



IP Video Baseline Simulation Sample Report

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Contact Information

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Project Scope

Determining network packet loss, jitter and delay is a critical step to the success of any IP video deployment. However, pre-video deployment measurements on a network can be misleading since network performance can dramatically change once bandwidth intensive IP video traffic is added to the network.

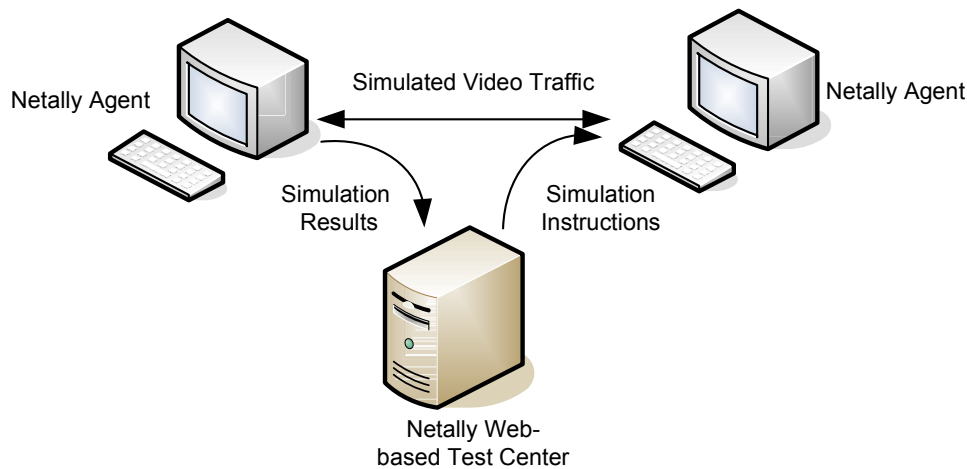
The scope of this project is to simulate traffic on the network to mimic the volumes and patterns of the proposed IP video solution while measuring any network packet loss, jitter and delay during the simulation. Ultimately this simulation will demonstrate the network's readiness to support the proposed IP video solution.

The deliverable is a report showing network packet loss, jitter and delays on each simulated IP video path with a pass, acceptable or failing score based on the network's ability to meet IP video thresholds for the proposed IP video system.

Methodology

NetAlly software was used to simulate traffic to the client network. Traffic patterns were configured on the web-based test-center. Test agents received instructions and simulated instructed traffic to another agent, sending results back to the web-based test agent. Traffic patterns were designed according to the table below with key factors being the video codec, resolution, and number of video feeds. Video traffic was simulated for 2 minutes at a time with 1 minute down time between intervals. Measurements were taken for each 2-minute simulation. This process was repeated for a 24 hour period.

Note that a successful video transmission includes a control plane or control traffic in addition to the video traffic or data plane. The control traffic is just as important as the video traffic but is only a fraction of the bandwidth. Thus, for the purpose of this test, measuring packet loss, jitter and delay, only the data plane traffic is simulated.



Interpreting and Understanding Results

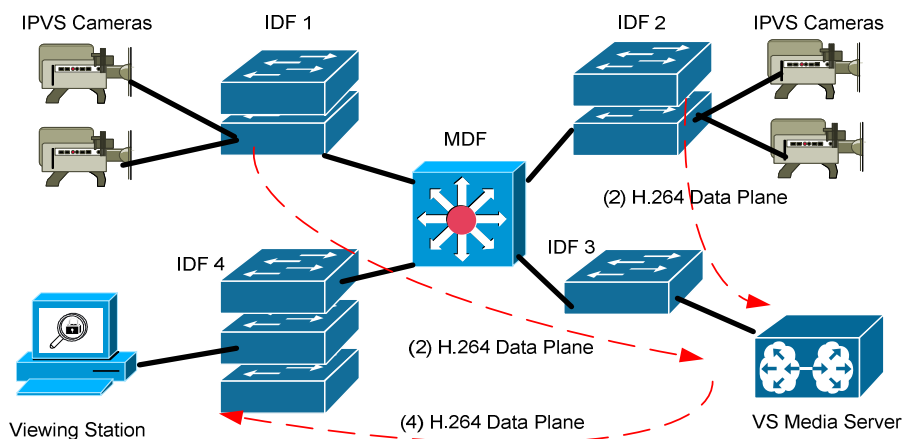
Packet loss in the network is noticeable in the video quality of MPEG-4 and H.264 video feeds. Packet loss is less of an issue for Motion JPEG, but impacts the usability of the video image. With standard definition below 0.5 of 1 percent may be acceptable, but with high definition (HD) even 1/10th of 1 percent can be noticeable. Result graph threshold is set a 0.5% for SD simulations and 0.1% for HD simulations. Results graphs show green below threshold and red above.

Latency depends highly on the transport protocol. MPEG-4/H.264 transported in a TCP session between a NDVR and a PC viewing station is more demanding than MPEG-4/H.264 transported in UDP/RTP between a camera and the NDVR. Two-way interaction for PTZ also requires lower latency. Latency in most LAN environments should routinely be less than 10ms. In a WAN environment, latency should be less than 50ms round-trip. Any WAN latency over 50ms round-trip may introduce poor video quality or issues with usability. Result graph threshold is set at 10 ms for LAN simulations and 50 ms for WAN simulations. Results graphs show green below threshold and red above.

Jitter generally increases as latency increases. If latency is less than 50ms round-trip, jitter should only be a few milliseconds at most. If jitter is high, latency is likely also an issue and should be addressed first. From an implementation standpoint, jitter is of little concern if sufficient bandwidth is available, latency is within the recommended values, and packet loss is approaching zero. Because of this, no specific range of jitter need be defined. As general rule, jitter should roughly be less than 10 percent of the measured latency value. Result graph threshold is set at an average of 1 ms for LAN simulations and 5 ms for WAN simulations. Results graphs show green below threshold and red above.

Proposed IP Video System

Implementation of 4 HD Cameras, one viewing workstation and one VSMS as per below Diagram



Test agent Table

Agent Name	Agent IP	Building Location	Closet Location	Switch name	Port #	Link Speed
VSMS	192.168.26.192	Main	IDF3	Switch1	Port48	Gig
Viewing Station	199.168.26.192	Main	IDF4	Switch3	Port48	Gig
Camera IDF1	192.168.26.155	Main	IDF1	Switch2	Port48	100 MB
Camera IDF2	192.168.26.155	Main	IDF2	Switch2	Port48	100 MB

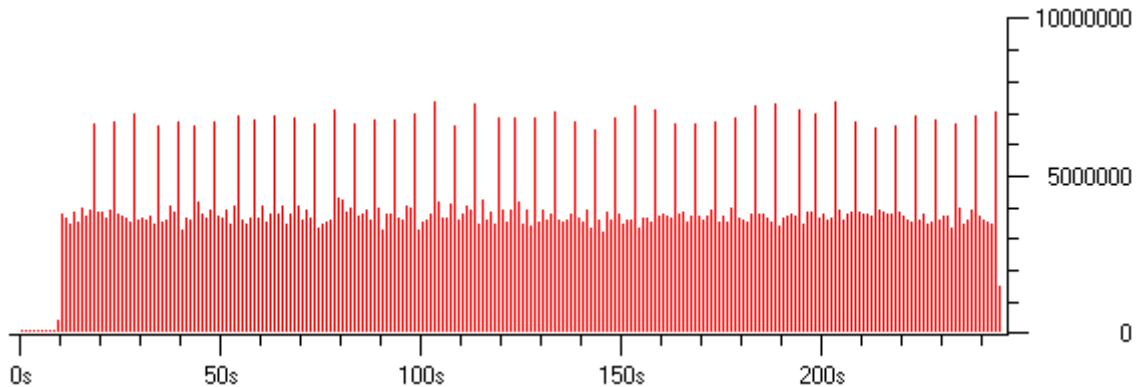
Test Pairing Table

Sending Agent	Receiving Agent	# Planes	Codec	Resolution	Avg Load	DSCP
VSMS	Viewing Station	4	H.264	1920 x 1080	4 Mbps	40
Camera IDF1	VSMS	2	H.264	1920 x 1080	4 Mbps	40
Camera IDF2	VSMS	2	H.264	1920 x 1080	4 Mbps	40

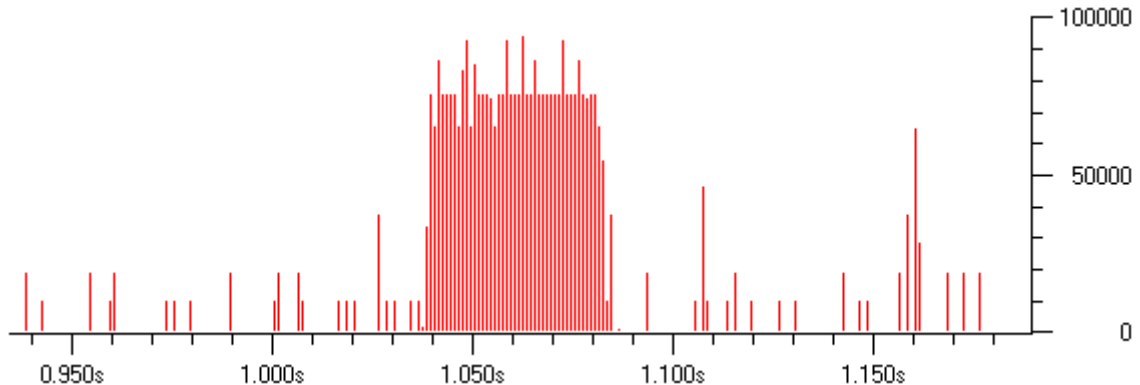
Test Simulation Pattern(s)

The below test simulation patterns were used in this test. These patterns represents a single data plane so actual bandwidth may be a multiple based on the number of simulated data planes per testing pair.

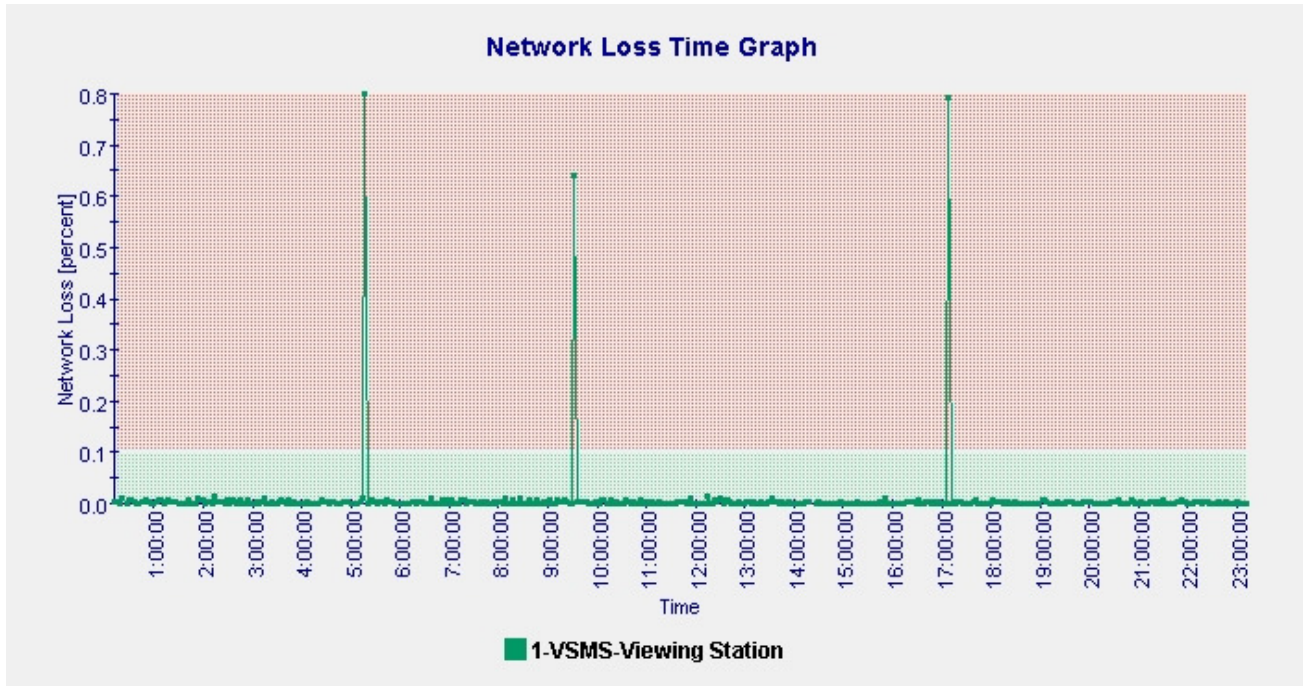
The below pattern is used for a camera using HD H.264 Codec with 1920 x 1080 resolution with average throughput of 4.3 Mbps.



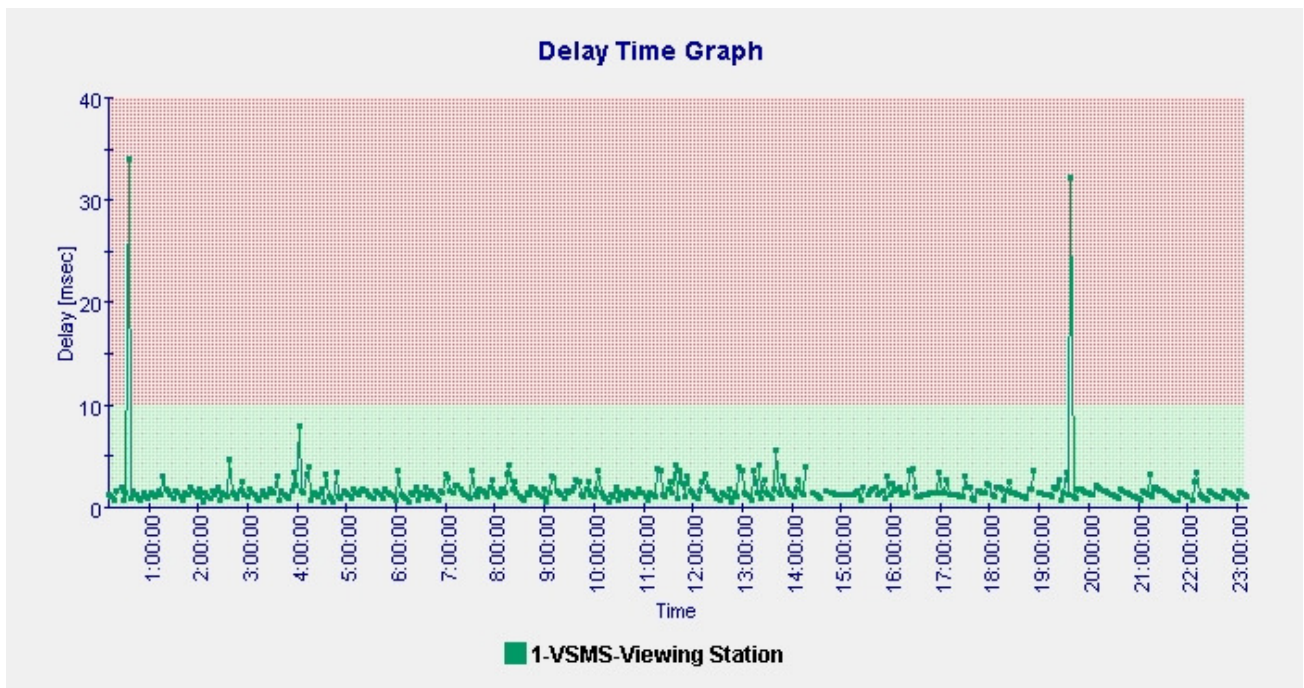
The chart below is a close up look at the I-Frame burst. Note that the x-axis is now represented as a millisecond per click. You can see the burst last about 50ms. You can also see that the burst is 80 – 90k bites each millisecond, equivalent to 80 – 90 Mbps.



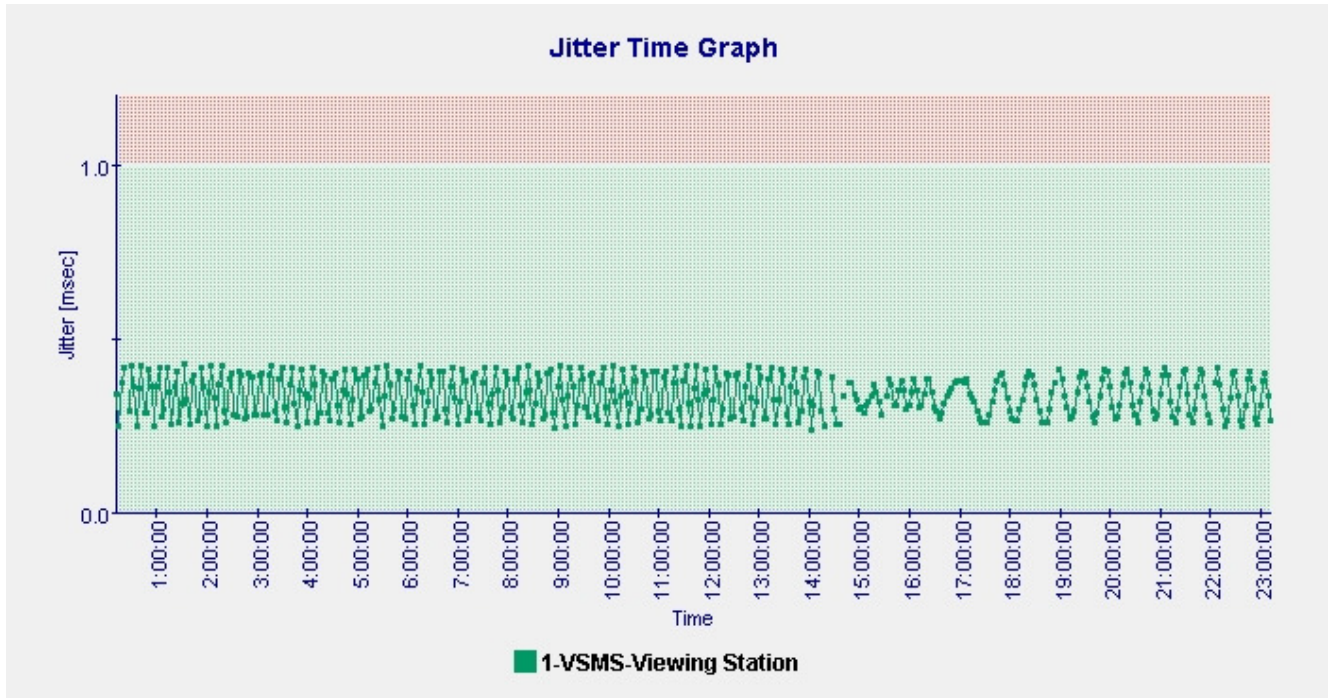
Results – Pair 1 – VSMS to Viewing Station



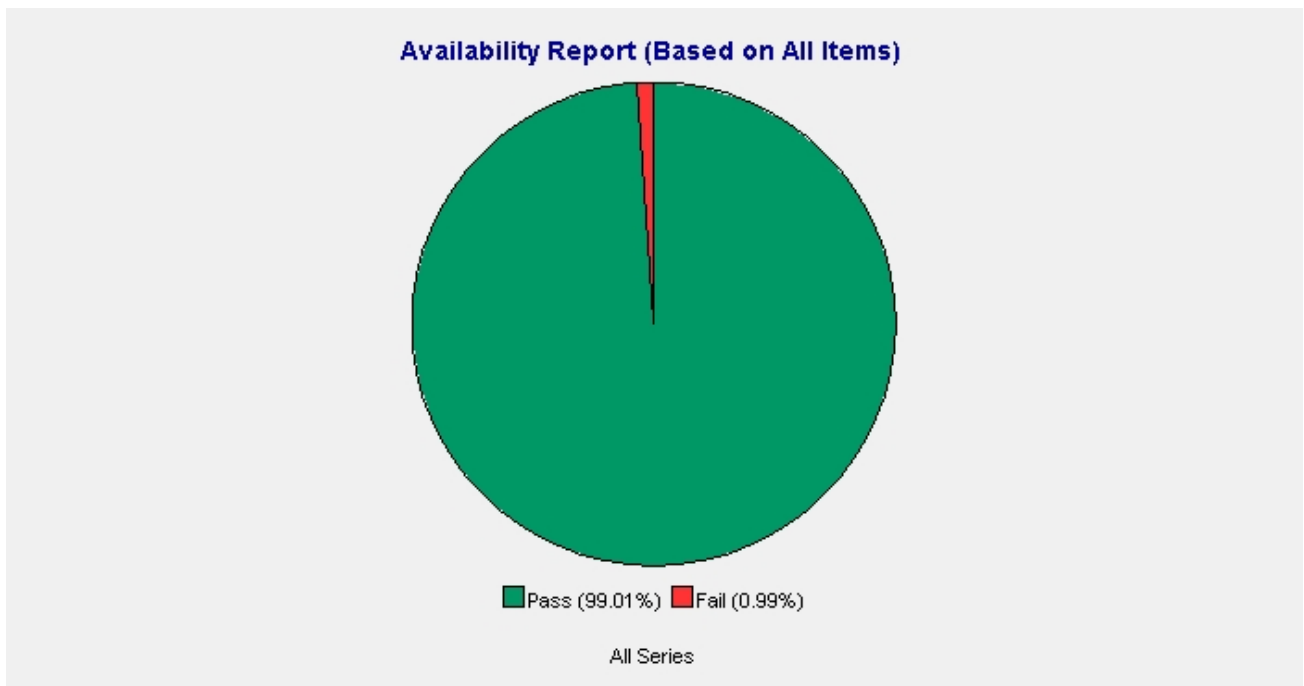
Network Loss graph threshold is set a 0.5% for SD simulations and 0.1% for HD simulations. Graph shows green below threshold and red above.



Network Delay graph threshold is set at 10 ms for LAN simulations and 50 ms for WAN simulations. Graph shows green below threshold and red above.

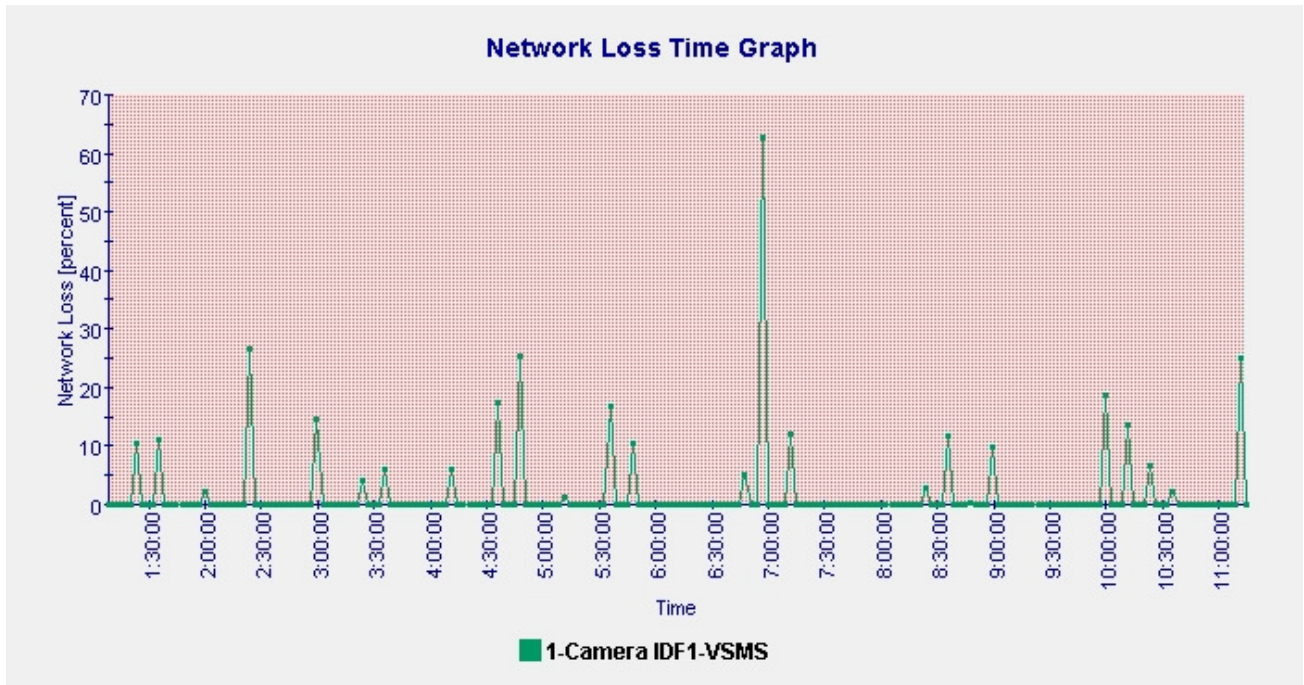


Network Jitter graph threshold is set at an average of 1 ms for LAN simulations and 5 ms for WAN simulations. Graph show green below threshold and red above.

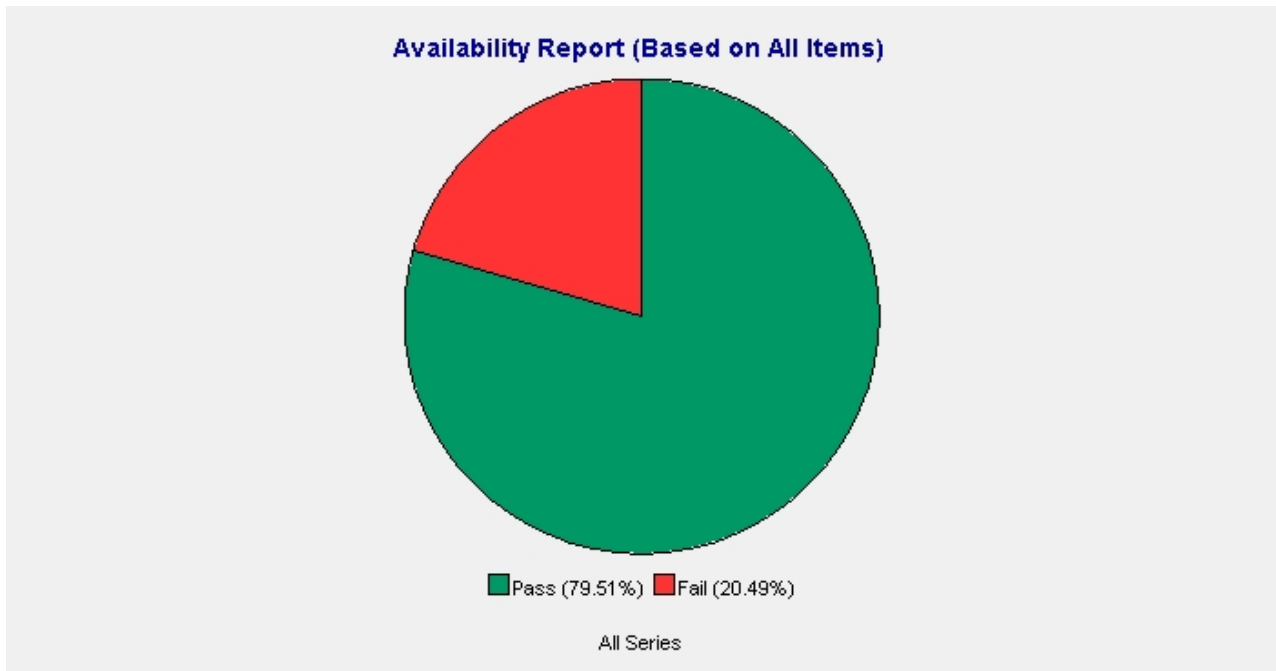


Network availability graph shows the percentage of time all thresholds were meet during a simulation.

Results – Pair 2 – Camera IDF1 to VSMS

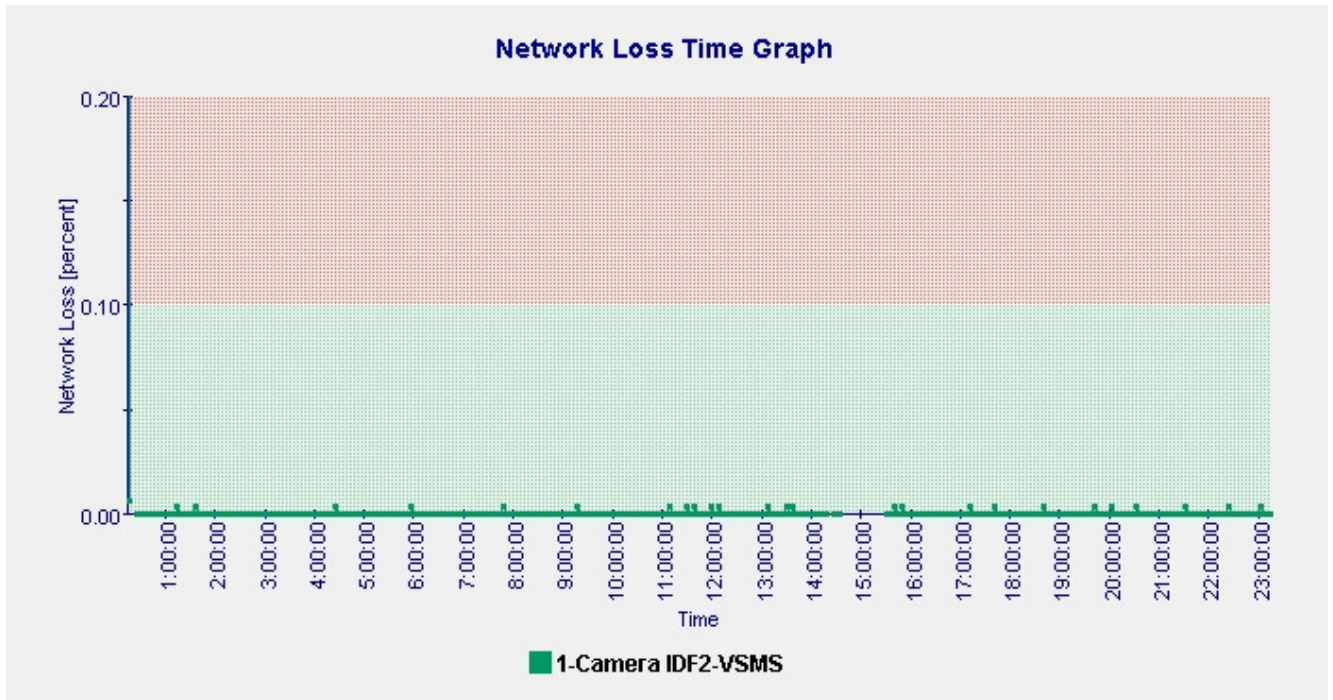


Network Loss graph threshold is set a 0.5% for SD simulations and 0.1% for HD simulations. Graph shows green below threshold and red above.

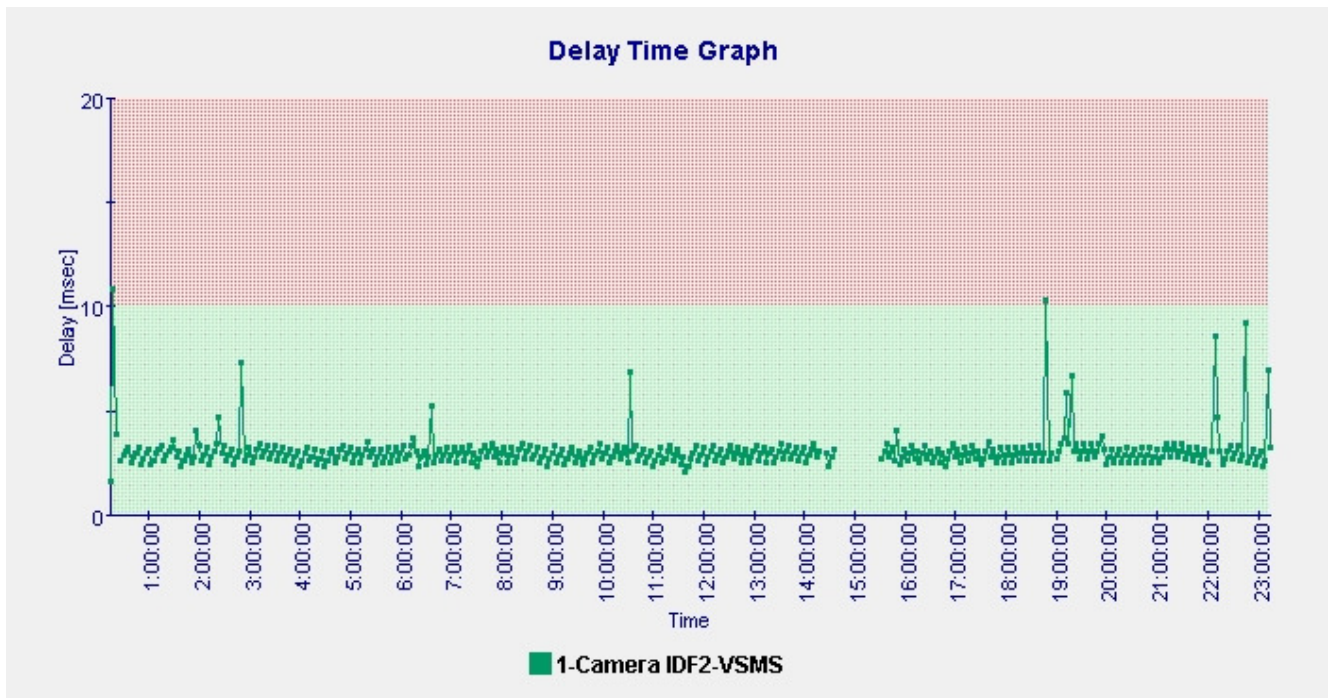


Network availability graph shows the percentage of time all thresholds were meet during a simulation.

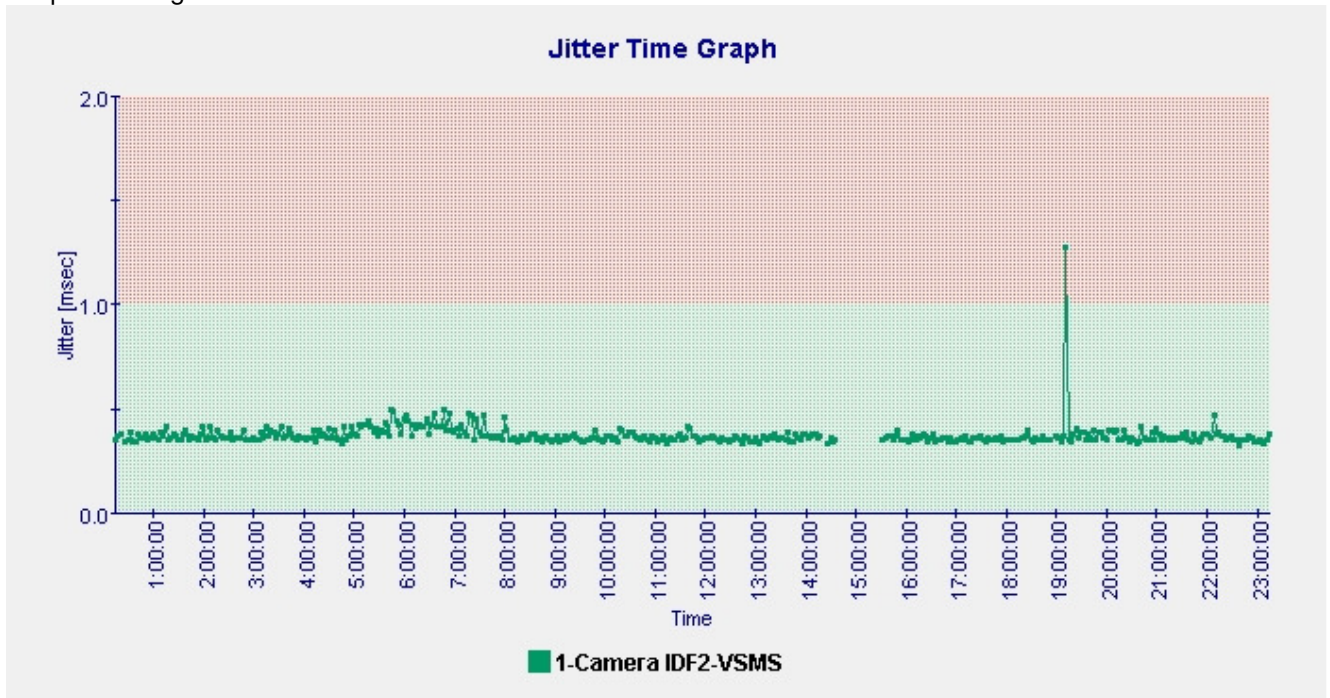
Results – Pair 3 – Camera IDF2 to VSMS



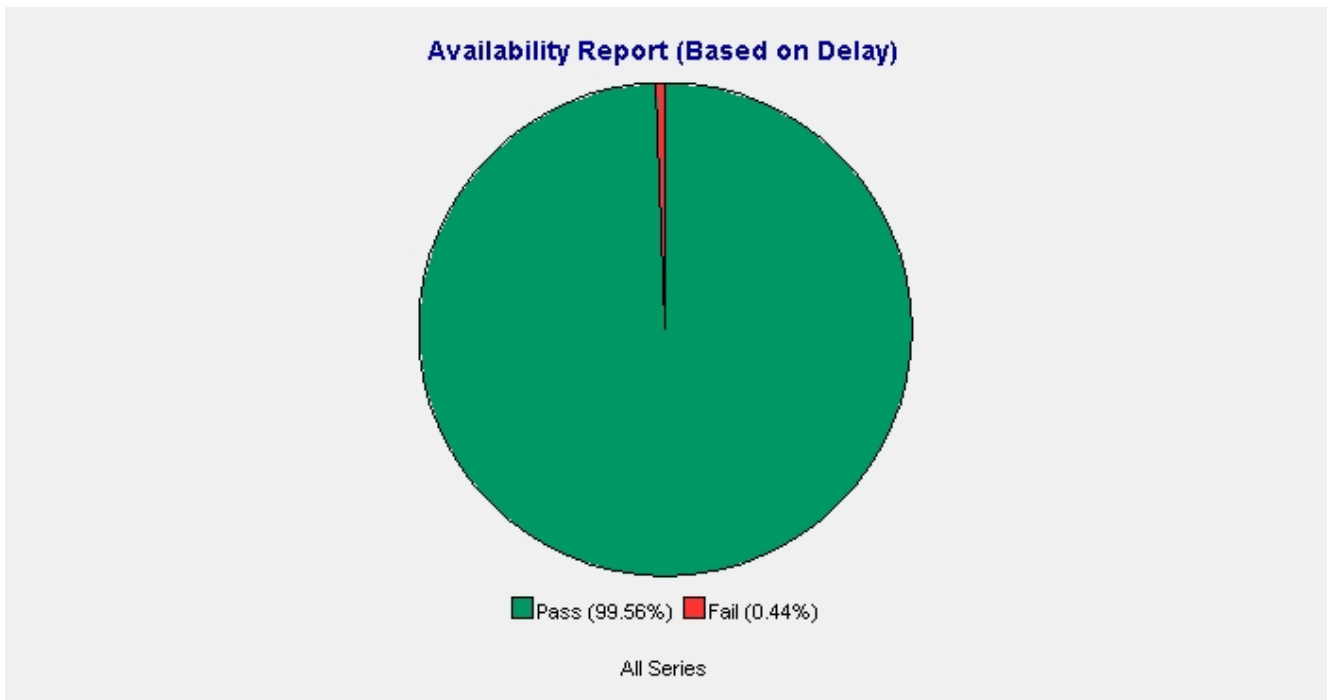
Network Loss graph threshold is set a 0.5% for SD simulations and 0.1% for HD simulations. Graph shows green below threshold and red above.



Network Delay graph threshold is set at 10 ms for LAN simulations and 50 ms for WAN simulations. Graph shows green below threshold and red above.



Network Jitter graph threshold is set at an average of 1 ms for LAN simulations and 5 ms for WAN simulations. Graph show green below threshold and red above.



Network availability graph shows the percentage of time all thresholds were met during a simulation.

Other Considerations

In addition to making sure the network meets minimum packet loss, jitter and delay requirements, there are other issues that must be addressed to ensure the success of the IP Video deployment. These issues include, but are not limited to the following:

- Quality of Service implementation
- VLAN implementation
- IP addressing
- Media server storage capacity
- Additional storage requirements
- Media server I/O capacity
- Archiving and back-up requirements
- Redundancy requirements
- Operations Manager (VSOM) requirements
- Viewing station(s) sound and video requirements
- Viewing station(s) memory and processor requirements
- Viewing station(s) network connection speeds
- Camera(s) PoE requirements
- Education and training
- Utilization, environmental, port availability, and management for network switches

Test Limitations

Although a simulation is extremely valuable in determining network readiness for IP video, no simulation can be a perfect duplication of a network situation. Additionally, network utilization and performance are ever changing. The below items detail some of these imperfections of the simulation so you can plan and prepare accordingly.

The simulation of traffic was run for a 24 hour period. Your IP Video solution will probably run for years. Thus 24 hours is a rather small snap shot of time in the grand scheme of things. Network performance and traffic patterns could be different at different times at time move forward and thus actual IP video performance would be different than on this test.

The simulation was run from test agent to test agent according to the pairings table above. If IP camera are placed in different locations, network segments, or switches, it is possible the traffic for these IP camera will not follow the same path that was tested during this baseline simulation and thus actual IP video performance would be different than on this test. Spanning tree, routing protocols or network outages could also cause video traffic to take network paths.

The test simulated traffic to and from test agent computers. IP cameras may go into different network ports on edge switches. There is not way the simulation test can verify these individual ports. It is a test of the core infrastructure paths. All per port performance must be manually verified.

The simulation added DSCP tags with value of 40 on all simulated traffic. Depending on how the network QoS was designed and working at the time of the simulation will affect actual IP video quality. Changes and verification of QoS schemes and DSCP tagging could improve or derogate actual IP Video performance.

As a result, all networks supporting IP Video should be monitored on an on-going basis and in real-time if possible to make sure the network continues to meet packet loss, jitter and delay requirements.

Final Grade

Each testing pair is given a final grade of passing, acceptable or failing.

A **Passing** score is given if all thresholds are met on 99.5%+ of simulations.

An **Acceptable** score is given if all thresholds are met on 98.0%+ of simulations.

Otherwise a **Failing** score is given.

Sending Agent	Receiving Agent	# Planes	Grade
VSMS	Viewing Station	4	Acceptable
Camera IDF1	VSMS	2	Fail
Camera IDF2	VSMS	2	Pass