SOLUTION

HughesON ActiveTechnologies™

Solving the Challenges of the Distributed Enterprise Network

Distributed enterprises today are deploying hybrid WANs that leverage both private connections, such as MPLS, and broadband Internet connections in an integrated WAN architecture to achieve optimal cost and reliable performance. Broadband connections, such as cable, fiber, and DSL, can provide improved price performance, thereby eliminating the need to add additional expensive MPLS connections at the branch locations.

However, broadband connections have been typically used as separate networks for less critical purposes, such as Internet access offload or as a backup to MPLS. Now, with distributed enterprises wanting to augment their existing WANs by pushing more real-time, latency-sensitive applications such as VoIP, video, Cloud services, and thin-client apps over broadband connections, certain inherent challenges are becoming clear:

- Unlike dedicated private MPLS networks, a distributed broadband network typically has a variety of upstream and downstream access rates at the last mile and uses a shared medium for Internet access. This technology exhibits variability in performance during peak usage periods and times of congestion making them unusable for real-time and latency-sensitive apps.
- Most router Quality of Service (QoS) implementations require Access Control Lists (ACLs) to be manually configured which map applications to multiple classes of service using Differentiated Services Code Point (DSCP) markings. This approach requires in depth knowledge of how each application performs and lacks the flexibility to account for application behavior changes or the addition of new apps to the network.
- The increased use of Cloud apps, Guest Wi-Fi services and streaming media apps at the branch demands more bandwidth along with consistent application performance and availability over the broadband connection. Because of application growth and performance variability, congestion is becoming a chronic problem for broadband connections.

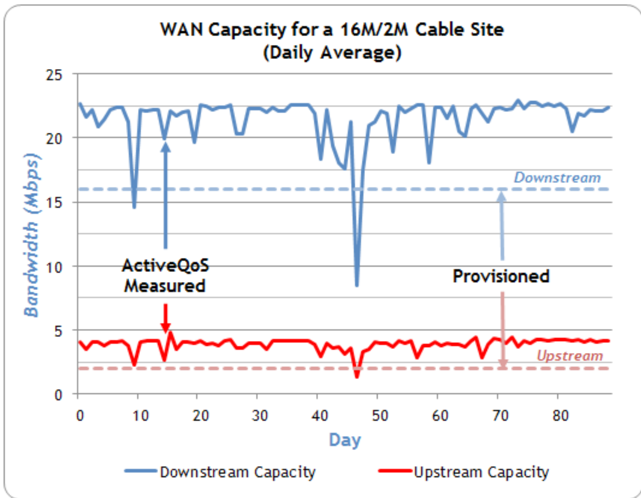
This white paper presents an overview of Hughes ActiveTechnologies™, which overcome the challenges mentioned above associated with broadband connections. By using patented state-of-the-art WAN optimization features combined with configuration automation, for reduced management complexity, real-time QoS becomes practical over best-effort broadband connections transforming them into highly reliable enterprise-grade WANs. This allows enterprises to deploy real-time and business-critical apps over broadband connections with high reliability and performance, while still allowing Cloud apps and Guest Wi-Fi services to be delivered over the same connection. Hughes ActiveQoS™, ActiveClassifier™, ActiveCompression™, and ActivePath™ are the core features in this suite of ActiveTechnologies. Hughes ActiveQoS enables real-time QoS using premises-based intelligence, compensating for the unpredictable bandwidth changes in broadband networks. Hughes ActiveCompression applies a compression technique which dramatically increases the "virtual" or effective bandwidth available at branch locations without incurring the expense of increasing the access link speed. Hughes ActiveClassifier intelligently classifies and prioritizes broadband traffic without the administrative overhead of defining specific traffic classification rules or ACLs. Hughes ActivePath is intelligent path control technology that maximizes the availability of applications at a branch by routing applications over the best performing path and utilizing multiple paths in an active-active fashion for mission critical applications.

The shift from MPLS to broadband is well underway as enterprises look to control WAN costs and improve performance, with a strategic objective of migrating to a next generation SD-WAN architecture. HughesON Managed Network Solutions, powered by ActiveTechnologies, provides an excellent solution for enterprise organizations seeking to upgrade their distributed branch network.

HughesON is a suite of innovative, Cloud-ready network and digital media solutions designed for the unique needs of distributed enterprises in industries such as retail, hospitality, and retail petroleum.

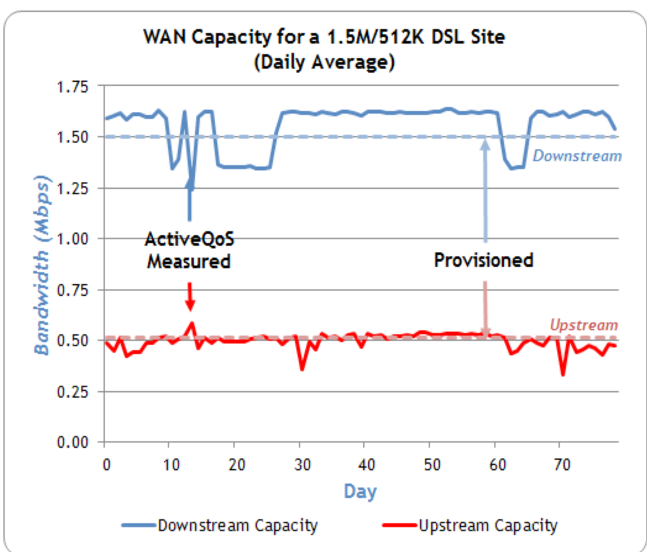
Broadband Network Variability

Unlike private MPLS networks, a distributed broadband network can have a variety of access rates across branch locations. These broadband connections exhibit variable performance over time, especially during periods of congestion, making them unsuitable for real-time and latency-sensitive applications. For example, in cable networks, the access rate may sync up at a lower rate than provisioned and may vary considerably over time. In addition, broadband networks are commonly oversubscribed by the service providers across the last mile or at the Central Office (CO), depending on the access technology. Oversubscription causes localized geographic congestion at peak times, which results in short-term performance variability in broadband networks.



	Min	Max	Average	Spread
Downstream Capacity	8.5 Mbps	22.9 Mbps	21.5 Mbps	14.4 Mbps
Upstream Capacity	1.333 Mbps	4.792 Mbps	3.898 Mbps	3.460 Mbps

Figure 1



	Min	Max	Average	Spread
Downstream Capacity	1.2 Mbps	1.6 Mbps	1.6 Mbps	0.4 Mbps
Upstream Capacity	330 kbps	582 kbps	498 kbps	253 kbps

Figure 2

Figures 1 and 2 show the ActiveQOS measured daily average WAN capacity for cable and DSL circuits at two branch locations of a casual dining restaurant chain. The broadband connections exhibit variable performance during this period, in both the upstream and downstream directions. There are several points over the multimonth period where the ActiveQoS measured upstream and downstream capacity was significantly different from the provisioned rates.

This variability in available capacity over a broadband connection presents several challenges to WAN platforms attempting to perform QoS and application prioritization. First, those WAN platforms typically require the user to statically configure the upstream and downstream network bandwidth per site and per tunnel. Across a distributed enterprise, maintaining individual configuration profiles quickly becomes very complex and unmanageable. In addition, if multiple WAN platforms are deployed at a single location, the administrative overhead increases further. Second, when the broadband connection provides less bandwidth than configured, the WAN platform is unable to adapt and prioritization is ineffective, which results in congestion. Alternatively, when the broadband connection provides more capacity than the configured bandwidth, the WAN platform will unnecessarily apply QoS and needlessly throttle applications.

Real-Time Capacity Tracking and Effective Flow Control with ActiveQoS

Hughes ActiveQoS intelligently monitors and manages the end-to-end network capacity over the WAN, while Hughes ActiveClassifier dynamically classifies traffic flows into eight different traffic classes in real time. Real-time traffic is optimally routed over the WAN without queuing delays while all other traffic is appropriately balanced among strict priority queues with starvation protection. This intelligent balancing of different traffic types over the broadband connection effectively mitigates congestion. In addition to effectively queuing the different traffic classes, individual TCP/UDP traffic flows are flow controlled in both the upstream and downstream direction to avoid exceeding the available WAN capacity and to accommodate concurrent real-time traffic while eliminating packet loss and latency spikes that are a result of congestion.

ActiveQoS automatically adjusts upstream and downstream bandwidth settings for each WAN connection based on the real-time measured end-to-end capacity of the entire path between the branch and the data center. This measurement is achieved efficiently without generating synthetic traffic in the presence of user traffic and is updated within seconds of changing network conditions. The solution scales well for a distributed enterprise with thousands of sites because of the automated bandwidth configuration provided by ActiveQoS. With active network capacity management and dynamic flow control, ActiveQoS enables real-time and latency-sensitive applications such as POS, VoIP, VDI and

Citrix remote desktop to run with minimal packet loss and jitter, even during periods of network variability by allocating the right amount of bandwidth to each of the eight WAN traffic classes. The result is that a guaranteed high-level of service is maintained for real-time and interactive applications, while fully utilizing the available capacity of the WAN at each branch location.

Building Effective Traffic Classification Rules for QoS with ActiveClassifier

QoS systems generally require that rules be defined to classify traffic into different classes. These rules or ACLs are typically based on IP and port numbers that result in the setting of the Type of Service (ToS) fields using DSCP in the Internet Protocol (IP) headers so the flows can be mapped into the correct WAN queues. However, this suffers from the limitation that administrative intervention is required to add or modify rules each time new applications are introduced into the network or existing application behavior changes. This is cumbersome, requires regular maintenance, and lacks the intelligence that allows the QoS system to operate most effectively and scale to a large distributed environment.

Hughes ActiveClassifier is an IP flow-based packet classifier that works both in the upstream and downstream directions independently and eliminates the administrative overhead of defining rules or ACLs in any type of network. It intelligently classifies traffic according to its QoS needs, ensuring that real-time and interactive applications receive the appropriate prioritization automatically, while new applications being added to the network are effortlessly blended in. ActiveClassifier classifies IP flows into four top-level classes: real-time, light-interactive, heavy-interactive, and, bulk, each defined by specific characteristics of the different classes, as shown in Figure 3. Heavy-interactive and bulk are further broken down into three separate classes for more granular control and a total of eight traffic classes are available.

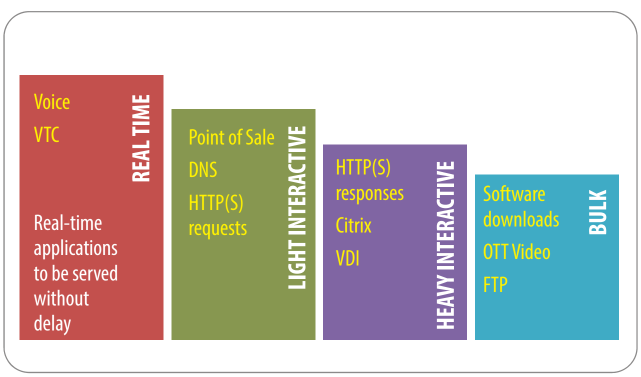


Figure 3. ActiveClassifier Classes of Service

An application traffic flow is initially classified by evaluating the flow's protocol, port, packet flow rates, and initial packet sizes. Once classified, flows are continuously analyzed and will be reclassified into a different class if their characteristics change over time. Thus, a web browsing session that leads to a software download gets automatically reclassified from heavy-interactive to bulk. Alternatively, an HTTP flow can be promoted to light-interactive once it is confirmed to be carrying a small amount of traffic. This is especially beneficial for Guest Wi-Fi services as it ensures that users performing interactive web browsing are not adversely impacted by other users running large downloads. The WAN connection can satisfactorily support a larger number of users by ensuring that light users have a positive experience, while heavy users make do with remaining bandwidth. A congested WAN link degrades gracefully with only the heaviest users experiencing flow control.

ActiveClassifier is more efficient and robust than solutions using Deep Packet Inspection (DPI) technology that require specific knowledge of application payload, because DPI technologies require higher system resource utilization. Furthermore, DPI technology provides limited benefits for encrypted applications such as those running over HTTPS or SSL. Using behavioral heuristics, ActiveClassifier can accurately determine the difference between real-time and interactive flows that require a higher priority and bulk or batch transfers that can operate at a lower priority. As flow characteristics change over time, they will be automatically reclassified and prioritized. ActiveClassifier also supports manual overrides or user-defined classification rules, if required for certain applications. By utilizing this approach, ActiveClassifier maintains a guaranteed high-level of service for the most critical real-time and interactive applications. This is accomplished without the administrative overhead of maintaining individual rules for every application across the enterprise, while fully utilizing available broadband capacity at each branch location.

Solving Congestion over Broadband Networks with ActiveCompression

The increased use of Cloud apps to deliver business critical services, Guest Wi-Fi services, and streaming media at the branch causes the overall network to become frequently congested. Figure 4 shows the WAN congestion for a casual dining restaurant chain, which offers Guest Wi-Fi services at its branches. WAN congestion implies the network capacity is more than 80% utilized. The graph shows the percentage of time the WAN is congested, averaged over a 24-hour period and during the peak busy hour of the day, for that branch location. Results show that on average the WAN capacity is congested over 30% of the time during the day, and congested for over 40 minutes during the peak usage hour, at these branches.

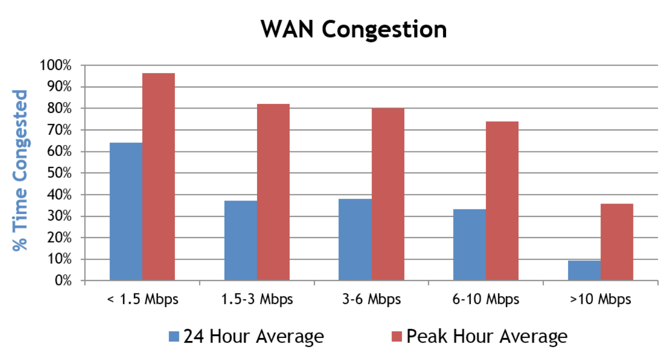


Figure 4

Similar congestion was noted in the upstream direction as well. WAN congestion causes network connections to slow down by creating packet loss and retransmissions, which results in the poor end-user performance and lower productivity.

Hughes ActiveCompression technology dramatically increases the "virtual" or effective bandwidth available at branch locations by improving throughput and application performance without incurring the expense of increasing the access link speed. Figure 5 shows the benefits of ActiveCompression in the downstream direction for the previously mentioned casual dining restaurant chain. Their WAN traffic was a combination of business critical credit/debit transactions, back office applications, and Guest Wi-Fi. ActiveCompression unlocked additional, virtual capacity which meant their critical transactions completed quicker and their patrons experienced faster downloads. This technology provided the restaurant brand significant cost savings by offsetting expensive capacity upgrades at the branch thereby delivering a reduced Total Cost of Ownership (TCO) to the enterprise.

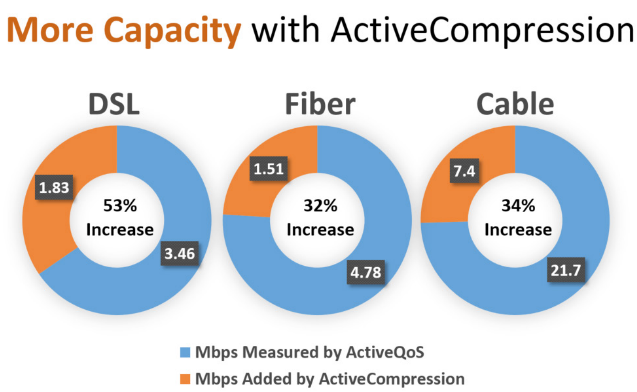


Figure 5

Table 1 summarizes the average increase in bandwidth expansion gained with the deployment of the HughesON platform across different market segments. The benefit of ActiveCompression is dependent on the type of traffic flowing through the WAN as evident from the results shown below. For example, in the casual dining market, the bandwidth expansion was on average 37% in the downstream speeds, and 57% for the upstream speeds.

	Applications	Downstream B/W Expansion	Upstream B/W Expansion
Casual Dining	Guest Wi-Fi, PoS, Back Office	37%	57%
Specialty Retail	PoS, Back Office	71%	99%
Retail Petroleum	Pos, Back Office	89%	16%

Table 1

Intelligent Path Control for High Application Availability with ActivePath

As outlined above, broadband connections suffer from performance variability. This variability is referred to as a brownout when the performance characteristics of the connection are degraded due to intermittent packet loss, latency spikes or drops in available bandwidth. Unlike blackouts, which are complete service outages, brownouts are difficult to mitigate with traditional routing technologies, often resulting in poor application performance at the branch. In large distributed organizations, it's common for a small percentage of the branch population to be impacted by brownouts or blackouts on broadband connections. While ActiveQOS, ActiveClassifier and ActiveCompression are always optimizing network flows independently for each path, based on the real-time characteristics, Hughes ActivePath takes application optimization one step farther. ActivePath ensures that the performance of each branch's WAN as a whole is always maximized by continuously comparing each link's real-time characteristics with application performance thresholds and directing traffic in the optimal direction. This allows application performance to inherit the characteristics of the best performing path, while alternative paths are suffering from degradation, without resetting TCP connections and minimizing the impact to the end user during path transitions.

Hughes ActivePath also uses Intelligent Multipath Replication (IMR) technology to automatically replicate mission critical application traffic across the available WAN paths. This allows ActivePath to eliminate the impact that brownout and blackout conditions have on sensitive applications, such as VoIP, at the branch when individual paths experience degradation. By proactively replicating the most important traffic, ActivePath can prevent the short outages that occur when applications are re-routed to alternative paths. ActivePath leverages ActiveClassifier to become application aware, which allows IMR to replicate real-time and interactive applications, while not oversubscribing alternative paths with the replication of lower priority bulk applications, such as software downloads and system updates, that are much more tolerant of path transitions and short outages.

Conclusion

While broadband connections such as cable, fiber, and DSL can provide improved price performance, they have been typically used as a separate network for less-critical purposes such as Guest Wi-Fi or Internet access offload. Today, distributed enterprises want to augment their existing WANs by pushing more real-time and latency-sensitive applications such as VoIP, video, Cloud services, and thin-client apps over broadband connections at the branch. However, network variability and periods of congestion present serious challenges to application performance over broadband connections.

The HughesON platform, powered by ActiveTechnologies, overcomes these challenges by integrating routing, WAN optimization, and security features into a single, robust platform, thereby avoiding deployment of multiple appliances at the branch and providing a superior TCO to the enterprise. The high level of configuration automation of network bandwidth, flow control, traffic classification and compression enabled by ActiveTechnologies greatly simplify the deployment and management of your branch WAN, while allowing you to scale to thousands of sites. The HughesON platform enables you to augment or replace your existing MPLS network using more cost-effective broadband connections, thus enabling enterprise-grade network performance and availability for the critical applications at all your branch locations.

For additional information, please call 1-888-440-7126 or visit business.hughes.com.

About Hughes

Hughes Network Systems, LLC (HUGHES) is the global leader in broadband satellite technology and services for home and office. Its flagship high-speed satellite Internet service is HughesNet®, the world's largest satellite network with over 1.2 million residential and business customers across the Americas. For large enterprises and governments, the company's HughesON™ managed network services provide complete connectivity solutions employing an optimized mix of satellite and terrestrial technologies. The JUPITER™ System is the world's most widely deployed High-Throughput Satellite (HTS) platform, operating on more than 20 satellites by leading service providers, delivering a wide range of broadband enterprise, mobility and cellular backhaul applications. To date, Hughes has shipped over 7 million terminals to customers in over 100 countries, representing approximately 50 percent market share, and its technology is powering broadband services to aircraft around the world.

Headquartered outside Washington, D.C., in Germantown, Maryland, USA, Hughes operates sales and support offices worldwide, and is a wholly owned subsidiary of EchoStar® Corporation (NASDAQ: SATS), a premier global provider of satellite operations. For additional information about Hughes, please visit www.hughes.com and follow @Hughes_Corp on Twitter.

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