Center for Convergence and
Emerging Networking Technologies

Network Technology Performance Evaluation
Cisco Application Visibility and Control (AVC)

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School of Information Studies
SYRACUSE UNIVERSITY

Executive Summary

As Wi-Fi continues its inevitable path towards the primary network access service in most modern enterprises, there is increasing pressure on IT professionals to insure very high levels of performance and availability. And as the variety of applications supported by this infrastructure increases, there is a clear need to prioritize access to mission-critical applications, especially real-time applications with consistent throughput and latency requirements. While the performance improvements of Wi-Fi have greatly enhanced capacity, the underlying architecture simply does not allow network administrators to address performance challenges through overprovisioning. Audio and video-based applications like Microsoft Lync as well as virtual desktop platforms like Citrix VDI all perform better if the network infrastructure is smart enough to prioritize their network traffic.

Cisco approached Syracuse University's Center for Convergence of Emerging Networking Technologies (CCENT), an applied technology research lab with 15 years of experience testing Wi-Fi products, to perform a systematic beta test, including before/after benchmarking of several applications, of their newest Wireless LAN Controller (WLC) Software (code version 7.4.1.52), which includes advanced network traffic classification and prioritization feature called Application Visibility and Control (AVC). The products tested for this feature were the Cisco 5508 Wireless LAN controller and the Cisco AIR-2602iAP.

Key Findings:

1. Citrix video streaming quality improves by **55%** from **Good to Excellent/9 fps to 14 fps** after applying the Cisco AVC profile.
2. The average latency for Citrix Video dropped from 14 ms to 2 ms i.e. after applying the AVC Profile, the latency reduced by a factor of 7.
3. The MOS of a single Lync voice call increases from **3.92 to 4.20** after applying AVC profile in presence of background traffic.
4. After applying the AVC profile, the Windows file transfer (CIFS) was pushed in the background queue and the data rate dropped down by 74% while two clients were doing a Lync voice call.

Test Methodology

A team of 3 graduate students, with supervision from a faculty member responsible for the CCENT wireless testing projects, worked with technical representatives from Cisco's Wireless Networks Business Unit (WNBU) to set up a test-bed in our lab. The testbed consisted of Cisco's AVC-enabled wireless network infrastructure and an array of enterprise application services that we used to evaluate AVC services. We focused our efforts on two commonly deployed enterprise applications, Citrix XenDesktop 5.6 VDI and MS Lync 2010. We began with a single client generating background traffic and then increased the number of clients to the point where application performance dropped below acceptable levels.

In order to ensure accurate measurements, the testbed was isolated from the University's wired and wireless systems. A Cisco 2911 Router configured for NAT services was used to provide access to testbed devices, when necessary, from the University network. Our network testbed included a Cisco

3750 Catalyst Switch, a Cisco UCS C210 server running VMware ESXi 5.0 that hosted all our Virtual machines including an Active Directory Domain Controller, Lync 2010 Server, Lync Monitoring Server and Citrix XenDesktop controller and VMs (see Figure 1 below). All the clients were Dell laptops with 3-stream capable Intel-based 802.11n network adapters. Eight of the Dell laptops were running Windows 7 while two of them were running Windows XP. All performance testing took place on the ground floor of Hinds Hall, home to SU's School of Information Studies, in a typical higher education classroom (Room 018). To eliminate potential impact of wireless interference, all tests were performed at night, between midnight to 6 a.m. , with the production building Wi-Fi network disabled. Before each test, we used Cisco's Spectrum Expert to sweep through the ground floor to insure that the RF environment was clear of RF interference.

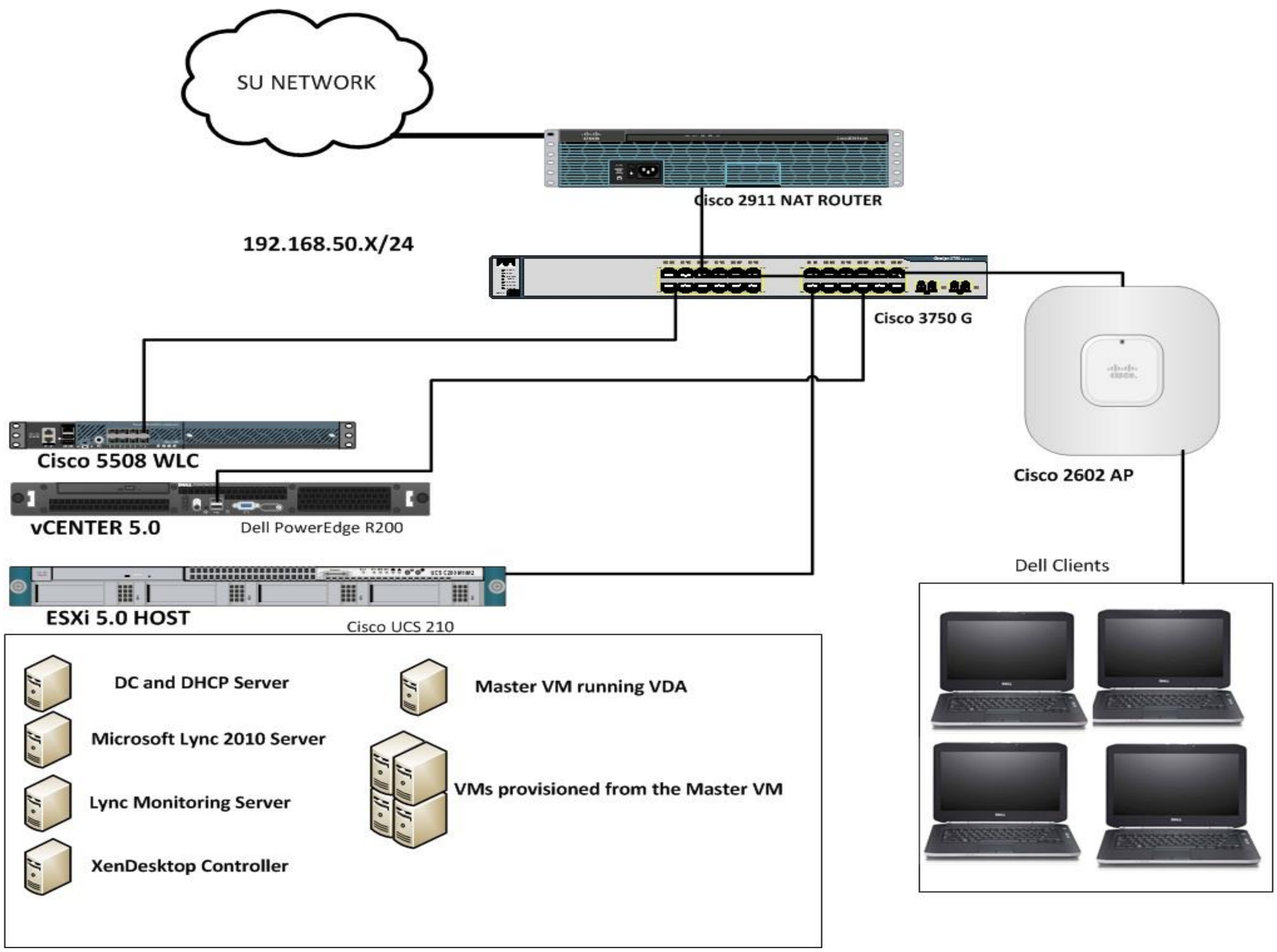

Figure 1 Network Testbed Diagram

Using AVC with Citrix XenDesktop 5.6

Citrix XenDesktop has achieved increasing popularity within enterprises in recent years as a mechanism for remotely delivering application services. XenDesktop provides location and device-independent secure virtual desktop and application services to users. As a network-intensive service, it is highly sensitive to performance issues. After configuring Citrix Xendesktop 5.6 Express edition on our testbed, we provisioned up to 10 Virtual machines to be accessed simultaneously across the network. To generate load, we configured nine wireless clients to stream HD 1080p video through the Citrix VDI sessions. We also configured one client to copy a 40 GB shared folder from the vCenter Server, which used the Common Internet File System (CIFS) protocol. Cisco's 5508 controller accurately identified this traffic on the wireless network. We then defined a profile on the controller to assign high priority to Citrix video traffic (a Gold WMM classification; DSCP value of 34) and lower, background, priority to CIFS file transfer traffic (a Bronze WMM classification; DSCP value of 10). After applying this profile, the data rate of the CIFS file transfer immediately dropped from 30 mbps to 10 mbps, a decrease of about 65%. This improved the video quality of the nine Citrix clients from 9 frames per second to 14 frames per second. Also, the average latency decreased from 14 ms to 2 ms. Judged subjectively, the results improved from marginal to good.

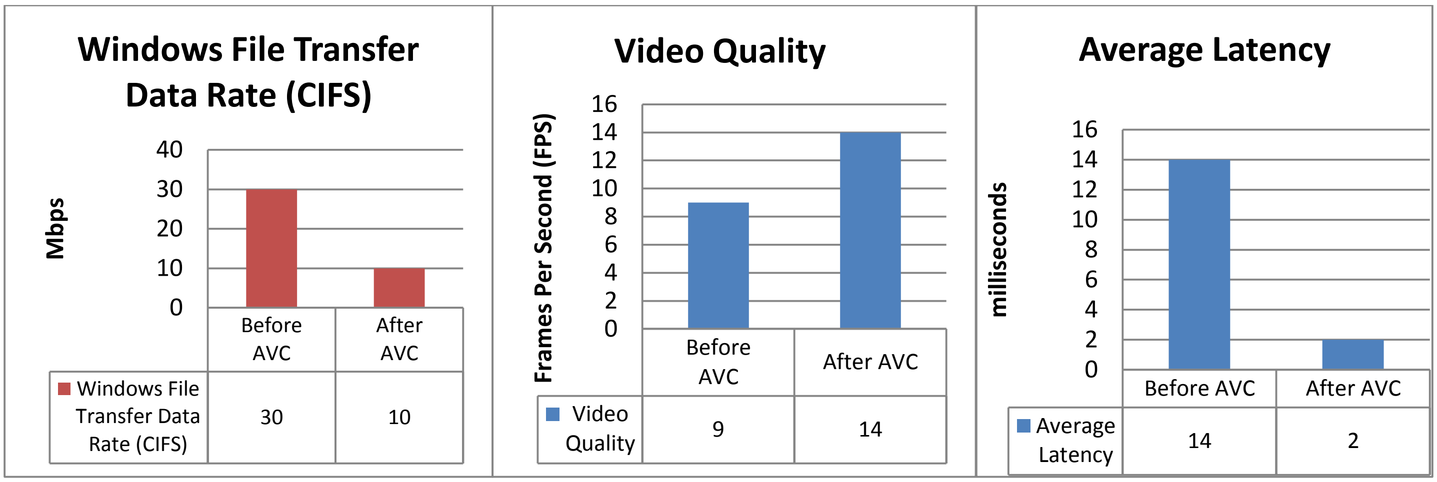

Figure 2

Citrix VDI Video Performance Before and After AVC

Using AVC with MS LYNC 2010

With enterprise adoption of unified communications systems steadily increasing, we chose Microsoft Lync 2010 as our second application for AVC testing. In this test, we made a voice call between two clients for one minute while continuous file transfer was taking place between a wireless client on the same network and one of our servers connected via Ethernet. The baseline data rate for the file transfer, with no other traffic on the network, was approximately 115 mbps. Cisco's AVC-enabled controller accurately classified the traffic types as 'MS-Lync-Media' and 'CIFS'. After maintaining the call for one minute, we observed the Call Media Quality report details in the MS Lync Monitoring Server installed on our testbed. We focused on 3 different performance metrics, comparing them before and after the AVC profile was applied. The metrics chosen were those we deemed most relevant to voice quality: average network MOS (mean opinion score, a measure of voice quality), average MOS degradation (decrease in voice quality attributable to network effects), and maximum jitter (variable delay, an enemy of voice quality). We then created a profile that marked 'MS-Lync-Media' with the Platinum profile (DSCP value of 46 corresponding to voice traffic) and CIFS was marked as Bronze (DSCP value of 10 corresponding to background traffic).

After applying the AVC profile we initiated another one-minute call between two clients. We noticed that the CIFS data rate immediately decreased from 115 Mbps to 30 Mbps immediately after we applied the profile. This represents a 74 % drop in the data rate of the CIFS file transfer. We found that the average network MOS increased from 3.92 to 4.20 while the average MOS degradation fell from 0.32 to 0.05. The maximum jitter also decreased, as expected, from 15 ms to 5 ms. These results show that the call quality improved significantly after applying the AVC profile. The following graphs give a clearer view of the figures.

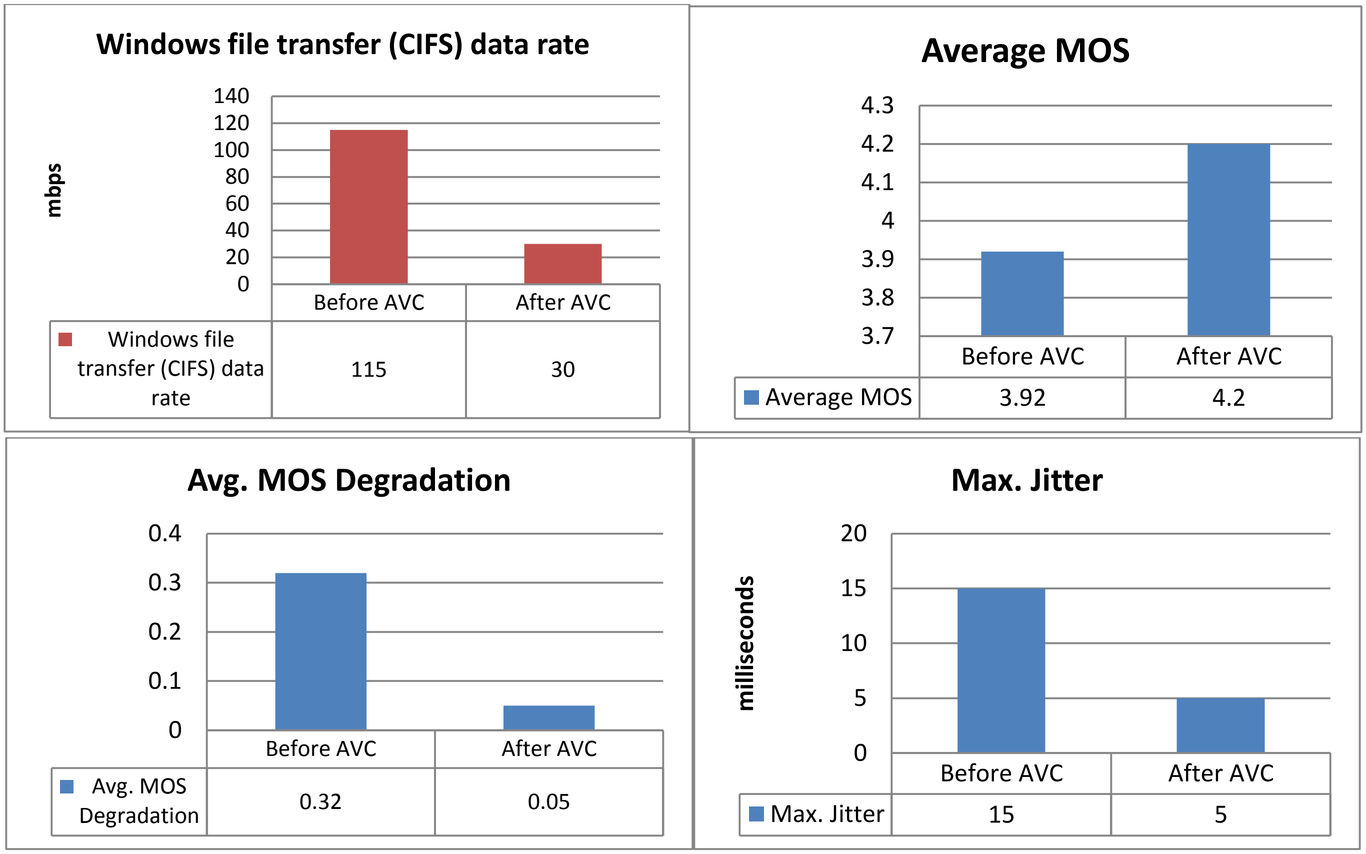

Figure 3
MS Lync Performance Before and After AVC

Conclusion

Our performance testing, while not exhaustive, verifies that Cisco's Application Visibility and Control is effective in classifying network traffic using deep packet inspection and prioritizing mission critical traffic, including Citrix virtual deskptop interface and Microsoft Lync voice calls, in the presence of background traffic on the wireless network. We were impressed by the product's results on our testbed. Enterprises adopting Wi-Fi for mission critical, real-time applications will likely find that AVC significantly enhances the performance of these applications and it does so with minimal management overhead. The following table summarizes all the findings from our tests.

	MS Lync 2010				Citrix XenDesktop 5.6		
	Before AVC	After AVC	Delta (Δ)		Before AVC	After AVC	Delta (Δ)
Windows file transfer data rate (Mbps)	115	30	Decreased by 73.91%	Windows file transfer data rate (Mbps)	30	10	Decreased by 66.6%
Average MOS	3.92	4.2	Improved by 7.14 %	Video Quality (FPS)	9	14	Improved by 55%
Max. Jitter	15	5	Improved by 66.67%	Visual MOS	Good	Excellent	
Avg. MOS degradation	0.32	0.05	Improved by 84.38%				

About CCENT

The Center for Convergence and Emerging Network Technologies (CCENT) is an applied network technology research center housed within the School of Information Studies at Syracuse University. CCENT has over 15 years of experience in systematically testing a range of network technologies and it is the former home of Network Computing Magazine's Real World Labs. This project was overseen by Associate Professor of Practice, Dave Molta, who manages the CCENT wireless testbed. Testing was conducted by a team of students enrolled in SU's MS in Telecommunication and Network Management. Nilesh Hirve served as team lead with contributions from Long Ren and Thomson Jacob.