

# Converged Internetwork Design and Implementation 1

Valencia High School (052480)

## Basic Course Information

Abbreviations:

Abbreviation	Course code
Computer Networking 1	6521

Length of course:

Full Year (2 semesters; 3 trimesters; 4 quarters)

Subject area:

Subject area	Discipline
College-Preparatory Elective ("g")	Interdisciplinary

UC honors designation:

No

Grade levels:

9th	10th	11th	12th

Course learning environment:

Classroom	Online

Is this course an integrated course?

Yes

## Course Description

Overview:

Converged Internetwork Design and Implementation 1 is an interdisciplinary course designed to prepare students for post-secondary success in the Information and Communication Technologies (ICT) field. The course engages students with studies of: the history and implications of network communications; the protocols which make the Internet possible; how networks provide access to

services; and college and career preparation in the ICT field. This course integrates the theory and application of network communications, and exposes students to media that invites them to consider how Internet engineers think, design, and solve problems. Students have several opportunities to produce college-ready writing, collaborate, research, develop study skills, and develop 21<sup>st</sup> century skills in this course.

Converged Internetwork Design and Implementation 1 is an interdisciplinary elective course offered as the second part of a three-year program of study in an Information and Communications Technology Track in the Val-Tech Academy . This course is designed to prepare students for further study and careers in Computer Engineering, and/or Information Communication Technology (ICT, formerly IT). Students will learn about theoretical networking models, including the OSI Theoretical Models and the TCP/IP Theoretical Model. While learning about the theoretical and applied design and architecture of different information systems, students also gain understanding of network protocols, distributed algorithms, and challenges and solutions related to information systems design and management. Students analyze the ways in which technology is changing both society and economics through case studies of individuals and firms who have reshaped the global economy. Students acquire the ability to evaluate information system performance at various levels of granularity, with emphasis on network systems level design and performance. They then analyze this real-world data against the theoretical models. Students learn to use binary, hexadecimal, and octal mathematical models to evaluate system throughput, flow, utilization, etc. In addition, students learn the principles involved in the formal design and management of computer information systems network and the use of tools such as probability theory, queuing theory, distributed systems, operating systems design, information systems measurement protocols, and heuristic design procedures. As part of their 21<sup>st</sup> Century College and Career Portfolio, students will show that they have the soft skills necessary to succeed in College and Careers.

Prerequisites:

<b>Prerequisite</b>	<b>Required / Recommended</b>
Algebra 1	Recommended

Co-requisites:

<b>Corequisite</b>	<b>Required / Recommended</b>
Computer Maintenance or Computer Applications or Comp Tech	Recommended

Course content:

## **Unit 1 – Introduction to Networks**

During this unit, students will be exposed to the networks which surround them every day and the societal changes which have resulted. Understanding how these networks have developed over time and have affected society will help students understand the affects of social, transportation, and communication networks on their own lives, and will help them to analyze trends which will impact society in the future.

Standards tie networks, including the Internet, together. This section of Unit 1 discusses those standards and the organizations which develop them, with the goal of helping students understand the collaborative nature and importance of the standards-making bodies.

As with so many modern careers, collaboration is key to success. Working in collaborative teams to solve problems and complete projects is a key skill for all students.

*Topics addressed:*

- Major developments in Computing and Internet history
- Exploring Networks:
  - How did networks develop over time?
  - How do networks affect the way we live, learn, interact, and play?
  - How do messages travel across a network?
  - Living in a network-centric world and how this has impacted society
  - Future impacts of the Internet on society and commerce
  - Utilize appropriate online technologies to collaborate and communicate
  - The “network as a platform”
  - How to work effectively and collaborate in teams to solve problems and complete projects

*Key assignments:*

a. Blog/Bulletin Board Discussion

Prompt: “How have protocols aided the development of the Internet? Provide examples from Network Basics Chapter 3 and your readings to support your thinking.”

#### b. Blog/Bulletin Board Discussion

Prompt: How did the readings change your understanding of the role of the Internet on society? Refer to specific sections of the readings that affected or deepened your understanding.

#### c. Learning Lab

Network Basics Lab Manual, Learning Lab Lab A (1.1.1.8) — Researching Network Collaboration Tools.

Interactive activity in which students research and reflect on

- Using Collaboration Tools (e.g., Google Docs)
- Sharing Documents with Google Drive
- Conference and Web Meetings
- Creating Wiki Pages and other publicly-shared collaborative documents

#### d. Learning Lab

Network Basics Lab Manual Lab 3.1.3.6 — Researching Networking Standards.

Interactive activity in which students gather information about the major network standards organizations and reflect on how the various networking standards organizations enhance our experience of the Internet and computer networking.

#### e. Guest Speaker Panel Reflection

How do network engineers think? Panel discussion with professionals from the Information Technology sector and local post-secondary learning institutions to discuss how Internet technologies are developed and supported in the business/IT world. Reflection paper discussing learning from panelists.

#### f. Argumentative Essay

Students will write a 4-5 page argumentative essay responding to the following prompt: “After viewing the TED talk ‘What is the Internet, Really?’, and reading The Internet and Everyday Life, Part II, Chapter 1, ‘Days and Nights on the Internet’ on the impact of the Internet on everyday life, write an essay that identifies a problem with Internet use and argues for a solution. Be sure to support your position with evidence from the text and TED Talk.”

## Unit 2 – Networking Protocols

Networks work because of standardization. With standards, components from multiple companies can work together to form a seamless whole; without standards, consumers and businesses are bound to only one vendor's products. Innovation and improvements come when the standards are followed. In this unit, students will learn about the OSI (Open Standards Interconnect) and TCP/IP (Transport Control Protocol/Internet Protocol) models, which provide a theoretical foundation for how network communication takes place.

TCP (Transport Control Protocol) and UDP (User Datagram Protocol) are methods of communicating across a network. Each has its own characteristics and, while largely invisible to the end user, these characteristics affect performance and quality of the network transmission. By discussing the theories governing TCP and UDP, and then exploring how these theories work in practice, students will understand how the networks operate and be able to enhance the user experience.

The OSI and TCP/IP models govern how the network is designed, and that affects the end-user experience. It is important that students have a practical example to see where this application affects them personally.

### *Topics Addressed:*

- OSI and TCP/IP Theoretical Models and the IPv4 (Internet Protocol, version 4) protocol
- How devices get messages to their destinations
- Application of the OSI and TCP/IP models
  - Functions of the application layer, session layer, and presentation layer working together to provide network services to end user applications.
  - The transport layer as manager of transportation of data
  - Theoretical and practical characteristics of the TCP and UDP protocols
  - Application of the OSI and TCP/IP models
    - Common application layer protocols that provide Internet services, and how that affects end users.

### *Key assignments:*

- a. Blog/Bulletin Board Discussion

Prompt: What are the benefits of an information system that relies on “layers” of functionality? What are the drawbacks? Refer to specific sections of the readings or TED Talk that affected or deepened your understanding.

#### b. Learning Lab

##### Lab 6.2.2.8 — Viewing Host Routing Tables.

Students access a host routing table, examine host routing table entries, and examine IPv6 (Internet Protocol, version 6) routing table entries. Students reflect on the differences of IPv4 from IPv6 and the implications of shifting to a new version of the Internet Protocol. Students reflect on the layers which are represented in the different elements of the routing table.

#### c. Blog/Bulletin Board Discussion

Prompt: What is it about the TCP protocol that makes it “reliable”? What is it about UDP that makes it “unreliable”? Provide examples from Networking Basics Chapter 10 and your other research to support your thinking.

#### d. Learning Lab

##### Lab 4.1.2.4 — Researching Peer-to-Peer File Sharing.

In this lab, students identify Peer-to-peer networks, file sharing protocols, and applications. Students research peer-to-peer file sharing issues and Copyright litigation.

#### e. Explanatory Essay:

Students will respond to the following “Standards and protocols make the pieces of the Internet work together. Research the development of the Ethernet, TCP/IP, and DNS standards and explain how they work together to ensure a seamless user experience. Be sure to support your position with evidence.”

### **Unit 3 – Network Addressing**

The OSI and TCP/IP theoretical models allow students to see why standardization is important. In addition, the protocol layers as implemented provide security and reliability, the study of which will assist students in understanding how the standards affect the societal changes discussed in Unit 1 and build upon the topics from Unit 2.

As students learn about Network Addressing, they need to answer the questions “What is a Network Address? How individual host devices on a network are uniquely identified? What are the challenges in providing access to the Internet of Everything?” These questions undergird much of the modern technical world, and are critical to understanding how practice is rooted in theory.

Once students understand the basic theory underlying networking, as well as the binary and Hexadecimal mathematics required to understand the network addressing, students will need to be able to apply that theory. ICMP (Internet Control Message Protocol) is used to implement and test IPv4 and IPv6 connectivity, and is also used to assist with routing decisions. Students also need to understand how routers work providing services between systems on different networks. Addressing schema will be introduced; by looking at the binary and hexadecimal mathematics of hierarchical designs, students will be able to see why certain design decisions are preferred to others as well as see how these decisions affect network performance.

*Topics Addressed:*

- Theoretical and practical implementation and operation of IPv4 addressing
  - The structure of an IPv4 address
  - The purpose of the subnet mask.
  - Characteristics and uses of the unicast, broadcast, and multicast addresses.
  - The use of public address space and private address space.
  - Network mathematics: Given a network and subnet mask, calculate the number of host addresses available.
  - Network Mathematics Calculate the necessary subnet mask in order to accommodate a given number of hosts.
  - Network theory Describe the benefits of variable length subnet masking (VLSM)
  
- Theoretical and practical implementation and operation of IPv6 addressing
  - Characteristics of the various types of IPv6 addresses.
  - Characteristics and structure of an IPv6 address.
  - The use and configuration of global unicast addresses.
  - The use of IPv6 multicast addresses.
  - Theory and implementation of IPv6 address assignments in a business network.

- Theory and implementation of ICMP in a IP network, including IPv4 and IPv6)
- Testing network connectivity.
- Theoretical and practical implementation of Routing
- Hierarchical addressing scheme theory and application.

*Key assignments:*

a. Learning Activity

Modeling Activity 7.0.1.2 in the online curriculum: Researching the concept of the Internet of Everything. Interactive activity in which students research and reflect on “Why do you think there is a need to address trees? Windmills? Cars? Refrigerators?”

b. Blog/Bulletin Board Discussion

Prompt: How did the reading and video change your understanding of the role of the Internet of Everything? Refer to specific sections of the readings that affected or deepened your understanding.

c. Blog/Bulletin Board Discussion

Prompt: How has the move to IPv6 enabled and affected the development of the Internet? Provide examples from Network Basics Chapters 7 and 8 and the supplemental reading to support your thinking.

d. Learning Labs

Labs 7.3.2.5 and 7.3.2.8 — Verifying and Troubleshooting IPv4 and IPv6 Addressing

In these labs students will be given a network scenario. Students will verify and troubleshoot IPv4 and IPv6 addresses and addressing.

e. Learning Lab

Network Basics Lab Manual, Labs 8.2.1.4 — Designing and Implementing a VLSM Addressing Scheme.

Students will use VLSM to meet the IPv4 addressing requirements provided in the simulation. They will design the VLSM address scheme, and configure the interfaces on the routers with the appropriate IP address information.



#### f. Team Learning Lab

##### Skills Integration Challenge:

Working in teams and using the network simulator Packet Tracer, students will take an existing network infrastructure and apply their knowledge and skills to finalize the configuration.

#### g. Team Debate

Working as a team, students will debate the pros and/or cons of one or more of the network addressing concepts.

### **Unit 4 – Network Access**

The OSI model covers more than just software-based addressing. The OSI model provides information about how the various components fit together, including the MAC (Machine Access Control) and IP addresses (both IPv4 and IPv6). The OSI model also addresses the cabling which connects the network together; the standards which govern this cabling allow for interconnection of various devices and the functionality of the whole. At the local network level, the most common of these standards is Ethernet, which implements the entire OSI model.

#### *Topics Addressed:*

- Theory and Implementation of the OSI model
- Layer 2 frame structure
  - - Operation of the Ethernet sub-layers
    - Compare the roles of the MAC address and the IP address.
    - Understand the purpose of ARP, and know how ARP requests impact network and host performance.
- Theory and Implementation of basic switching concepts, both for layer 2 and layer 3 switches.
- The use of Standards to govern and regulate data transmission.
- Theory and Functions of logical topologies and physical topologies, including both WAN and LAN.

- Basic characteristics of copper cabling, fiber-optic cabling, and wireless media, including advantages and disadvantages of each.
- Design and Construction of physical cabling in simulated and authentic networks.

*Key assignments:*

a. Blog/Bulletin Board Discussion

Prompt: Based on the readings about conferences and networking, compare how conference proceedings and computer networking have similarities. Compare how devices and attendees are similar and different in these situations.

b. Blog/Bulletin Board Discussion

Prompt: Compare and contrast structured network design, including specific design parameters for IPv4 and IPv6 networks. Use specific sections of the readings and supplements to support your points.

c. Learning Lab

Lab 9.4.4.5 in main text—Network Connection Examination and Analysis

Interactive activity in which students research and reflect on

- - Connections between wired networks, including multiple physical topologies and types.
  - Connections between wireless networks, including multiple physical topologies and types.
  - Examination of layer 2 LLC frame types as they are prepared for various media
  - Examination and discussion of the standards documents which govern data transmission

d. Learning Lab

Lab 10.1.4.3 — Researching Network Monitoring.

Interactive activity in which students will research and reflect on

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- Using a network monitoring tool such as Wireshark to examine Ethernet packets.
- Identifying and examining the different parts of Ethernet packets collected from the live network
- Compare and contrast these network packets with the packets as defined within the network standards documents. What information is not included in the WireShark frame as displayed? Why? Be sure to support your position with evidence from the text and readings.
- Examine the MAC addresses. Students will respond to the following questions What hardware information is identifiable from the information provided in the frame? How is this defined by the standards documents? Be sure to support your position with evidence from the text and readings.

#### e. Argumentative Essay

- - Argumentative essay responding to the following prompt: “After viewing the video ‘History of the Internet,’ write an essay that pinpoints a problem with current Ethernet architecture (including hardware, media, and layer 2 addressing), and argue for a solution. Be sure to support your position with evidence from the text and the videos.”

### **Unit 5 – It’s a Networked World, and I Want to Be Part of it**

Small networks have many things in common with larger networks. Applying the theoretical foundation from the prior units, the students will explore how these theoretical concepts apply in larger settings. Since they will have experienced some small networks in class already, they will be expanding their knowledge to larger network scenarios. Industry best practices theory will be explored alongside real-world network scenarios.

Students need to be ready to go into the world, both College and Career. To assist with this they will be preparing a Career Readiness Portfolio. This includes their research into careers in ICT (Information Computing Technology—formerly IT, Information Technology) career pathways, as well as exploration of college majors which may be applicable to these fields.

Reflection on learning is a critical element of a 21<sup>st</sup> Century learner. The final major assignment is designed to help students reflect on what they’ve learned.

## *Topics Addressed*

- Theory, design, and implementation of Networks
  - How small networks serve as the basis of larger networks
  - Design and plan networks
  - Theoretical and practical application of security vulnerabilities and general mitigation techniques
  - Theoretical and practical application of security strategy for securing network devices
  - Career Readiness Portfolio
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    - Prepare and publish a professional resume and cover letter
    - Explore careers in internet engineering, information systems, and related ICT job titles
    - Investigate career ladders in ICT, including but not limited to Chief Technology Officer, Manager of Information Systems, and Senior Network Engineer
    - Demonstrate professional communications during an interview
    - Demonstrate learning outcomes through a professional portfolio

## *Key Assignments:*

### a. Case Study Setting up an Internet Café.

In this case study, students engage in decision making, recognizing business opportunities, and apply course content knowledge to design an efficient and cost effective Internet business.

### b. Learning Lab

#### Lab 11.2.2.6 — Researching Network Security Threats

Students explore the SANS web site, identify recent network security threats, detailing a specific network security threat. Students will produce written deliberations regarding the steps necessary to secure an organizations IT infrastructure.

### c. Resume, cover letter, and interview workshops.

Supported by partner educators and professionals from the Information Communications Technology (ICT) sector, students participate in workshops facilitated by the educators/professionals.

d. Blog/Bulletin Board Discussion

Prompt: How do network engineers think? What guides the thinking of professionals who design and implement networks? Refer to specific sections of the readings or TED Talks to support your discussion.

e. College and Career Portfolio.

Students produce a cumulative college and career readiness portfolio that provides evidence of meeting the course learning outcomes. Specific pieces of evidence are required resume, cover letter, professional writing sample, and college-ready work samples.

f. College and Career Portfolio Defense (Mock Interview)

ICT professionals and educators from the industry sector or post-secondary education participate in mock interviews. Interview skills workshops with professionals and educators scaffold the final interview, where each student defends their College and Career Readiness Portfolio to a professional or educator. Common assessment rubrics are used by the interviewing adults to calibrate feedback.

g. Final Blog/Bulletin Board Discussion

Prompt: How have you grown as a learner and problem solver during this course? What strategies or methods helped you with the readings, labs, lectures, and other course content? How will you take on the challenge of learning after high school? Refer to specific learning/study skills that you have developed or improved as a result of this course.

### **Key Assignments**

Various types of assignments will be key to learning in the Internet Engineering 1 course. They are listed here by assignment type, with the specific prompts detailed together toward the end of each type.

### **Activity Type: Blog/Bulletin Board Discussion:**

- In the online Blog/Bulletin Board system, students will respond to the prompt and comment on at least two additional classmates in the thread/post.
- Students will answer the prompt as listed below. The prompts are designed to assist students in analyzing and developing mastery of the topics presented.
- The assignment is designed to have students provide evidence of their learning in a shorter format than an exploratory essay. Students reply to the prompt using proper grammar and references to their text. They need to be able to show a deeper understanding of the topics presented. By having the students respond to others they will learn both collaborative and deliberation skills.
- Each student will provide an entry answering the prompt and giving evidence to support their position. They will also respond to at least two other students, providing evidence either in support of or against the other student's views.
- By providing this type of deliberate feedback to the prompt and to each other, students will show the deeper understanding of the topics presented. In addition, they will be able to see where they may have misunderstood a particular element or otherwise need more specific direction. Furthermore, the assignment gives the instructor immediate feedback on student learning, and provides opportunities for quieter students to participate more fully in the course

### **Specific Blog/Bulletin Board Assignments:**

#### Unit 1, Discussion 1:

- Prompt: How did the readings change your understanding of the role of the Internet on society? Refer to specific sections of the readings that affected or deepened your understanding.

#### Unit 1, Discussion 2:

- Prompt: How have protocols aided the development of the Internet? Provide examples from Network Basics Chapter 3 and your readings to support your thinking.

#### Unit 2, Discussion 1:

- Prompt: What are the benefits of an information system that relies on “layers” of functionality? What are the drawbacks? Refer to specific sections of the readings or TED Talk that affected or deepened your understanding.

#### Unit 2, Discussion 2:

- Prompt: What is it about the TCP protocol that makes it “reliable”? What is it about UDP that makes it “unreliable”? Provide examples from Network Basics Chapter 10 to support your thinking.

#### Unit 3, Discussion 1:

- Prompt: How did the reading (The Internet of Everything) and video (Tomorrow Starts Here) change your understanding of the role of the Internet of Everything? Refer to specific sections of the readings and the video that affected or deepened your understanding.

#### Unit 3, Discussion 2:

- Prompt: How has the move to IPv6 enabled and affected the development of the Internet? Provide examples from the Network Basics Chapter 7 and the CNET Breaking News article to support your thinking.

#### Unit 4, Discussion 1:

- Prompt: Based on the readings, compare how conference proceedings and computer networking have similarities. Compare how devices and attendees are similar and different in these situations. Give evidence from the readings to support your positions.

#### Unit 4, Discussion 2:

- Prompt: Compare and contrast structured network design, including specific design parameters for IPv4 and IPv6 networks. Use specific sections of the readings and supplements to support your points.

#### Unit 5, Discussion 1:

- Prompt: How do network engineers think? What guides the thinking of professionals who design and implement networks? Refer to specific sections of the readings or TED Talks to support your discussion.

#### Unit 5, Final Discussion:

- Prompt: How have you grown as a learner and problem solver during this course? What strategies or methods helped you with the readings, labs, lectures, and other course content? How will you take on the challenge of learning after high school? Reflect on what you have learned about the topics and about yourself. Refer to specific learning/study skills that you have developed or improved as a result of this course.

### **Learning Activities**

#### **Activity Type: Learning Lab:**

- This is an interactive activity in which students research and reflect specific topics in the curriculum. They are designed to help them apply the theoretical learning to real-world situations.
- Students will be conducting research (as described in the Learning Lab) and detailing the results. They will also need to provide evidence of their mastery of each type of activity or tool used.
- The students will produce a Lab Report detailing their findings, including evidence of their use mastery.
- By researching specific tools and tasks, students will be able to connect the theoretical learning with real-world situations. The critical thinking required of this applied theory will serve them well in their other classes. This will also assist them in their Blog/Bulletin Board Discussions as well as their culminating argumentative essay.

#### *Specific Learning Lab Assignments:*

#### Unit 1, Learning Lab 1:

- Network Basics Lab Manual, Learning Lab A 1.1.1.8 – Researching Network Collaboration Tools.



- This is an interactive activity in which students research and reflect on using Collaboration Tools, Sharing Documents with Google Drive and other file sharing sites, Web Conferences and Web Meetings, and Creating Wiki Pages.
- Students will be conducting Internet research about online tools (described above) and describing their use. They will also need to provide evidence of use of each type of tool.

#### Unit 1, Learning Lab 2:

- Network Basics Lab Manual, Learning Lab 3.1.3.6 – Researching Networking Standards.
- This is an interactive activity in which students research the major network standards organizations and reflect on how the various networking standards organizations enhance our experience of the Internet and computer networking.

#### Unit 2, Learning Lab 1:

- Network Basics Lab Manual, Learning Lab A 4.1.2.4 – Researching Peer-to-Peer File Sharing
- In this Lab, students identify Peer-to-Peer networks, file sharing protocols, and applications. Students research peer-to-peer file sharing issues and Copyright litigation. Students will be exploring legal and technical issues of the Peer-to-Peer and other file sharing networks, protocols and applications. Copyright law will be emphasized as well.

#### Unit 2, Learning Lab 2:

- Network Basics Lab Manual, Learning Lab 6.2.2.8 – Viewing Host Routing Tables
- In this Lab, students access a host routing table, examine IPv4 host routing table entries, and examine IPv6 routing table entries. Students reflect on the differences of IPv4 from IPv6 and the implications of shifting to a new version of the Internet Protocol. Students will access the host routing table (the routing table on a specific Internet host device) and analyze the results. By analyzing the content of the host routing table, the students will be able to explain and depict the issues surrounding the move from IPv4 to IPv6 in a network. Security and functionality in IPv4 and IPv6 networks will be explored through this analysis.

#### Unit 3, Learning Lab 1:

- Network Basics Lab Manual, Modeling Activity 7.0.1.2 – Researching the concept of the Internet of Everything.
- This is an Interactive activity in which students research and reflect on: Why is there is a need to give an IP address to trees? Windmills? Cars? Refrigerators? Why will just about anything be able to use an IP address? Students will complete the activity exploring the use of IP addresses on various everyday devices and the societal changes which might result.

#### Unit 3, Learning Lab 2:

- Network Basics Lab Manual, Labs 7.3.2.5 and 7.3.2.8 — Verifying and Troubleshooting IPv4 and IPv6 Addressing.
- The joint labs collectively require a student to explore, verify, and troubleshoot networks running IPv4 and IPv6, including addressing and security. Students will complete the activity examining the network scenario and verifying and troubleshooting issues, using both IPv4 and IPv6 networks.

#### Unit 3, Learning Lab 3:

- Network Basics Lab Manual, Labs 8.2.1.4 — Designing and Implementing a VLSM Addressing Scheme.
- Students will use VLSM to meet the IPv4 addressing requirements provided in the simulation. They will design the VLSM address scheme, and configure the interfaces on the routers with the appropriate IP address information. Students will complete the simulation, applying the theoretical models discussed in class with the practical issues during the simulation.

#### Unit 4, Learning Lab 1:

- Network Basics Lab Manual, Lab 9.4.4.6 — Viewing Wired and Wireless NIC Information.
- Students will analyze connections between wired and wireless networks, including multiple physical topologies and types. Students will examine layer 2 LLC frame types as they are prepared for various media. Students will then discuss the standards documents which govern data transmission and how the theoretical model is implemented in real networks. Students will complete the simulation, applying the theoretical models discussed in class with the practical issues during the simulation.

#### Unit 4, Learning Lab 2:

- Network Basics Lab Manual, Lab 9.5.1.1 — Network Design.
- Using network design best practices, students will design a network to meet the specifications listed. Students will need to evaluate the network plan to ensure that it follows the standards documents, identify the cable types needed, and be prepared to justify their answers with examples from the text and readings. Students will apply the theoretical knowledge to design a network, including wired and wireless connections. They will need to apply best practices for security, cabling, and end device specification and placement.

#### Unit 4, Learning Lab 3:

- Network Basics Lab Manual, Lab 10.1.4.3 — Using Wireshark to Examine Ethernet Frames.
- Using a network monitoring tool such as Wireshark, students will examine Ethernet packets. Identify and examine the different parts of Ethernet packets collected from the live network. They will then compare and contrast these network packets with the packets as defined within the standards documents. Students will need to examine what information is not included in the WireShark frame and why, being sure to support your position with evidence from the text and readings. They will also need to examine the MAC addresses. Students will need to respond to the following questions: What hardware information is identifiable from the information provided in the frame? How is this defined by the standards documents? As always, students need to support their position with evidence from the text and readings. By examining Ethernet packets in a live network, students will be able to compare the information contained with that expected from the theoretical model learned earlier. In their analysis, there are several questions asked (see above) which will assist students in their evaluation of the differences between the theoretical models and the actual implementation.

#### Unit 5, Learning Lab 1:

- Network Basics Lab Manual, Lab 11.2.2.6 – Researching Network Security Threats.
- Students explore the SANS web site ([www.sans.org](http://www.sans.org)), identify recent network security threats, and detail a specific network security threat. Students produce written reflections regarding the steps necessary to secure an organization's IT infrastructure. The media frequently discusses

security vulnerabilities. This exercise takes students into the depths of some of the attacks on networks, and gives a different perspective to that of the public media. In examining some of these actual attacks students can see what might need to be revised when working on a security plan and methods needed to secure systems.

### **Activity Type: Essay:**

- Students will write a 4-5 page argumentative essay responding to the prompt.
- Through their writing, the students will analyze and explore the topic.
- The final product should be 4 to 5 pages in length, MLA format (the standard for my school), argumentative essay (supporting standards from their English classes).
- The essay will allow the students to show that they understand the concepts within the unit and are able to express their learning in written form.

### *Specific Essay Assignments:*

#### Unit 1, Argumentative Essay:

- Prompt: “After viewing the TED talk ‘What is the Internet, Really?’, and reading *The Internet and Everyday Life*, Part II, Chapter 1, ‘Days and Nights on the Internet’ on the impact of the Internet on everyday life, write an Argumentative essay that identifies a problem with Internet use and argues for a solution. Be sure to support your position with evidence from the text and TED Talk.”

#### Unit 1, Guest Speaker Panel Reflection:

Prompt: “How do network engineers think? Panel discussion with professionals from the Information Technology sector and local post-secondary learning institutions to discuss how Internet technologies are developed and supported in the business/IT world. Reflection paper discussing learning from panelists.”

#### Unit 2, Explanatory Essay

- Prompt: “Standards and protocols make the pieces of the Internet work together. Research the development of the Ethernet, TCP/IP, and DNS standards and explain how they work together to ensure a seamless user experience. Be sure to support your position with evidence.”

#### Unit 4, Argumentative Essay

- Prompt: “After viewing the video ‘History of the Internet,’ write an essay that pinpoints a problem with current Ethernet architecture (including hardware, media, and layer 2 addressing), and argue for a solution. Be sure to support your position with evidence from the text and the videos.”

#### Activity Type: Skills Integration Challenge, Unit 3:

- The Skills Integration Challenge is similar in functionality to a Learning Lab but with many more pieces to synthesize together Working in teams and using the network simulator Packet Tracer, students will take an existing network infrastructure and apply their knowledge and skills to finalize the configuration.
- Student teams will be tasked to complete the IPv4 and IPv6 addressing scheme, implement IPv4 and IPv6 addressing, and verify connectivity.
- Students will complete the simulation, applying the theoretical models discussed in class with the practical issues during the simulation, and detailing how they solve the problems presented.
- The students will produce a Lab Report detailing their findings, including specific results of their inquiry. The Lab Report will need to include evidence of their simulated activities and provide information about how the theoretical model compared with the practice.
- In simulation, students will be able to see how the theoretical networking models fit into practice. These will assist them in their Blog/Bulletin Board Discussions as well as their culminating argumentative essay.

#### Activity Type: Team Debate, Unit 3:

- Students will be split into teams to debate on a specific topic.

- The topics will vary based on the individual team. Topics may include Pro/Con within the following: IPv4 or IPv6 addressing; Classful versus Classless Addressing; Threats using IPv4 versus IPv6; VLSM versus Network Address Translation (NAT). Working as a team, students will prepare and debate the pros and/or cons of one or more of the network addressing concepts.
- The assignment is designed to allow students the opportunity to provide evidence of their learning in an oral format. Students need to collaborate with their team in order to prepare their defense and then work together to defend their issues orally against another class team. Students will learn both collaborative and deliberation skills.
- Each student will provide an oral response answering their particular topic and giving evidence to support their position. They will also need to be ready to defend their position against other students.
- By participating in this type of activity, students will show the deeper understanding of the topics presented. In addition, they will be able to see where they may have misunderstood a particular element or otherwise need more specific direction.

#### **Activity Type: Case Study, Unit 5**

- Case Study title: Setting Up an Internet Café.
- In this case study, students engage with decision making, recognizing business opportunities, and apply course content knowledge to design an efficient and cost effective Internet business.
- Students will complete the simulation, applying the theoretical models discussed in class with the practical issues during the simulation.
- The students will produce a Lab Report detailing their findings, including specific results of their simulation.
- Theoretical knowledge is applied in the Case Study. Students who are successful at the Case Study will have examined many disparate elements and been able to apply them in a new whole. These will assist them in their Blog/Bulletin Board Discussions as well as their culminating argumentative essay.

### **Activity Type: College and Career Portfolio, Unit 5:**

- Students produce a cumulative College and Career Readiness Portfolio.
- The students will need to produce a portfolio which shows that they are College and Career Ready. The portfolio will include several items, including a resume, cover letter, professional writing sample, and college-ready work samples.
- The 21<sup>st</sup> Century is 1/8 over; students need certain skills to succeed. The College and Career Readiness Portfolio is one tool toward that end. Students will learn and apply soft skills which are necessary for College and Career success.
- The final product of their College and Career Readiness Portfolio will include the elements listed above, along with a reflection of why each component is important for long-term success.
- Students need to be taught how to be successful. The elements included in the College and Career Readiness Portfolio will help a student in their future success.

### **Activity Type: College and Career Portfolio Defense, Unit 5:**

- Interview skills workshops with professionals and educators scaffold the final interview. Students are given the opportunity to learn proper techniques for interviewing and career development. Students will sit for Mock Interviews with Industry and Community partners to defend their College and Career Portfolios. Common assessment rubrics are used by the interviewing adults to calibrate feedback.
- In this exercise, the students will defend their Portfolios in the form of a Mock Interview. ICT professionals, business partners, and educators from the ICT industry sector or post-secondary education will assist participate in mock interviews.
- Students need to show that they are ready for the world of College and Careers. By defending their Portfolios in the interview, the students will show that they are ready to take on the world, being College and Career ready.
- The final product will be a document showing that they are ready for College and Careers. In Yolo County, this is the Chamber of Commerce's Work Ready Certificate, which will be awarded to successful candidates following a successful Mock Interview and College and Career Portfolio defense.

- Students will be able to show their skills. They've worked very hard, and this will allow them to show off to the public.

## **Methodologies and Strategies**

### **Assessment Methods**

Several types of assessments will be present throughout the course. Where the assessment type is present in only one unit, that will be noted below.

**Argumentative Essays** will require students to analyze readings and video (often a TED talk) about various networking-based topics. The students will need to support their argumentative position with evidence from both their readings and the video. There will be an Argumentative Essay or Explanatory Essay in each Unit. Essays will be assessed according to focus, controlling idea, reading/research, development, organization, conventions, and content understanding.

**Explanatory Essays** will require students to explain specific technical theories and their practical application. Support from their text and other readings will be required. There will be an Argumentative Essay or Explanatory Essay in each Unit. Essays will be assessed according to focus, controlling idea, reading/research, development, organization, conventions, and content understanding.

**Unit and Final Exams** will be given to students. These will consist of multiple choice, short essay questions, and real-world problem solving scenario simulations. Students must demonstrate mastery of learning outcomes and essential knowledge for each unit during Unit Exams, and for the course during the Final Exam. Students will have opportunities for relearning and retesting.

**Learning Labs** will be used to assess student application of theoretical concepts presented in the course. The student will also be required to write a summary document describing their performance and their learning. Learning Lab practical activities are assessed through demonstrated content understanding; Lab Summaries are assessed according to content understanding, clarity, and focus.

Packet Tracer **Skills Based Assessments** will be used to assess student application of theoretical concepts presented in the course. The student will also be required to write a summary document describing their performance and their learning.



**Team Debate** will be used as well. Students, working in teams, will debate the pro/cons of selected networking topics. Students and Teams will be assessed on addressing the issue, supporting with facts, persuasiveness, teamwork, and organization. This will be in Unit 3.

**Blog/Bulletin Board Discussions** are online wiki- or discussion board-based exercises. Students are required to answer, with evidence to support their position, a prompt from the instructor. They are also required to respond to at least two other students, providing this same type of evidence. These discussions are provided in each of the units. Blog/board posts are assessed according to content understanding, focus, and organization.

**Case Studies** will present scenarios and students will engage in decision-making, recognizing business opportunities and applying course content knowledge to design and efficient and cost effective Internet business.

The **College and Career Readiness Portfolio** will be prepared for Unit 5. In this portfolio, students will present evidence of their 21<sup>st</sup> Century College and Career Readiness skills. They will then **defend this portfolio** through a Mock Interview Process with community members. Common assessment rubrics will be used by the interviewing adults to calibrate feedback; the rubric will emphasize the skills critical for the College and Career interview process. The College and Career Readiness Portfolio must contain or demonstrate evidence of independent learning, collaboration, profession/college ready communications, and critical thinking.

#### **Course Methods and/or Strategies:**

A variety of literacy strategies will be employed by the instructor to help students access the technical writing, reading, and other content inherent in the course. One such model literacy strategy, The Literacy Design Collaborative, uses template tasks to design and implement college-level reading and writing, providing the scaffolding necessary to support their mastery of the curriculum. In this model, the instructor provides specific scaffolding around task preparation, the reading process, the transition to writing, and the writing/editing process. The instructor provides additional scaffolding in selecting evidence, establishing a claim, revisions, and editing.

Individual and Pair-Share skill building activities will be used to assist students in mastery of the binary and hexadecimal numbering systems. This is especially true in Unit 3, Network Addressing,

where the mastery of these numbering systems is crucial to understanding IPv4 and IPv6 addressing. The instructor will model the skill building techniques and activities.

Interactive Lecture will be utilized throughout the course to give direct instruction. In Unit 1, the Interactive Lecture will concentrate on the impact of computing on everyday life and the major milestones in the computing/networking industry. In Unit 2, the Interactive Lecture will focus on the Network, Transport, and Application Layers of the OSI theoretical model. In addition, Copyright Law and Ethics will be discussed as part of the lessons on Peer-to-Peer file sharing. Unit 3 will center on the importance of IPv4 and IPv6 addressing and naming schemes, demonstrating the design, calculation, and application of subnet masks and addresses. Additional emphasis will be on how these naming and numbering schemes differ between IPv4 and IPv6 networks. Unit 4 concentrates on Ethernet, including the historical design and the evolution to modern-day Ethernet networks. Additionally, the lectures will discuss physical cable design. Unit 5 will discuss the scaling of networks from smaller to larger, with the inherent security challenges involved. In addition, the broader format of ICT careers will be discussed, with clear guidelines toward creation of the Career Portfolio. These lectures will include time for small group discussion and sharing, responding to guiding questions, responding to student questions, and formative assessments to assess student understanding at several points during each lecture.

Assigned readings will be used to introduce students to the topics of the course. These include readings in the Network Basics course materials as well as various Supplemental Readings, as detailed throughout the course description.

Hands-on Learning Labs will be part of the course. The instructor will model what students are to accomplish and will then monitor them throughout. In Unit 1, a lab will be based on researching Network Collaboration Tools (e.g., Google Docs), and a second lab will have the students researching Networking Standards. The instructor will monitor students' for completion and mastery of the material. In Unit 2, the labs concentrate on file sharing protocols and applications and on routing through a network. Unit 3 introduces scenarios for the students to analyze and then resolve. Some of these will be group and others individual exercises. Unit 4 learning Labs will concentrate on topology of the network, where the students will apply the network theory into physical networks. They will need to be able to defend their choice of different networking physical and logical topologies as well. They also will monitor the network for security vulnerabilities. The instructor will

need to ensure that they are careful to not cause additional vulnerabilities themselves. Unit 5 continues the security discussion with research on outside attacks reported to the SANS institute.

Instructor demonstrations are used frequently in this course. . In Unit 4, the instructor will demonstrate creation of an Ethernet cable so students can visualize the procedure. The instructor will also include information about the history of the cables and will explain that EIA/TIA created the 568A and 568B standards to help with interactivity between different manufacturers.

Short on-campus field trips will be used as well. The school has a Network, and the instructor will take students on a tour of the main network of the school building. In so doing, the students will see the practical application of the theories presented in class. This will also take place during Unit 4.

Video will be part of the course as well. In Unit 1, the TED talk “What is the Internet, Really” by Andrew Blum discusses the physical, world-wide Internet itself. Many students see the Internet as some magical ethereal thing, and don’t realize that it really is simply a series of physical cables and connections. In Unit 5, items from the TED playlist entitled “Who are the hackers” and the video “The accelerating power of technology” will be used to show students the professional side of networking. In addition, instructor-made video will be available for students to view outside of class. These will be on specialized topics, such as creation of Ethernet cables, which students may wish to explore further or view again for mastery.

The instructor will work with the community and advisory committee to provide real-world guest speakers. These community members, including Network Engineers (Unit 1), Network Cable Installers, Network Designers and Engineers (Unit 4), and Career Development professionals (Unit 5) will discuss various parts of network theory with the intention of showing students how the network operates in the real world. In addition, the Career Development professionals in Unit 5 will assist with development of the Career Portfolios and will Interview the students. In addition, Unit 5 features mentorship and collaboration with industry professionals in the ICT sector.

## Course Materials

### Textbooks

<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Edition</b>	<b>Website</b>
Introduction to Networks-ISBN: 9781587133169	Not Listed	Cisco Press	2013	<a href="http://ptgmedia.pearsoncmg.com/imprint_c">http://ptgmedia.pearsoncmg.com/imprint_c</a>
The TCP/IP Guide: A Comprehensive, Illustrated Internet Protocols Reference 1st Edition:ISBN:068-9145704709	Charles M. Kozierok	No Starch Press, Inc.	2005	<a href="http://www.amazon.com/The-TCP-Guide-">http://www.amazon.com/The-TCP-Guide-</a>

## Manuals

<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Edition</b>	<b>Website</b>
Introduction to Networks (Lab Manual) - ISBN: 9781587133121	Not Listed	Cisco Press	2013	<a href="http://ptgmedia.pearsoncmg.com/imprint_dow">http://ptgmedia.pearsoncmg.com/imprint_dow</a>