Networking and Cyber Security Overview

Acknowledgements

Manitoba Education and Training gratefully acknowledges the contributions of the following individuals in the development of *Grades 9 to 12 Networking and Cyber Security: Manitoba Technical-Vocational Curriculum Framework of Outcomes*.

Charles Bazilewich	Sisler High School	Winnipeg School Division
Jonathan Funk	Garden Valley Collegiate	Garden Valley School Division
William McBride	Manitoba Institute of Trades and Technology	

Manitoba Education School Programs Division Staff

John Finch	Learning Support and Technology Unit
Coordinator	Instruction, Curriculum and Assessment Branch
Gilles Landry	Learning Support and Technology Unit
Project Leader	Instruction, Curriculum and Assessment Branch
Kim Poirier	Technical Vocational Education Unit
Consultant	Instruction, Curriculum and Assessment Branch

Technical-Vocational Education Overview

In 2013, Manitoba Education released the document *Technical-Vocational Education Overview* <*http://www.edu.gov.mb.ca/k12/cur/teched/sy_tech_program.html*> to provide the philosophical and pedagogical underpinnings for curriculum development and the teaching of courses in the Senior Years Technology Education Program.

This overview presents educators with the vision and goals of technical-vocational education (TVE) in Manitoba. Topics include the following:

- curriculum revitalization and renewal
- curriculum framework and implementation
- articulation
- assessment and reporting
- safety
- employability/essential skills and career development
- sustainable development

TVE clusters of courses are designed to encourage students to explore career options in designated trades and trained occupations, and to address labour shortages in these areas. The TVE curriculum includes course clusters for both *designated trades* (those designated for apprenticeship training and certification by Apprenticeship Manitoba) and *trained occupations* (those not designated as trades).

The TVE curriculum is significantly different from other subject areas such as computer science or information and communication technology. It has distinct qualities that, when respected, will provide students with a uniquely valuable experience that they cannot receive from any other curriculum.

TVE gives students the opportunity to learn the theoretical and practical aspects of one trained occupation in order to facilitate their transition from school to work or to post-secondary education in that trained occupation, or into an associated occupation. This transition is accomplished by having students complete an entire TVE cluster of courses, learning from industry-certified teachers with industry experience in a setting that, as much as possible, emulates an actual workplace.

The TVE curriculum includes Grades 9 to 12 courses in a variety of areas, including networking and cyber security.

Networking and Cyber Security as a TVE Cluster

Grades 9 to 12 Networking and Cyber Security: Manitoba Technical- Vocational Curriculum Framework of Outcomes identifies the goals, general learning outcomes (GLOs), and some of the specific learning outcomes (SLOs) for nine networking and cyber security courses. This framework is intended for use in all Manitoba schools teaching networking and cyber security as part of the Senior Years Technology Education Program.

Like all other TVE courses, Networking and Cyber Security courses can be taught only as part of a complete cluster by a school which Manitoba Education and Training has approved to do so.

Employment Opportunities

Students in the Networking & Cyber Security cluster learn the fundamental skills required to design, install, configure, manage, secure and troubleshoot networks and their associated devices.

Students who complete the program are eligible to find entry-level employment in such fields as desktop support, call centre technician, network administrator, and computer technician. They also have the opportunity to pursue post-secondary studies in Information Technology.

Delivery

To receive a Senior Years Technical Education diploma, a student must complete eight departmentally developed courses from an approved technical-vocational cluster, together with 17 compulsory credits and five optional credits.

The grade level in which the courses are offered are a local, school-based decision, but it is highly recommended that the sequencing of credits follow the schedule set out below.

Cross-curricular learning outcomes include essential skills from subject areas including, but not limited to, English language arts, mathematics and the sciences. These essential skills are to be integrated into the authentic activities of the course.

Learning outcomes dealing with the following topics are also integrated into most courses:

- health and safety
- evolution, technological progression, and emerging trends
- sustainability
- ethical and legal standards
- employability skills
- the IT industry

In most courses, the emphasis is on applied activities. For instructional purposes, the sequence of learning outcomes can vary based on the activities within the course. Teachers are advised to select the activities best suited to teach the learning outcomes, based on a variety of factors, including access to resources or regional needs.

The curriculum is not sequential. In other words, learning outcomes might be taught in an order different from how they appear in the document. In light of rapid changes in technology, teachers are encouraged to update their activities in order to meet the needs of students.

Teacher Qualifications

Only vocationally certified teachers are allowed to teach TVE courses, including the ones in this cluster. Vocational certification for Networking and Cyber Security includes three components:

1. **IT Industry Certification:** Networking and Cyber Security teachers need to have personally achieved certification in the IT industry so that they can share it with their students. In order for students to receive the industry certification from organizations such as Cisco and Microsoft, around which this cluster has been developed, the teachers must have earned instructor certifications from those organizations in order to access the exams that students need to write in order to earn their industry certification.

2. **Industry Experience:** Networking and Cyber Security teachers need to have been employed in the IT industry for at least six years. This will enable them to share their industry experience with students, which will, in turn, prepare them for working in the IT industry.

3. **Technical-Vocational Teaching Certificate:** TVE teachers should have a technical vocational teaching certificate, obtained by completing Red River College's one-year Technical-Vocational Teacher Education Diploma program. For information about this program, see

   http://me.rrc.mb.ca/Catalogue/ProgramInfo.aspx?RegionCode=WPG&ProgCode=TECVF-DP

Employing only vocationally certified teachers to teach TVE courses preserves the integrity of TVE programming by ensuring that teachers are able to share their first-hand experience working in IT, as well as their familiarity with industry certification. Students receive instruction from somebody who has been involved in that industry.

School boards risk significant liability if they employ non-vocationally certified teachers to teach TVE courses. Vocational certification confirms that a teacher has the requisite skills and knowledge to teach the health, safety and security concerns associated with networking and cyber security.

For further information, see "Professional Certification: Technical Vocational Teacher" on the Manitoba Education and Training website at
www.edu.gov.mb.ca/k12/profcert/certificates/vocational.html

Comparison of Networking and Cyber Security with Courses in Computer Science, and Information and Communication Technology

Like all TVE curricula, *Grades 9 to 12 Networking and Cyber Security* has been developed to prepare high school students for a career in an occupation. In this case, students will learn the knowledge, skills, and attitudes required to work in the area of networking and cyber security.

This curriculum has not been developed as a general interest cluster of courses in computer science or information and communication technology. Schools interested in teaching those types of courses are invited to teach the following non-TVE courses:

- Computer Science: https://www.edu.gov.mb.ca/k12/cur/cs/index.html

- Information and Communication Technology: https://www.edu.gov.mb.ca/k12/cur/ict/framework.html

- Grade 12 Applied Business Technologies: https://www.edu.gov.mb.ca/k12/cur/teched/ace_framework/index.html

Although Networking & Cyber Security and the non-TVE curricula listed above share some common content, they have been developed for completely different purposes, and have significant differences in content. The chart on the following page summarizes some of the differences between them.

Comparison Chart: Networking & Cyber Security and non-TVE IT Courses (such as Computer Science and ICT)

	Networking & Cyber Security	Non-TVE IT Courses
1. Is the purpose to facilitate students' transition to the IT industry?	Yes	No
2. Does the instruction try to emulate, as far as possible, a regular IT workplace?	Yes	No
3. Does the curriculum mandate employability skills such as punctuality and time management?	Yes	No
4. Is the teacher required to have certification in the IT industry?	Yes	No
5. Is the teacher required to have experience working in the IT industry?	Yes	No
6. Does the cluster focus on preparing students for entry-level employment in IT after high school?	Yes	No
7. Is the teacher required to have a Manitoba General Teacher Certificate?	No	Yes
8. Is the teacher required to have a Manitoba Vocational Teacher Certificate?	Yes	No
9. Is the teacher required to have instructor certification from Microsoft and Cisco in order to teach the courses in this cluster?	Yes	No
10. Do schools require special permission from Manitoba Education and Training to teach the courses?	Yes	No
11. Do schools have to offer all of the courses in the cluster?	Yes	No
12. Can schools offer hybrid clusters, made up of courses from several clusters?	No	Yes
13. Will students receive a Senior Years Technology Education Program (SYTEP) Diploma when they complete a cluster of courses?	Yes	No

Networking and Cyber Security Goals, General Learning Outcomes (GLOs) and Specific Learning Outcomes (SLOs)

Grades 9 to 12 Networking and Cyber Security: Manitoba Technical- Vocational Curriculum Framework of Outcomes identifies some of the specific learning outcomes (SLOs) for use in all Manitoba schools teaching the Grades 9 to 12 networking and cyber security courses as part of the Senior Years Technology Education Program. SLO statements define what students are expected to achieve by the end of a course.

It is essential for students to learn and to demonstrate safety practices and employability skills; therefore, some SLOs related to health and safety, as well as to employability skills are repeated in several courses.

Please note that SLOs are not identified for the goals and GLOs that are not addressed in a given course.

Goal 1: Describe and apply appropriate **health and safety** practices.

>   **GLO 1.1:** Describe and apply appropriate **health and safety** practices

Goal 2 Demonstrate an awareness of the **evolution, technological progression, and emerging trends** in IT.

>   **GLO 2.1**: Describe the **evolution, technological progression** and **emerging trends** in IT.

Goal 3 Demonstrate understanding of **hardware, operating systems, applications, networking** and **cyber security**.

>   **GLO 3.1**: Demonstrate understanding of **concepts** related to **hardware**.

>   **GLO 3.2**: Demonstrate a **theoretical** understanding of **operating systems**.

>   **GLO 3.3**: Demonstrate a **theoretical** understanding of **applications**.

>   **GLO 3.4**: Demonstrate a **theoretical** understanding of **networking**.

>   **GLO 3.5**: Demonstrate a **theoretical** understanding of **cyber security**.

Goal 4: Install, configure, manage, secure and troubleshoot **devices**, operating systems and applications.

      GLO 4.1: **Install** devices, operating systems, and their associated software.

      GLO 4.2: **Configure** devices, operating systems, and their associated software.

      GLO 4.3: **Manage** devices, operating systems, and their associated software.

      GLO 4.4: **Secure** devices, operating systems, and their associated software.

      GLO 4.5: **Troubleshoot** devices, operating systems, and their associated software.

Goal 5: Design, configure, manage, secure and troubleshoot **networks**, operating systems and applications.

      GLO 5.1: **Design** networks and their associated software.

      GLO 5.2: **Configure** networks and their associated software.

      GLO 5.3: **Manage** networks and their associated software.

      GLO 5.4: **Secure** networks and their associated software.

      GLO 5.5: **Troubleshoot** networks and their associated software.

Goal 6: Document the installation, design, configuration, management, security and troubleshooting of devices, networks, and their associated software.

      GLO 6.1: Document the installation, design, configuration, management, security and troubleshooting of devices, networks, and their associated software.

Goal 7: Describe and demonstrate the transferable **cross-curricular** knowledge and skills relevant to IT.

      GLO 7.1: **Research, read, interpret and communicate** information relevant to IT.

      GLO 7.2: Apply the knowledge and skills from **mathematics** relevant to IT.

      GLO 7.3: Apply the knowledge and skills from **the sciences** relevant to IT.

Goal 8: Demonstrate awareness of **sustainability** as it pertains to networking and cyber security.

> **GLO 8.1:** Describe the IT industry's **sustainability practices** and impact on the environment.

> **GLO 8.2:** Describe the impact of **human sustainability** on the well-being of those employed in IT and the users of their services.

> **GLO 8.3:** Describe **sustainable business practices** within the IT industry.

Goal 9: Demonstrate awareness of the **ethical and legal standards** as they pertain to IT.

> **GLO 9.1:** Demonstrate an awareness of the **ethical and legal standards** as they pertain to IT.

Goal 10: Demonstrate **employability skills**.

> **GLO 10.1:** Demonstrate **fundamental employability skills**.

> **GLO 10.2:** Demonstrate an awareness of **cultural proficiency**, and its importance in the workplace.

> **GLO 10.3:** Demonstrate an understanding of the **business operation** of an IT organization.

> **GLO 10.4:** Demonstrate **critical thinking skills**.

> **GLO 10.5:** Demonstrate **project management** skills.

Goal 11: Demonstrate understanding of the **IT industry**.

> **GLO 11.1:** Demonstrate an understanding of the scope of the **IT industry**.

> **GLO 11.2**: Demonstrate understanding of the **educational and career opportunities,** as well as **industry and professional associations**.

> **GLO 11.3**: Demonstrate understanding of **working conditions** in IT.

Critical Information on SLOs in this Document

In order to give students the opportunity to earn certain industry certifications, most of the courses include some or all of the outcomes or content found in the documents that are associated with those certifications. **Since these outcomes and content are proprietary to those organizations (such as Microsoft and Cisco) they cannot be included in this curriculum. Teachers will have to gain access to those industry documents and certifications in order to teach those outcomes.**

Industry Certifications

Here is a list of the certifications associated with six of the courses in this cluster.

Course	Content / Certification
9103 Hardware & Software Essentials 20S/20E/20M	CompTIA A+ certification exams 220-901 and 220-902 from the *IT Essentials 5.0 curriculum* (Cisco Networking Academy)
9104 Operating Systems 30S/30E/30M	*Microsoft Technology Associate Certification Exam Review Kit: 98-349 Windows Operating System Fundamentals*, Course 10753
9105 Networking Technologies 30S/30E/30M	The first half of Cisco Level 1 Introduction to Networks
9107 Advanced Operating Systems 40S/40E/40M	Content from Linux Essentials by the Network Development Group (NDG)
9108 Advanced Networking Technologies 40S/40E/40M	The second half of Cisco Level 1 Introduction to Networks
9109 Server Administration 40S/40E/40M	Microsoft Technology Associate Certification Exam Review Kit: 98-365 Windows Server Fundamentals

Course Descriptions

9102 Exploration of Networking & Cyber Security   15S/15E/15M
                                                        10S/10E/10M

In this optional course, students will explore the world of networking and cyber security. They will learn about hardware, operating systems and applications.

9103 Hardware & Software Essentials   20S/20E/20M

This course covers the fundamentals of computer hardware and software, and the responsibilities of an IT professional. It is designed for students who want to pursue careers in ICT and to gain practical knowledge of how a computer works.

Students who complete this course will be able to describe the internal components of a computer, assemble a computer system, install an operating system, and troubleshoot using system tools and diagnostic software. Students will also be able to connect to the Internet and share resources in a networked environment. Additional topics include mobile devices such as tablets and smartphones and client side virtualization.

This course contains the learning outcomes found in *IT Essentials 5.0* from the Cisco Networking Academy. This curriculum helps students prepare for the *CompTIA A+ certification exams 220-901 and 220-902*. Resources for this course may be found here:
https://certification.comptia.org/certifications/a
https://www.netacad.com/

9104 Operating Systems   30S/30E/30M

This course covers the installation, deployment, and troubleshooting of the current Microsoft Desktop Operating system. The hands-on approach will prepare students to face the real life challenges of a Microsoft desktop technician and assist students in preparing for the Microsoft Technology Associate (MTA) certification exams. This course includes the learning outcomes from the *Microsoft Technology Associate Certification Exam Review Kit: 98-349 Windows Operating System Fundamentals: Course 10753.* Useful resources may be found on the following sites. Please note that Manitoba Education and Training does not promote any of these sites or products over any other. This is simply a listing of sites that Manitoba Education and Training staff were aware of when this document was written:

https://www.microsoft.com/en-ca/education/imagine-academy/default.aspx

https://www.microsoft.com/en-us/learning/exam-98-349.aspx

https://www.wiley.com/en-us/Exam+98+349+MTA+Windows+Operating+System+Fundamentals%2C+2nd+Edition-p-9781119308416

https://www.pluralsight.com/courses/microsoft-operating-system-fundamentals

9105 Networking Technologies   30S/30E/30M

The focus of this course is on learning the fundamentals of networking. Students will learn both the practical and conceptual skills that build the foundation for understanding basic networking. They will:
- Examine human versus network communication and see the parallels between them
- Introduce the two major models used to plan and implement networks: OSI and TCP/IP
- Understand the use of the "layered" approach to networks
- Examine the OSI and TCP/IP layers in detail to understand their functions and services

This course includes the specific outcomes from the first half of *Cisco Level 1 Introduction to Networks*. The specific outcomes from the second half of that program are found in *9108 Advanced Networking Technologies 40S/40E/40M.*

In order to teach this course, schools have to be authorized as Cisco Networking Academies. Teachers need to be authorized Cisco Certified Instructor to view and teach the course. Resources for this course can be found on the following sites. Please note that Manitoba Education and Training does not promote these sites or products over any other. These are simply sites that Manitoba Education and Training staff were aware of when this document was written:

https://www.pearson.com/us/higher-education/professional---career/information-technology/training---certification/cisco-networking-academy-program/ccna-1-introduction-to-networks.html

https://www.netacad.com/

9106 Cyber Security Essentials   30S/30E/30M

The focus of this course is on learning the fundamentals of cyber security, focusing on both theory and practice. Students will learn to secure devices, operating systems, networks, including routers and switches, and their associated software.

9107 Advanced Operating Systems   40S/40E/40M

Linux is a popular operating system in many core areas of business. Students will learn to install, deploy, and troubleshoot Linux as a desktop operating system. To avoid confusion between the many flavors of Linux, each with its own GUI, students work with the command line to complete the necessary tasks. This course includes the content from the *Linux Essentials* course developed by the Network Development Group (NDG), which can be found here:

https://www.netdevgroup.com/online/courses/ndg_linux_essentials.html

9108 Advanced Networking Technologies 40S/40E/40M

This course is a continuation of *9105 Networking Technologies 30S, 30E, 30M*. Students will:
- continue to examine the OSI and TCP/IP layers in detail to understand their functions and services
- understand the various network devices and network addressing schemes
- discover the types of media used to carry data across the network

By the end of this course, students will be able to build simple LANs, perform basic configurations for routers and switches, and implement IP addressing schemes.

This course includes the specific outcomes from the second half of *Cisco Level 1 Introduction to Networks*. In order to teach this course, schools have to be authorized as Cisco Networking Academies. Teachers need to be authorized Cisco Certified Instructor to view and teach the course. Resources for this course can be found on the following sites. Please note that Manitoba Education and Training does not promote these sites or products over any other. These are simply sites that Manitoba Education and Training staff were aware of when this document was written:

https://www.pearson.com/us/higher-education/professional---career/information-technology/training---certification/cisco-networking-academy-program/ccna-1-introduction-to-networks.html

https://www.netacad.com/

9109 Server Administration   40S/40E/40M

This course gives students practical experience with Microsoft's server operating system and covers users and permissions, security, and server services such as DNS, DHCP, and Active Directory. Students will develop the knowledge needed to manage servers on small to large networks. The hands-on approach will prepare students to face the real life challenges of a Microsoft professional and assist students in preparing for the MTA certification exams.

This course includes the specific outcomes from *Microsoft Technology Associate Certification Exam Review Kit: 98-365 Windows Server Fundamentals.*

Exam: https://www.microsoft.com/en-us/learning/exam-98-365.aspx

Information on this exam can be found on the following sites. Please note that Manitoba Education and Training does not promote any of these sites or products over any other. This is simply a listing of useful sites that Manitoba Education and Training staff were aware of when this document was written:

https://www.microsoft.com/en-ca/education/imagine-academy/default.aspx

https://www.amazon.ca/98-365-Windows-Server-Administration-Fundamentals/dp/0470901829

https://www.udemy.com/mta-windows-server-2016-administration-fundamentals-98-365/

https://www.youtube.com/watch?v=4smwj9PxhwA&list=PLsrZV8shpwjMmq9hw_vIpDswWWw8jGJnZ

9111 Applied Networking & Cyber Security   40S/40E/40M

Students will synthesize and apply knowledge and skills acquired in the previous courses to initiate, complete and document each of the steps involved in the design, installation, configuration, management, securing and troubleshooting of devices, operating systems and applications in an office environment.