Performance Analysis of Ethernet Network

ENSC 427 – COMMUNICATION NETWORKS

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Group 12

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Road Map

- Introduction
  - Performance Analysis of Transferring Large Data Files in Ethernet Network
- Video File Formats
- Ethernet Technology
- Riverbed Modeler Implementation and Simulations
- Conclusion
- Future Work
- References

Introduction

- Simulated a post-production facility where editor workstations access media on a shared, network-attached server storage video files
  - FTP, AFP, and SMB commonly used for this task. This project simulates an FTP implementation.
- Transfer of files simulating three prevalent video file formats with different data rates
- Collected the delay, utilization, and throughput statistics over time
- Analyzed results to determine viability of different Ethernet links in simulated scenario

Video File Formats

- Many different methods of encoding captured video into digital storage possible
- All codecs have trade-offs between image quality and file size/computational complexity.
- Three different files transferred simulating short clips of the following commonly used video codecs:
  - Consumer: AVCHD 1080p @ 30 Mbps
  - Television: ProRes 422 1080p @ 117 Mbps
  - Feature Film: ProRes 422 4K @ 503 Mbps

Ethernet Technology

- Foundational to networking today, Ethernet has seen numerous iterations to the technology since it's invention in 1973.
- Originally intended for bus topology, now used in switch connected start topologies.
- New iterations achieve greater throughput with an evolution in the protocol.
- This project performs simulations over three different generations:
  - 802.3u: Fast Ethernet (1995) Rated at 100 Mbps
  - 802.3z: Gigabit Ethernet (1998) Rated at 1000 Mbps
  - 802.3ae: 10 Gigabit Ethernet (2002) Rated at 10 Gbps

Riverbed Modeler Simulations

- 9 scenarios created simulating the network transfer of each of the three video file formats over each of the three Ethernet links
- Files transferred:
  - 13 second AVCHD 1080p video file (50 MB)
  - 34 second ProRes 422 1080p video file (500 MB)
  - 81 second ProRes 422 4K video file (5 GB)
- Parameters to analyze
  - Ethernet Delay (seconds)
  - Utilization Rate (percentage)
  - Throughput (bits/second)

Implementation

- Office Sized Network with 8 clients, 1 switch, and 1 server for File Transfer Protocol (FTP)

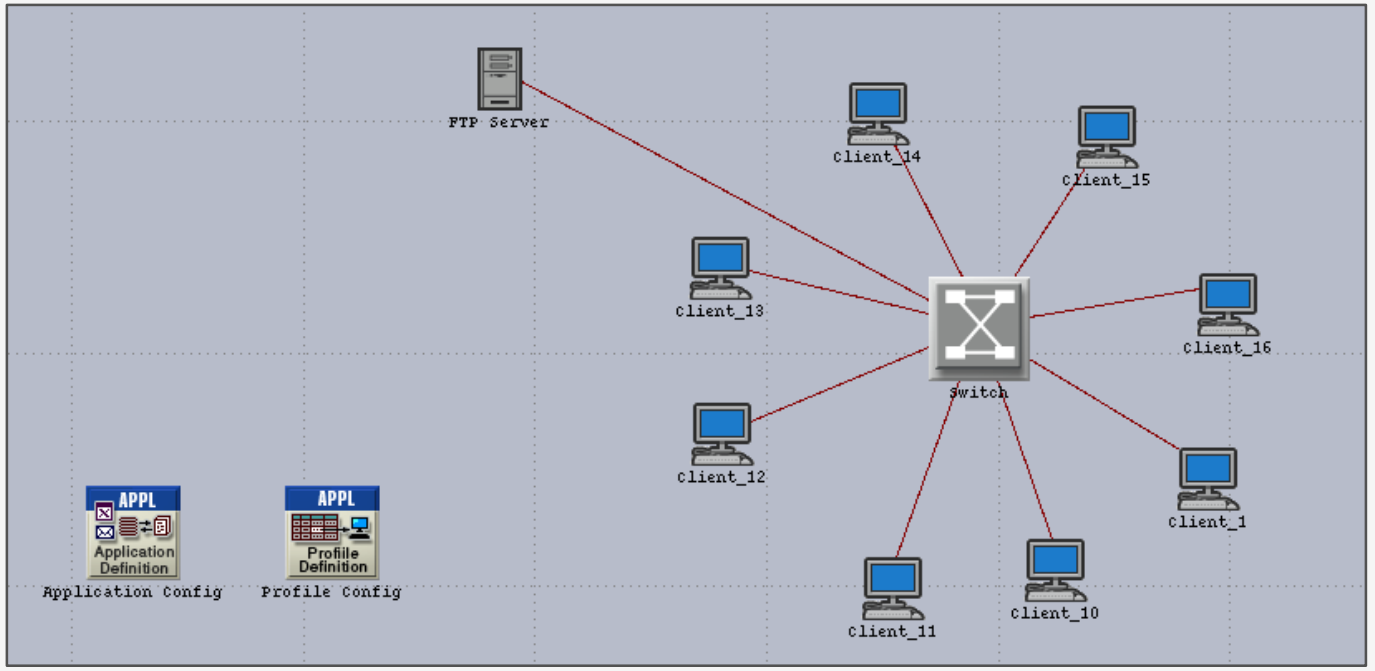

Figure 1 - Topology of Office Sized Network

Results – AVCHD 1080p

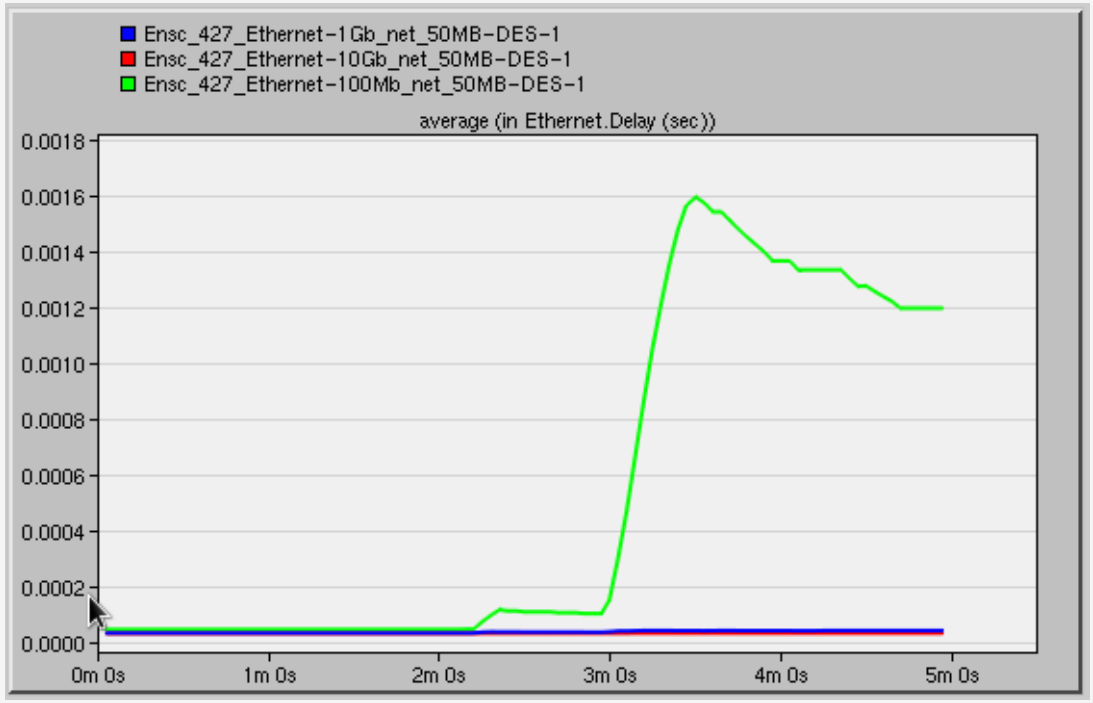

Figure 2: Ethernet Delay for 50MB transfer

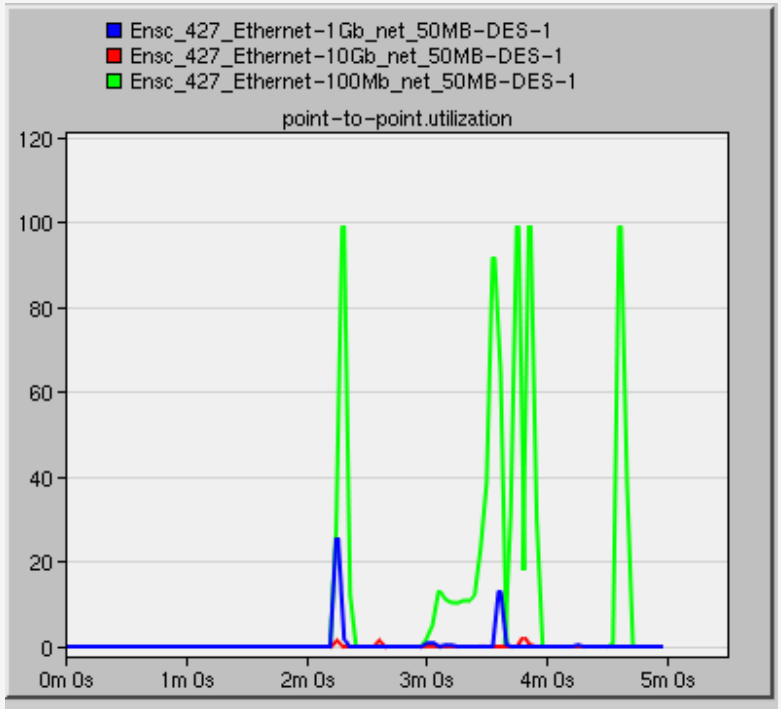

Figure 3: Utilization Rate for 50MB transfer

Results – ProRes 422 1080p

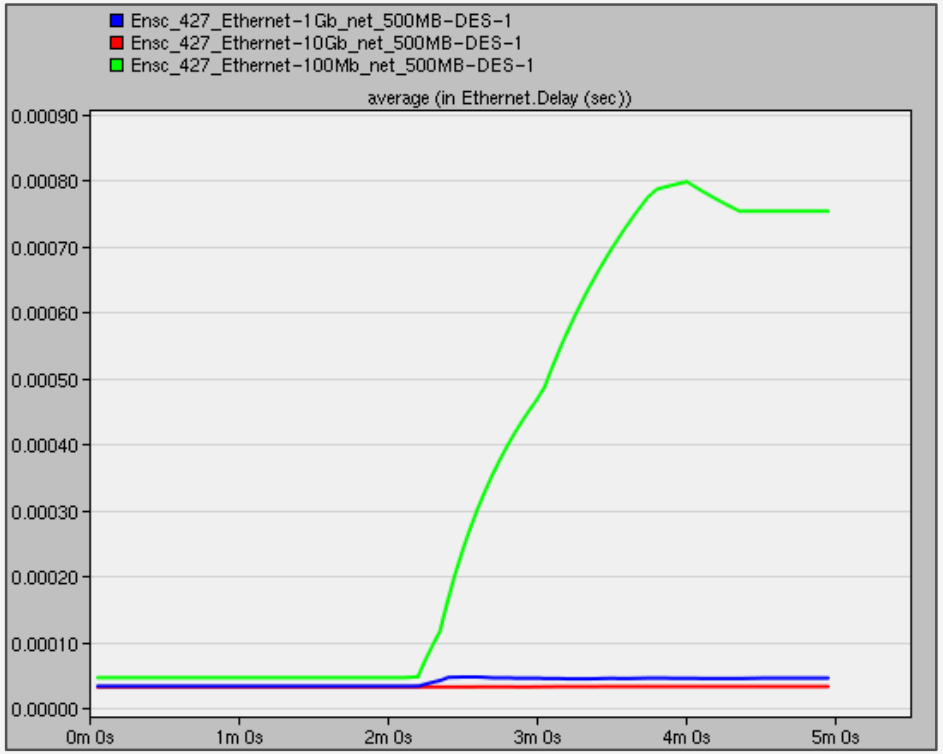

Figure 4: Ethernet Delay for 500MB transfer

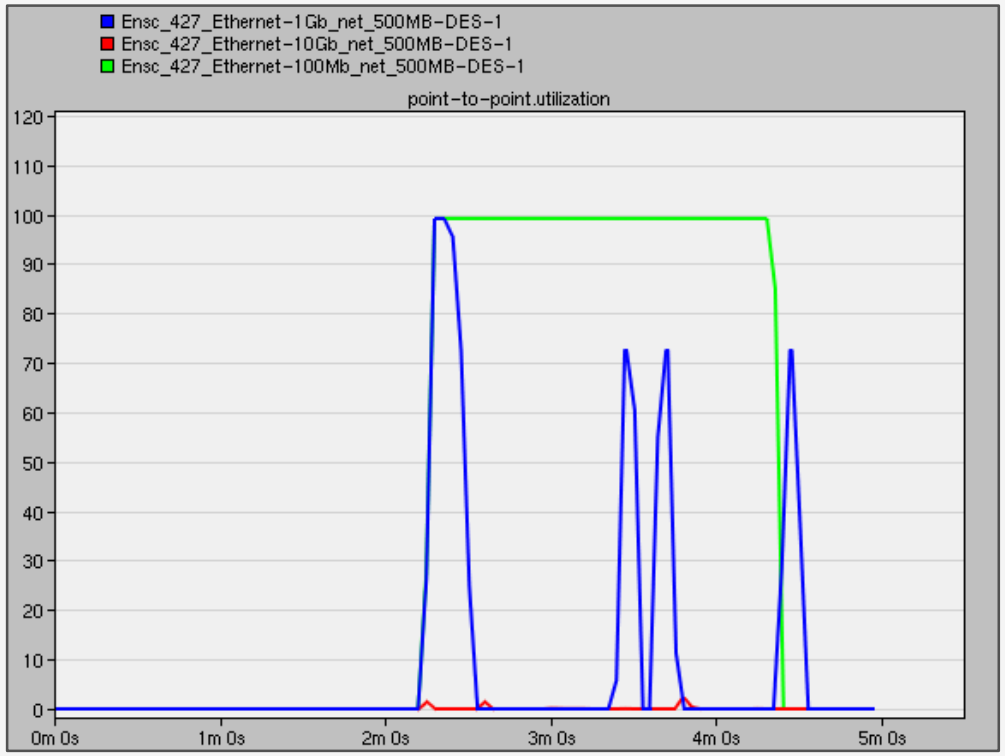

Figure 5: Utilization Rate for 500MB transfer

Results – ProRes 422 4K

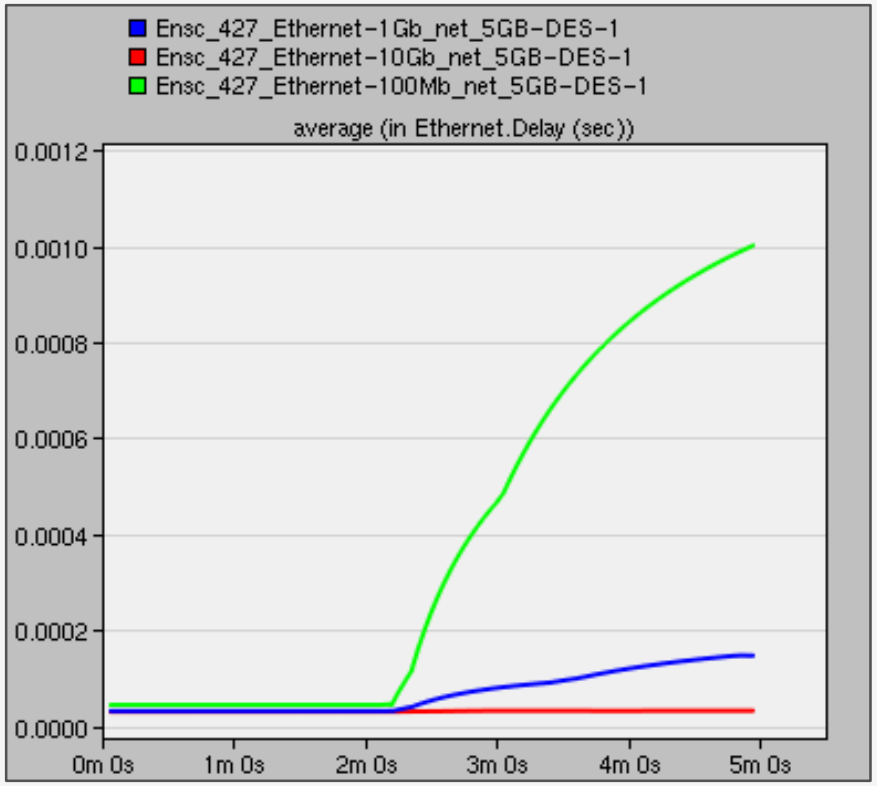

Figure 6: Ethernet Delay for 5GB transfer

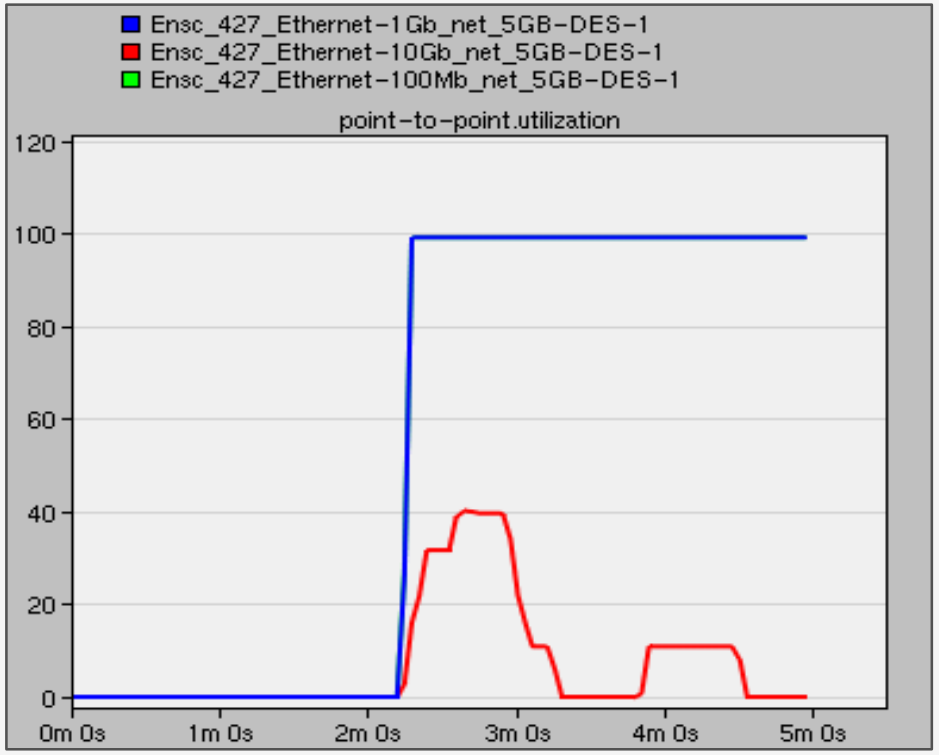

Figure 7: Utilization Rate for 5GB transfer

Utilization and Throughput

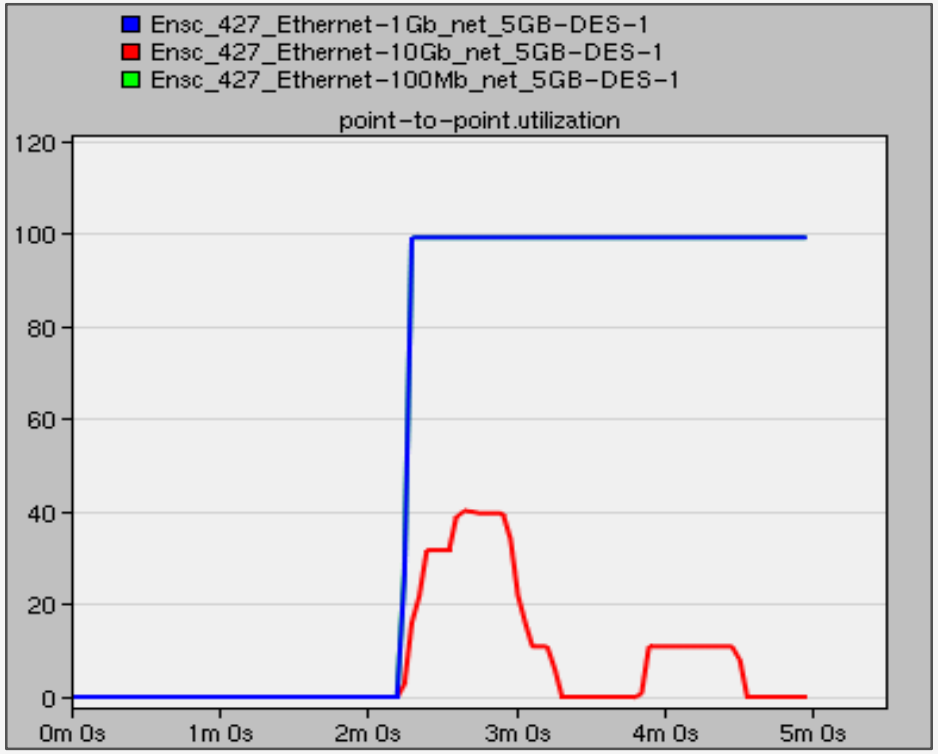

Figure 7: Utilization Rate for 5GB transfer

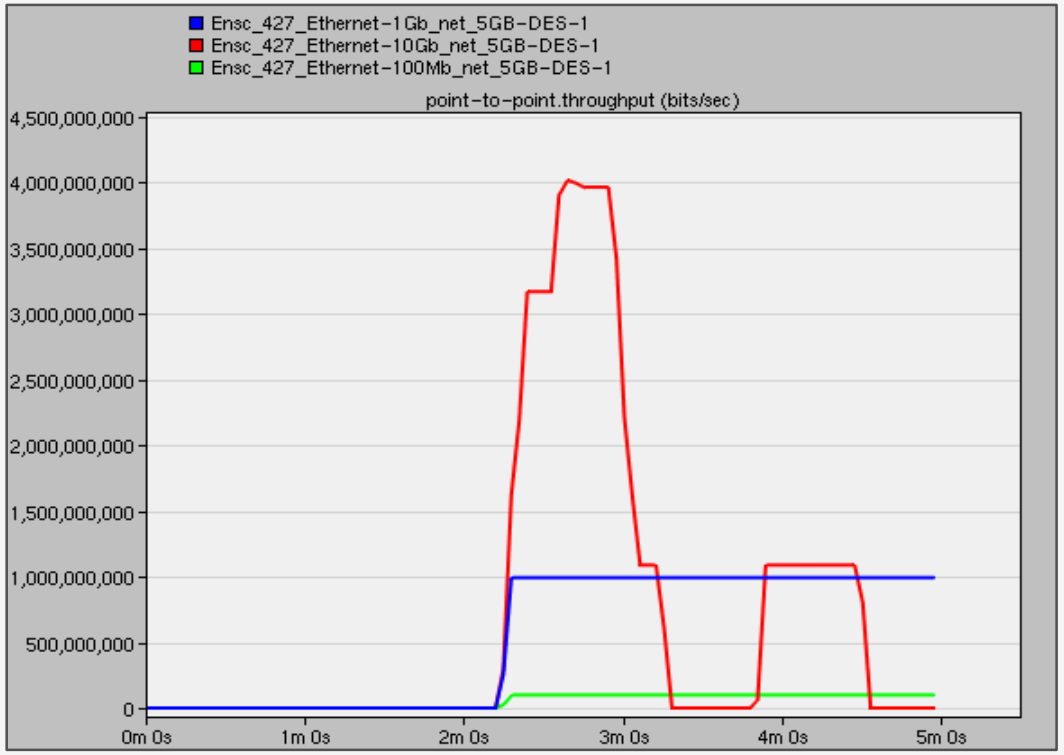

Figure 8: Throughput for 5GB transfer

Future Work

- Extend simulation time to determine steady state delay
  - Simulated transfer did not complete in either ProRes 422 trials leading to uncertain results
- Capture live traffic flow from post-production studio and use rather than FTP High Load
  - *Will improve overall accuracy of simulation*
- Perform parametric simulation with varying number of clients attempting simultaneous access to shared video storage
  - *Will help determine the exact number of simultaneous connections over a given link*
- Include and analyze the effects of background traffic
  - *Background traffic will increase the bandwidth needed and simulation time*

Conclusion

- Ethernet technology continues to develop impressive throughput advancements
- Fast Ethernet no longer able to keep up with modern applications of Ethernet
- Gigabit Ethernet able to handle AVCHD and ProRes 422 1080p video file transfers, but reaches the limit with eight connected workstations
- 10 Gigabit Ethernet is positioned as the next generation of Ethernet and easily handles even the most demanding 4K footage
- Past trends predict ever increasing demand for high bandwidth links which will soon eclipse 10 Gigabit Ethernet capability

References

[1] JDSU, Fundamentals of Ethernet. 2015 [Online]. Available: http://www.jdsu.com/ProductLiterature/fundethernet_wp_cpo_tm_ae.pd

[2] A. Atayero, A. Alatishe, and J. Iruemi (2012) Modeling and Simulation of a University LAN in OPNET Modeller Environment Environment [Online]. Available: http://www.academia.edu/2755380/Modeling_and_Simulation_of_a_University_LAN_in_OPNET_Modeller_Environment

[3] 10GEA, Gigabit Ethernet, 2015. [Online]. Available: https://www.10gea.org/whitepapers/gigabit-ethernet-2/

[4] J. Cioara, D. Minutella, H. Stevenson (2006, February 6) CCNA Exam Prep: Data Link Networking Concepts [Online]. Available: http://www.pearsonitcertification.com/articles/article.aspx?p=438038&seqNum=3

References

[5] Cisco, Deploying Gigabit Ethernet to the Desktop: Drivers and Application, 2007. [Online]. Available: http://www.cisco.com/en/US/technologies/tk389/tk214/tk277/technologies_white_paper09186a00801a7595_ns17_Networking_Solutions_White_Paper.html

[6] W. Feng, P. Balaji, L. Bhuyan, and D. Panda (2005) Performance Characterization of a 10-Gigabit Ethernet TOE [Online]. Available: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&tp=&arnumber=1544578&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D1544578