allows site-to-site connectivity, Region 2 does not. Also, Region 1 cannot talk to Region 2, but Region 1 and Region 2 can both communicate with headquarters (HQ). Each regional office only talks to its associated sites, HQ, and other regional offices. The HQ location is in another EUG and Internet overlay is allowed for those sites.

QoS Implementation

A unique capability of SPACEWAY is the ability to support multiple Classes of Service (CoS), each yielding its own QoS from the same router. The result is that each application is handled with the correct treatment to optimize its performance. Not only is there local prioritization within the router, but there is also system-wide prioritization which enforces the end-to-end QoS.

Prior to a discussion on QoS, it is important to note that the SPACEWAY system offers two basic types of access from a remote site: Bandwidth-on-Demand (BoD) and dedicated access. BoD access provides bandwidth as required to a site and is generally used for branch locations. Dedicated access provisions bandwidth to a site regardless of usage. Generally, dedicated access is used for hub/data center sites in an enterprise network.

Within the BOD access, there are four classes of service defined in the SPACEWAY system: CoS 1 is constant rate; CoS 2 is transactional priority data; CoS 3 is high-priority data traffic; and CoS 4 is normal priority data. Each customer application is mapped into one of the four CoS levels.

CoS 1 is a constant rate connection designed for low jitter, low packet loss, and low latency, with committed bandwidth for applications such as voice and video. CoS 2 is for real-time applications that need very little bandwidth where latency needs to be minimized (for example, point of sale). CoS 3 is for real-time data traffic, such as database queries, where slightly higher latency is acceptable and there are higher bandwidth requirements than CoS 2. CoS 4 is for best effort data traffic such as Web access and email.

Once a CoS 1 connection is set up, all traffic on the connection is accorded the highest priority in the system. CoS 2 traffic is sent into the network without any requests made. This results in potentially higher packet loss, but minimizes latency. These packets are given the next level of priority behind CoS 1. CoS 3 is for bursty traffic; the system makes bandwidth requests when the traffic is presented from the site. Traffic is granted ahead of CoS 4 and behind CoS 1 and 2.

CoS 4 is for best effort traffic and essentially has the lowest priority within the system. After all the other priorities have been granted their capacity, this traffic gets access to its bandwidth. There is always some bandwidth available for this priority level, but how much capacity can be granted is directly related to how much capacity the other applications with higher CoS are requesting. If the other applications aren't asking for their minimum bandwidth allocation, then the CoS 4 may utilize this bandwidth.

Within the SPACEWAY satellite, bandwidth allocations are made in priority order—CoS 1 to CoS 4. Just as the satellite router prioritizes CoS 1 traffic over CoS 4 traffic, so does the satellite when granting access bandwidth. Again, this prioritization ensures priority applications are treated as such over the satellite link, and at the same time, non-mission critical traffic has access to a share of the bandwidth.

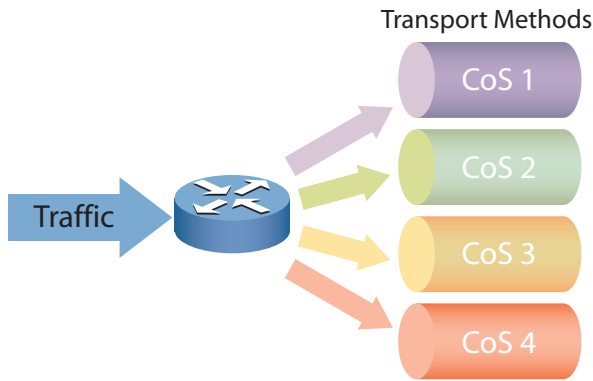


Figure 3. Transport CoS

Figure 3 shows traffic from the LAN entering the SPACEWAY router for mapping into one of the four CoS levels.

Applications are mapped into their CoS based on IP addresses, protocols, or port numbers (TCP or UDP). This can be configured on a site-by-site basis. Once they are mapped, they can be prioritized within the CoS by placement into one of four (4) priority queues (3 for TCP and one for UDP). The three TCP queues are termed Performance Enhancing Proxy (PEP) backbones. This allows for further prioritization beyond the mapping to different CoS levels. The four priority queues are configured with a minimum amount of transmit bandwidth. If all queues are transmitting at their maximum, then each queue will be reduced to a certain pre-configured percentage. This prevents queues and applications from being starved, and at the same time, prevents one queue and set of applications from dominating the traffic. The system is flexible enough to allow one queue to grab more bandwidth from another's allocation, if the other queue is not utilizing its minimum preset amount of bandwidth at that instant.

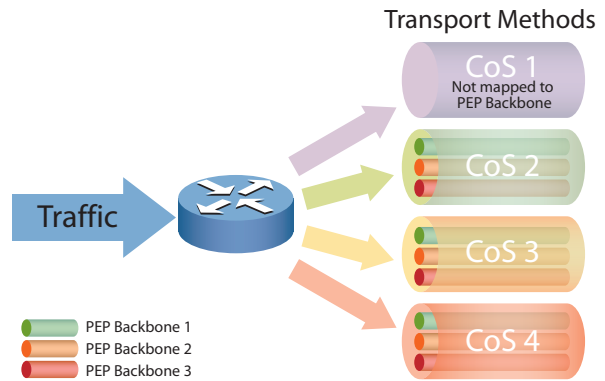


Figure 4. CoS Mapping to PEP Backbones

Figure 4 shows the next level of prioritization into the Performance Enhancing Proxy (PEP) backbones.

Conclusion

The SPACEWAY system provides extremely robust functionality by offering high speeds, meshed connectivity, and QoS. This paper has described how SPACEWAY's meshed architecture and QoS is enabled and enforced.

For meshed networks there is inherent security, which ensures that if sites need to communicate with each other, they are allowed to. Conversely, if sites are not allowed to communicate with each other (for example, between customers), then connectivity is strictly forbidden. Additionally, QoS is managed and configured by Hughes. CoS and PEP backbone application mapping is required to achieve the desired QoS for the customer.

The customer can be confident that Hughes properly secures their network from any unwanted connectivity, as well as ensures that QoS is managed appropriately for the intended applications.

Proprietary Statement

All rights reserved. This publication and its contents are proprietary to Hughes Network Systems, LLC. No part of this publication may be reproduced in any form or by any means without the written permission of Hughes Network Systems, LLC, 11717 Exploration Lane, Germantown, Maryland 20876.

HUGHES, HughesNet, IPoS, SPACEWAY, AIReach, Broadband Unbound, and Connect to the future are trademarks of Hughes Network Systems, LLC. All other trademarks are the property of their respective owners.