Teaching Data Communications Using Cisco Networking Academy's Curriculum

J. Art Gowan, Jr.
Department of Information Systems and Operations Management
University of North Carolina at Wilmington
Wilmington, NC 28403-5611

Abstract

A program that should be considered closely when looking at curriculum for teaching a course in data communications is Cisco's Networking Academy Program. The curriculum is entirely online, web-based, with substantial online support features for both faculty and students. The content of the first semester is basic data communications theory. The content of the subsequent semesters is more Cisco specific. A major strength of the curriculum is the numerous hands-on labs that bring the theory to life through application. It also provides the foundation for students who may wish to continue the Cisco-based training and become a Cisco Certified Network Administrator (CCNA). The curriculum can be effectively used to teach data communications at the university level. A general description of how it is used in an undergraduate, information systems program is provided.

Keywords: data communications, networking, curriculum, Cisco

1. INTRODUCTION TO THE CNA

The Cisco Networking Academy (CNA) program was first offered in 1997. It is a private/public partnership that has proven extremely successful. Cisco's initial investment to create the program was $50 million. As of this date, there are almost 6,600 academies, 10,000 graduates as of the summer 2000, and over 190,000 currently enrolled students (as of Spring 2001). The target audience is comprised of students from high school through four-year universities. The goal is to support schools and programs to help prepare and train network professionals in response to the present and forecasted worsening shortage.

Cisco Certification
The Cisco Certified Network Associate (CCNA) and Cisco Certified Network Professional (CCNP) are two industry-recognized certifications, which are the foundation for the Networking Academy program. The entire program is delivered across eight semesters in 280 semester hours. To obtain CCNA certification, a student will typically complete the first four semesters of the Networking Academy program and successfully pass the Cisco Certified Network Associate exam. The CCNP recommends an additional four semesters, 280 semester hours, and examination. Network+ certification is also available through a partnership between Cisco and Computing Technology Industry Association (CompTIA). For more information about the Network+ certification, visit:
http://www.comptia.com/certification/index.htm

2. THE CURRICULUM

The curriculum is web-based. It is accessible through the web and can be downloaded for local access using any HTML browser. What makes this curriculum so exciting and dynamic are the hands-on labs. The first semester material covers at least 80% of the material delivered in a typical undergraduate data communications course, when compared to other popular business data communications textbooks, like those authored by Panko (2001), Shelly, Cashman and Serwatka (1998), or Fitzgerald and Dennis (1999). The first semester uses the framework of the OSI model, with 15 chapters of content across the seven OSI layers as follows:

- Computing Basics
- The OSI Model
- Local Area Networks
- Layer 1 – Electronics and Signals
- Layer 1 – Media, Connections, and Collisions
- Layer 2 – Concepts
- Layer 2 – Technologies

- Design and Documentation
- Structured Cabling Project
- Layer 3 – Routing and Addressing
- Layer 3 – Protocols
- Layer 4 – The Transport Layer
- Layer 5 – The Session Layer
- Layer 6 – The Presentation Layer
- Layer 7 – The Application Layer

The primary topics that are integrated across the fifteen chapters are:
- Data encapsulation (protocol data units: segments, packets, and frames)
- TCP/IP
- Devices (NICs, repeaters, bridges, switches, and routers)
- Ethernet, Token Ring, FDDI LAN technologies
- Cabling
- Subnetting LANs
- Network design and management

Topics, which require the use of additional or supporting materials, are:
- Modems
- Telephone systems (telephony)
- Encryption (specific methods)
- Compression (specific methods)
- LAN management specific to any NOS like NT or Novell*

(* in order to understand the management of user and group accounts, privileges, and access control via a traditional server)

The first semester is vendor neutral. It includes a number of hand-on labs including cabling, testing, and implementing peer-to-peer networks. The second, and subsequent semesters include advanced topics that are vendor-neutral, but applications that are Cisco-specific, which involves learning Cisco's internetwork operating system (IOS) for router and switch configuration. This is where substantial hands-on learning takes place. The second semester involves designing and implementing subnetted IP-based address schemes, configuration of router interfaces (ports) and routing protocols, as well as troubleshooting. Semester three involves more specific use and configuration of switches, including the design and implementation of virtual LANS. Semester four addresses more advanced WAN configuration, with heavy emphasis on PPP, ISDN and Frame Relay.

Updated versions of the curriculum continue to be published. Version 2.1 was published in the summer of 2000 and version 2.12 in the winter of 2000. Textbooks are available, but are not as current as the online curriculum

3. EQUIPMENT REQUIREMENTS

At the university level, some of the labs and curriculum related to cabling and physical testing may not be feasible or desirable for inclusion. The advantage of having a current web-based curriculum, with substantial hands-on exercises, far outweighs the necessity to limit use of some of the material. The use and configuration of routers brings the material to life, and enhances understanding of the Internet and internetworking.

The second semester curriculum refers to a standardized "router lab topology", which is composed of five routers, four hubs, one switch, and a number of workstations, as shown in Figure 1. The basic set of equipment required to effectively deliver the curriculum is called a "Local Academy Lab Bundle" and is available, at a substantial discount, through Cisco Academy. This includes the 5 routers and two switches (which is used to functionally substitute for the separate hubs and switch). The cost is approximately $10,000.
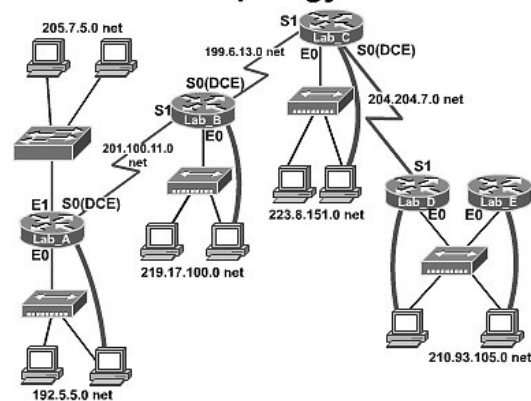

Figure 1

Additional hubs, switches and hosts/workstations can be used to enhance the lab configuration, but is not required. If space is available for a dedicated lab, the equipment can be integrated in an existing computer lab, or, can be made mobile, and brought into a classroom or lab for presentation and/or use. The author uses a mobile system with routers and switches mounted in a standard data communications rack, which is mounted on a platform with wheels. One limiting factor is that only one student may directly access each router at a time and manipulate its configuration. This means that a "lab bundle" will support five students simultaneously. Other students at workstations can view and test a lab configuration externally using ping and trace-route functions. An optimal solution to this limitation is to purchase additional lab bundles. A maximum of $20,00 of equipment can be purchased by any local academy at the academy discount. The more bundles, the more awkward it would be to maintain a mobile lab, therefore requiring dedicated space. Alternatives include the use

of an access server, simulation software, and virtual labs.

An access server is a specialized Cisco router that can be used to allow students access to a lab bundle(s) through the network without having physical access. The server provides a firewall function, which will not allow traffic to exit the lab bundle, thus not interfering with a school's production network. This allows up to five students to access a lab bundle, simultaneously, in order to complete hands-on assignments. One access server can support up to two bundles, or 10 students at a time. The cost of such a server is approximately $2500.

An additional solution includes the use of simulation software. The following is a list of links to vendors who offer such software. Each has its limitations, but provide an interface with basic functionality to allow students to practice the use of the IOS:
www.routeru.com, www.sybex.com,
www.routersim.com

4. ANCILLARY SUPPORT

End-of-chapter quizzes are available for students to practice for the online chapter and end-of-semester tests. All tests are multiple-choice and are graded automatically online. Online tests can be managed and administered through the Academy's site (cisco.netacad.net) by the instructor. The instructor sets up student accounts at the beginning of each semester, with passwords. The instructor can set up a time to start and duration of a test and monitor performance. Tests can be set up for specified students or the entire class and are available in multiple languages. An online grade book is updated as students complete tests and can be downloaded in a variety of formats. Online analysis of tests and specific test questions are available, including a comparison of how a local class performs on a test item as compared to all other current Academy students around the world.

In addition to the web-based curriculum, testing, and class maintenance facilities, other services are made available to instructors through the web. The "Instructor Community", which provides a forum for shared intelligence among educators, allowing teachers around the world to compare best practices and most effective techniques for teaching specific lessons and the "Online Instructor's Guide", which is a comprehensive teaching resource, provides lesson plans for every lesson, as well as laboratory exercises for hands-on experience. The Instructor's Guide is constantly evolving to reflect recommendations from the instructors and improvements in teaching methods. Additional materials are available to instructors through online discussion forums and a multitude of linked articles.

Students are also provided a wide array of resources, including discussion forums, articles, access to the "Academy Store" to purchase hardware, software, books, etc. at discounts, as well as the "Work-Based Learning Web Site". "This site is intended to foster a collaborative environment for students, schools and employers to work together to create work-based learning opportunities in the form of internships and coops" (http://wbl.netacad.net/index_new.asp). Students and businesses come together at this site for the purpose of matching students with intern/coop opportunities.

5. CONCLUSION

The Cisco Networking Academy Program offers an excellent curriculum, which is current and dynamic. The additional support services are excellent. In order to have your own college or university designated as a Local Cisco Academy, an instructor must attend training and complete the semester-level examination for at least the first two semesters, which takes about 3 weeks. It also requires the school/college/university to purchase necessary equipment.

If you are interested in starting an academy at your school, visit the following site:

http://www.cisco.com/warp/public/779/edu/academy/get_involved/start.html

Additional information is available at Academy Fast Facts:

http://www.cisco.com/warp/public/779/edu/academy/overview/fast_facts.html

6. REFERENCES

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