

## Career Technical Credit Transfer (CT<sup>2</sup>) Information Technology (IT) - Networking Consensus Support Document Final Draft

### Introduction

Amended Substitute H.B. 66 directed the Ohio Board of Regents to work collaboratively with the Ohio Department of Education's Office of Career-Technical and Adult Education (CTAE), public adult and secondary career technical education, and state-supported institutions of higher education to establish criteria, policies, and procedures by April 15, 2007, to transfer agreed-upon technical courses from one system to another.

The intent of H.B. 66 enables students to take equivalent technical courses anywhere within the public educational system and transfer technical credits without unnecessary duplication or institutional barriers. Technical courses identified as equivalent will adhere to recognized industry standards and reflect agreed-upon knowledge and skills. Career Technical Credit Transfer (CT<sup>2</sup>) is the name for this state pathway initiative.

### Faculty Panel Process

In support of H.B. 66 and in an effort to formalize a state-wide guarantee enabling progression to higher education, twenty secondary (8), adult (2), and higher education (10) IT– networking faculty members were impaneled to make recommendations for equivalent course content. See the attached faculty panel list.

On November 3 and December 8, 2006 and January 12 and February 2, 2007, faculty panel meetings were lead by co-chairs Mike Haines from Auburn Career Center and Robert Sherman from Sinclair Community College. The process was supported by Sara Mazak from the Ohio Department of Education and Vicki L. Melvin from the Ohio Board of Regents. The panel meetings focused on the following:

- To develop an understanding of IT-networking programs taught by secondary, adult, and higher education panel members.
- To further knowledge of the H.B. 66 mandate and the activities underway to implement articulation and transfer.
- To examine, in relation to equivalent coursework, the commonly taught curriculum and assessments that serve as the basis for IT basic and networking knowledge and skills (*itWORKS.OHIO*).
- To examine, in relation to equivalent coursework, vendor neutral industry expectations and certifications (i.e., CompTIA A+, Networking+), and vendor specific expectations and certifications (i.e., Cisco, Microsoft) that are expectations for many networking careers.

- To identify CT<sup>2</sup> implications of Accrediting Board of Engineering and Technology (ABET), the nationally recognized accreditor for college and university technical programs.
- To identify common basic and networking content in high school, adult, and higher education IT – networking programs.
- To reach consensus agreement on IT basic learning outcomes of equivalent technical courses; IT-networking learning outcomes of equivalent technical courses; and equivalent coursework related to vendor specific and neutral industry certifications, such as, Microsoft, Cisco and CompTIA.
- To make any additional recommendations (assessment, credit, currency) regarding IT-networking equivalent technical courses.

The learning outcome recommendations for IT-basic, IT-networking, and vendor specific and neutral were determined through the following process:

1. *itWORKS.OHIO* competencies as aligned to current courses of faculty panel members were utilized as the basis for determining equivalent learning outcomes for IT basic and networking content.
2. Faculty panel small groups recommended IT basic and networking content and provided information on current course requirements, articulation agreements, and credit granted. Consensus was reached through small group discussion and email.
3. Faculty panel small groups also made recommendations for vendor specific and vendor neutral courses, examinations, and certifications. Since vendor specific and vendor neutral certification expectations are established by the industry, guaranteed credit recommendations focused on certification currency and amount of credit.

## **IT Industry Recognized Standards and Certifications**

Recognized industry standards are expectations established by a business, industry, state agency, or professional association that defines training program curriculum requirements, establishes certification or licensure criteria, and often is the basis for program accreditation. Information technology has multiple organizations developing and promoting standards. In addition to state initiatives, such as *itWORKS.OHIO* that establishes technical content standards for Ohio networking and College Tech Prep information technology programs, the Accrediting Board of Engineering and Technology (ABET) defines standards for higher education networking programs.

Information technology standards are also defined by networking businesses (Cisco or Microsoft) or non-profit industry associations that represent the industry as a whole (CompTIA or American National Standards Institute). Complex protocols per operating system and credentials/certifications associated with the unique networks proliferate. To reflect the greatest number of Ohio secondary, adult, and higher education networking programs, the faculty panel focused on *itWORKS.OHIO*, ABET, and major networking vendor specific and neutral certifications. In the future, other recognized industry standards and certifications may be considered.

## **Technical Content Standards - *itWORKS.OHIO***

As a basis to organize the work of the faculty panel, competencies from the recently revised *itWORKS.OHIO* technical standards resource were used to determine common content of faculty panel member's current information technology courses. *itWORKS.OHIO* is the career field technical content document that serves as the information technology curricular framework (technical standards) for Ohio's College Tech Prep and Career-Technical Education programs. In 2005, building on the original 1999 *itWORKS.OHIO* document, the standards development was a collaborative effort of over 100 secondary and postsecondary educators, as well as, business and industry professionals. Observations from the data analysis included:

- *itWORKS.OHIO* was good, comprehensive resource to identify common/equivalent learning outcomes
- All institutions have a course or two that address the majority of the basic competencies
- High school networking programs are overall aligned to the IT-networking competencies
- Adult IT-networking programs addressed all of the networking competencies within their courses
- Higher education programs teach the IT-networking competencies in multiple courses

## **State IT Assessment**

The Ohio Career-Technical Competency Assessment (OCTCA), also known as Webxam, is an Ohio developed competency assessment system to measure technical competence as mandated by federal legislation. OCTCAs measure the mastery of knowledge associated with Ohio career-technical content standards and are created from industry-verified competency lists. The state testing system offers end-of-program and modular type tests for students in qualifying career-technical programs. All tests may be taken online through Webxam, a Web-based administration interface where students can be scheduled to take tests, and student test results can be viewed. All tests are aligned to state technical standards, such as, *itWORKS.OHIO*. Secondary career-technical IT-networking

programs are required to document student performance and administer OCTCA technical assessments. Adult career-technical IT-networking programs also document student performance through OCTCA or nationally recognized industry certification examinations.

To address questions on the state developed assessment for information technology programs, Robert Mahlman, Senior Research Associate at The Ohio State University (OSU), presented the history of OCTCA, development and maintenance of the assessment, and the advantages of the system. At a subsequent meeting, the faculty panel also had an open testing window to review the examination. A follow-up conference call with OSU addressed additional questions on alignment to the CT<sup>2</sup> learning outcomes and use as documentation for CT<sup>2</sup> guaranteed credit.

### **ABET Accreditation**

To further understanding of higher education accreditation, panel members Mark Stockman from University of Cincinnati and Paul Weingartner from Cincinnati State Technical and Community College presented an overview of the Accrediting Board of Engineering and Technology (ABET) and provided specific information on program criteria for information technology. Although many of the higher education faculty were familiar with requirements, the high school and adult members were apprised of the expectations of 2-year and 4-year IT graduates and the association's process of developing the accreditation requirements. The faculty panel considered the ABET higher education expectations into the identification of career-technical and higher education equivalent learning outcomes.

### **Education Pathways**

A seamless educational pathway for information technology has numerous exit and re-entry points and recognition of industry-based credentials. To be successful, degree programs, certifications, employment, and career development/lifelong learning are ongoing and responsive to the rapidly changing information technology environment. Education requirements and industry certification expectations vary for entry level, technical, and professional network design and administration careers.

Ohio's career-technical programs for secondary students advance information technology knowledge and skills by offering networking specialized programs. Frequently, these programs are designated as College Tech Prep and may lead to recognized industry certifications (CompTIA A+ or Cisco CCNA). Career-technical programs for adult students may be long-and short-term technical skills training targeted to labor market needs. Typical adult networking programs yield a vendor specific (Microsoft or Cisco) or neutral credential (CompTIA).

Graduate, 4-year, 2-year, and certificate based IT-networking programs are offered in Ohio's higher education institutions. Higher education opportunities include degrees (Associate of Applied Business, Associate of Applied Science, Associate of Technical Studies, Bachelor of Science in Information Technology, and others) or may be credit or noncredit occupational programming yielding industry certifications. Ohio higher education networking programs and courses may be housed within business or engineering colleges/departments and typically follow three pathways – computer science, management information systems, or information technology completion.

In Ohio, local pathways to postsecondary education via a sequential course of study without duplication of coursework have been facilitated by College Tech Prep and other local partnerships. By creating a state system of recognized learning outcomes and common equivalent coursework, CT<sup>2</sup> guaranteed credit will strengthen these options for transition to advanced education.

### Learning Outcomes and Guaranteed Credit Recommendation Summary

In support of H.B. 66 and in an effort to improve mobility of students throughout the state and improve access to higher education, the IT-networking faculty panel members made recommendations for the three (3) types of networking CT<sup>2</sup> equivalent learning outcomes – basic, networking, and vendor specific and neutral certifications.

Pertinent to H.B. 66 legislation, industry standards and certifications provide documentation of student learning. The state career-technical assessment system was also considered as an end of program measure of student learning for basic and networking equivalent learning outcomes. The credit recommended for the three types of networking CT<sup>2</sup> equivalent learning outcomes form a menu of options pertinent to the program content and design of the secondary and adult career-technical institution as well as the course content and design at the higher education institution. Bi-lateral local agreements or College Tech Prep articulation agreements may also award additional credit.

Learning Outcomes/Courses/Other	Documentation of Learning/Certification	Guaranteed Credit
<b>IT – Basic</b> <ul style="list-style-type: none"> <li>3 equivalent learning outcomes derived from <i>itWORKS.OHIO</i></li> <li>access credit within 3 years of completing program</li> </ul>	Ohio Career-Technical Competency Assessment – IT Basics (Module 1) at the specified benchmark level <u>or</u> IC <sup>3</sup> certificate (Computing Fundamentals, Key Applications, and Living Online components) <u>or</u> International Computer Driving License (ICDL) certificate	Equivalent introductory or application courses (1 or more) incorporating IT-basic learning outcomes = minimum of 3-4 quarter or 2-3 semester hours per course
<b>IT – Networking</b> <ul style="list-style-type: none"> <li>28 equivalent learning outcomes reflect <i>itWORKS.OHIO</i> networking competencies</li> <li>access credit within 3 years of completing program <u>or</u> within currency of certificate</li> </ul>	Ohio Career-Technical Competency Assessment – IT Networking (applicable modules) at the specified benchmark level <u>or</u> CompTIA Network + certificate <u>or</u> Cisco INTRO certificate	Equivalent networking courses (1 or more) incorporating IT-Networking learning outcomes 1 – 28 = minimum of 3-4 quarter or 2-3 semester hours per course
<b>Cisco</b> <ul style="list-style-type: none"> <li>4 semester courses</li> <li>current certification</li> </ul>	INTRO examination, ICND examination, <u>or</u> CCNA certification	Minimum of 3-4 quarter hours/2-3 semester hours per course (12-16 quarter hours/8-12 semester hours for CCNA)
<b>Microsoft</b> <ul style="list-style-type: none"> <li>multiple courses</li> <li>current certification</li> </ul>	MCSA, MCSE	Minimum of 3-4 quarter hours/2-3 semester hours per course
<b>CompTIA</b> <ul style="list-style-type: none"> <li>multiple courses</li> <li>certification within 3 years</li> </ul>	CompTIA A+, CompTIA Network+	Minimum of 3-4 quarter hours/2-3 semester hours per course

**IT - Basic**

Learning Outcomes - Basic information technology is the computing knowledge and skills equipping students with the basic literacies necessary for higher education and the workplace. The three (3) overarching CT<sup>2</sup> equivalent learning outcomes were derived from *itWORKS.OHIO* technical content standards.

Documentation of Learning - Learning may be verified by the Ohio Career-Technical Competency Assessment – IT Basics (Module 1) at the specified benchmark level, an IC<sup>3</sup> certificate (Computing Fundamentals, Key Applications, and Living Online components), or the International Computer Driving License (ICDL) certificate.

CT<sup>2</sup> Guaranteed Credit - Higher education institutions requiring an applicable introduction course and/or a basic computer applications course should guarantee credit for content equivalent to the basic information technology learning outcomes at no less than 3-4 quarter hours or 2-3 semester hours per required course. To acquire the CT<sup>2</sup> guaranteed credit for basic information technology, students must enter higher education within three years of completing a secondary or adult career-technical information technology- networking program.

IT-Basic	<i>itWORKS.OHIO</i> Competencies	Documentation of Learning	CT <sup>2</sup> Guaranteed Credit
1. Demonstrate basic knowledge of information technology history and the future of information technologies.	1.1, 1.5, 1.6, 1.16, 1.18		
2. Demonstrate basic knowledge of the information technology impact on society including security.	1.2, 1.6, 1.14, 1.16, 1.18		
3. Demonstrate basic proficiency with computer tools and applications, such as, software installation, word processing, databases, spreadsheets, presentations, email, and Internet.	1.3, 1.4, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19		
		Ohio Career-Technical Competency Assessment – IT Basics (Module 1) at the specified benchmark level <u>or</u> IC <sup>3</sup> certificate (Computing Fundamentals, Key Applications, and Living Online components) <u>or</u> International Computer Driving License (ICDL) certificate.	Equivalent introductory or application courses (1 or more) incorporating IT-basic learning outcomes = minimum of 3-4 quarter or 2-3 semester hours per course



**IT - Networking**

Learning Outcomes - Networking learning outcomes prepare students for careers in the design, installation, maintenance, and management of network systems. The twenty-eight (28) equivalent learning outcomes reflect the *itWORKS.OHIO* technical content standards.

Documentation of Learning - Learning may be verified by the Ohio Career-Technical Competency Assessment – IT Networking (applicable modules) at the specified benchmark level, a CompTIA Network + certificate, or a Cisco INTRO certificate.

CT<sup>2</sup> Guaranteed Credit - Higher education institutions with equivalent information technology courses incorporating CT<sup>2</sup> networking learning outcomes must guarantee credit at no less than 3-4 quarter hours or 3- 4 semester hours per course. The networking CT<sup>2</sup> guaranteed credit is in addition to basic information technology CT<sup>2</sup> guaranteed credit; and the networking CT<sup>2</sup> guaranteed credit may be in lieu of or in addition to guaranteed credit for vendor specific and/or vendor neutral CT<sup>2</sup> guaranteed credit. To acquire the CT<sup>2</sup> guaranteed credit for networking, students must enter higher education within three years of completing a secondary or adult career-technical information technology- networking program or within the number of years that an industry certification is current.

IT-Networking	<i>itWORKS.OHIO</i> Competencies	Documentation of Learning	CT <sup>2</sup> Guaranteed Credit
1. Identify and describe connectivity devices related to hardware design, operation, and maintenance.	<u>Hardware Design, Operation, and Maintenance</u> - 16.9		
2. Demonstrate knowledge of basic network classifications and topologies. 3. Demonstrate knowledge of local-area network trends and issues. 4. Demonstrate knowledge of network physical layer. 5. Demonstrate knowledge of network connectivity basics. 6. Demonstrate knowledge of networking protocol concepts 7. Demonstrate knowledge of the Open Systems Interconnection (OSI) standard (ISO Standard 7498). 8. Demonstrate knowledge of communication standards for networks. 9. Demonstrate knowledge of data encoding basics for networks. 10. Demonstrate knowledge of IP addressing schemes for networks.	<u>Networking</u> - 18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.9		
11. Demonstrate knowledge of the basics of network architecture. 12. Demonstrate knowledge of the basics of Ethernet technology. 13. Demonstrate knowledge of the TCP/IP protocol suite details for networking architectures.	<u>Networking Architectures</u> 19.1, 19.2, 19.3		
14. Demonstrate knowledge of the network operating systems characteristics. 15. Install and administer network operating system and services.	<u>Network Operating Systems</u> 20.1, 20.2		
16. Demonstrate knowledge of basic telecommunications and the interconnection of networks. 17. Assess user needs for a wide-area network (WAN). 18. Design WAN systems for networks.	<u>Wide Area Networks</u> - 21.1, 21.2, 21.3		

19. Demonstrate knowledge of network management activities and procedures. 20. Demonstrate knowledge of network applications. 21. Perform network installation procedures. 22. Perform network maintenance and diagnostics and testing.	<u>Network Management</u> - 22.1, 22.2, 22.6, 22.9		
23. Demonstrate knowledge of telecommunications transmission line applications. 24. Demonstrate knowledge of concepts and techniques used in working with communications systems. 25. Demonstrate knowledge of telecommunications networks.	<u>Telecommunications</u> - 26.1, 26.2, 26.3		
26. Provide for user authentication for security compliance 27. Apply systems operations procedures 28. Maintain and respond to system needs	<u>Operating Systems</u> - 2.3.10, 2.4, 2.5		
		Ohio Career-Technical Competency Assessment – IT Networking (applicable modules) at the specified benchmark level <u>or</u> CompTIA Network + certificate <u>or</u> Cisco INTRO certificate	Equivalent networking courses (1 or more) incorporating IT-networking learning outcomes 1 – 28 = minimum of 3-4 quarter/ 2-3 semester hours per course



**Vendor Specific and Neutral Certifications**

The IT-Networking Faculty Panel was not charged with generating learning outcomes for vendor specific or vendor neutral courses or certifications. The knowledge and skills necessary to receive vendor specific certifications are determined by the networking certification sponsor. The information technology industry prescribes the content for vendor neutral certifications. Recommendations were made to standardize the process of CT<sup>2</sup> state guaranteed credit for networking courses preparing students for Cisco, Microsoft, and CompTIA certifications.

The minimum vendor-based credit is in addition to the basic information technology courses, as required by some higher education institutions, and as recommended for CT<sup>2</sup> guaranteed credit. The vendor specific and/or vendor neutral CT<sup>2</sup> guaranteed credit may be in lieu of or in addition to networking course CT<sup>2</sup> guaranteed credit. Bi-lateral local agreements may also award additional credit.

**Cisco** - Cisco Networking Academies prepare high school, adult, and higher education students for the Cisco Certified Networking Associate (CCNA) certification. CCNA is a comprehensive curriculum that includes four separate modules. The CCNA certification may be taken as a single comprehensive examination or individually as the Introduction to Cisco Networking Technologies (INTRO) and Interconnecting Cisco Networking Devices (ICND).

Requirements for guaranteed credit at higher education institutions include passage of one or more current Cisco end of program examinations as aligned to the Cisco semester courses or attainment of CCNA. To acquire the CT<sup>2</sup> guaranteed credit for Cisco courses, the Cisco certification must be current (3 years in duration).

Higher education institutions with equivalent Cisco courses should guarantee credit at no less than 3-4 quarter hours or 2-3 semester hours per individual Cisco course (12-16 quarter hours or 8-12 semester hours total). A CCNA certificate should guarantee credit of 16 quarter hours or 12 semester hours.

Vendor Specific or Neutral Course	Examination & Certification	CT <sup>2</sup> Guaranteed Credit
<b>Cisco</b>		
Cisco - CCNA I – Networking Basics Semester 1	INTRO	Minimum of 3-4 quarter hours/2-3 semester hours
Cisco - CCNA II– Routers and Routing Basics Semester 2	INTRO	Minimum of 3-4 quarter hours/2-3 semester hours
Cisco - CCNA III – Switching Basics and Intermediate Routing Semester 3	ICND	Minimum of 3-4 quarter hours/2-3 semester hours
Cisco - CCNA IV – WAN Technologies Semester 4	ICND	Minimum of 3-4 quarter hours/2-3 semester hours
	CCNA (one test combining INTRO and ICND)	Minimum of 12-16 quarter hours/8-12 semester hours

**Microsoft** – Microsoft offers certifications for professionals who support, implement, and develop solutions using Microsoft technologies. Multiple exams are available which collectively can lead to various designations, such as, Microsoft Certified Systems Administrator (MCSA) or Microsoft Certified Systems Engineer (MCSE).

Requirements for guaranteed credit at higher education institutions include passage of one or more current Microsoft examinations (if closely aligned to courses offered by that institution). To acquire the CT<sup>2</sup> guaranteed credit for Microsoft courses, Microsoft certification must be current, i.e., related to the current or immediately preceding versions of the operating system.

Higher education institutions with equivalent Microsoft courses should guarantee credit at no less than 3-4 quarter hours or 2-3 semester hours per individual Microsoft course.

Vendor Specific or Neutral Course	Examination & Certification	CT <sup>2</sup> Guaranteed Credit
<b>Microsoft</b>		
Microsoft - Installing, configuring, and administering Windows XP Professional	Exam 70-270 – Microsoft Windows XP Professional	Minimum of 3-4 quarter hours/2-3 semester hours
Microsoft - Managing and maintaining a Microsoft Windows Server 2003 Environment	Exam 70-290 – Microsoft Windows Server 2003	Minimum of 3-4 quarter hours/2-3 semester hours
Any Microsoft course aligned to Microsoft Certified Systems Administrator (MCSA) or Microsoft Certified Systems Engineer (MCSE) certifications	Multiple Microsoft MCSA and MCSE certification examinations (specific to the Microsoft course offered by the institution)	Minimum of 3-4 quarter hours/2-3 semester hours per course

**CompTIA** – CompTIA, representing the international technology community, provides vendor-neutral information technology certification examinations. CompTIA certifications are frequently used by companies to validate foundation-level skill sets and guide development of educational program curriculum.

Skills and knowledge are measured through recently updated assessments. To become A+ certified individuals must pass multiple examinations - CompTIA A+ Essentials and CompTIA A+ 220-602 as well either CompTIA A+ 220-603 or CompTIA A+ 220-604. The A+ Essentials examination validates knowledge of basic computer hardware and operating systems. 220-602 is targeted for individuals in a mobile or corporate technical environment with a high level of face-to-face client interaction while 220-603 examination focus is remote-based work environment and 220-604 examination focus is targeted to settings with a hardware related emphasis. As a vendor-neutral certification, CompTIA Network+ validates the knowledge and skills of networking professionals. The certification examination includes describing the features and functions of networking components and installing, configuring, and troubleshooting basic networking hardware, protocols, and services.

To acquire the CT<sup>2</sup> guaranteed credit for CompTIA courses, passage of current examinations is required and the certification must be current (within three years).

Higher education institutions with equivalent CompTIA courses should guarantee credit at no less than 3-4 quarter hours or 2-3 semester hours per individual CompTIA based course.

Vendor Specific or Neutral Course	Examination & Certification	CT <sup>2</sup> Guaranteed Credit
<b>CompTIA</b>		
CompTIA - Networking course specific to CompTIA A+	CompTIA A+ Essentials	Minimum of 3-4 quarter hours/2-3 semester hours
	CompTIA A+ Essentials <u>and</u> 220-602, 220-603, or 220-604	Minimum of 4 quarter hours/3 semester hours
CompTIA - Networking course specific to CompTIA Networking+	CompTIA Networking +	Minimum of 3-4 quarter hours/2-3 semester hours

### **Current Status**

On March 5, 2007, the draft Information Technology- Networking Consensus Support Document was emailed to the faculty panel for review and comment. The Advisory Committee received the document on March 21, 2007. The next stage is to move to step two in the development process (Educational partners agree to the learning outcomes). In late March or early April, a web-based survey will be disseminated to all Ohio secondary and adult career-technical institutions and higher education public institutions with information technology-networking programs. Based upon the survey results, the faculty panel may meet to address any necessary modifications to their current recommendations.

Attachments: IT-Networking Faculty Panel List