

Computer Networking

Inland Empire/Desert Region (IEDR, Riverside and San Bernardino counties combined)

This workforce demand report uses state and federal job projection data developed before the economic impact of COVID-19. The COE is monitoring the situation and will provide more information as it becomes available. Please consult with local employers to understand their current employment needs.

Summary

- The community college computer networking programs lead to seven middle- and higher-skill occupations collectively referred to as the *computer networking occupational group*.
- Employment for the middle-skill computer networking occupational group is expected to **increase by 8% between 2019 and 2024**. A total of **688 annual job openings** will be available each year over the five-year timeframe.
- The **25th percentile hourly wages** for the middle-skill occupations in this group are between **\$21.59 and \$35.02 per hour, exceeding the \$19.94 per hour self-sustainable hourly wage** estimate for a single adult with one child in the region.
- There were **113 awards issued** from regional community college *computer networking* programs over the last three academic years. There were 34 awards issued annually from private educational institutions in the region that offer related training programs in the previous three academic years.
- The COE **recommends** creating new computer networking programs based on the projected demand for more workers and the high wages offered by the middle-skill occupations in this group.

Introduction

This report provides data on programs and occupations related to computer networking. The California Community College computer networking (TOP 0708.10) program prepares students for employment through the instruction of local, metropolitan, and wide-area computer networking design, installation, maintenance, and troubleshooting (Taxonomy of Programs, 2012). This report includes a section that details the demand for [Cisco networking certifications](#) from online job advertisements.

While there are entry-level positions within computer networking, most of the occupations working in this field require a bachelor's degree. The computer networking occupational group has been split into **middle-skill** occupations and **higher-skill** occupations to illuminate students' opportunities with various levels of

educational attainment. The recommendations section of this report focuses on **middle-skill employment** since this level of education is closely associated with community college training.

The **middle-skill computer networking occupational group** consists of four occupations that typically require workers to obtain an associate degree to enter employment. Although *network and computer systems administrators* and *computer network architects* typically require a bachelor's degree to enter employment, 37% of workers in the field hold a community college-level education as their highest level of educational attainment. This indicates that employers are willing to hire well-qualified community college program completers. The occupations included in the middle-skill computer networking occupational group are:

- Computer Network Support Specialists (SOC 15-1231)
- Computer User Support Specialists (SOC 15-1232)
- Computer Network Architects (SOC 15-1241)
- Network and Computer Systems Administrators (SOC 15-1244)

The **higher-skill computer networking occupational group** consists of three occupations that typically require a bachelor's degree and may require work experience to enter employment. These occupations are displayed throughout the report to illustrate the job opportunities available to students continuing their education at a four-year university; they are not considered in the final recommendation due to the higher educational attainment requirement. The occupations included in the higher-skill computer networking occupational group are:

- Computer Systems Analysts (SOC 15-1211)
- Information Security Analysts (SOC 15-1212)
- Database Administrators and Architects (SOC 15-1245)

Definitions, alternative job titles, education, and training requirements for each occupation is available in the appendix.

Job Opportunities

In 2019, there were 7,033 middle-skill jobs in the computer networking occupational group in the Inland Empire/Desert region (IEDR). The middle-skill occupations in this group are projected to increase employment by 8% through 2024. Employers are expected to have 3,439 job openings for middle-skill occupations over the next five years to fill new jobs and backfill jobs that workers are permanently vacating (includes occupational transfers and retirements). Exhibit 1 displays five-year projected job growth, and Exhibit 2 displays historical (2014 to 2019) and projected (2019-2024) jobs for the

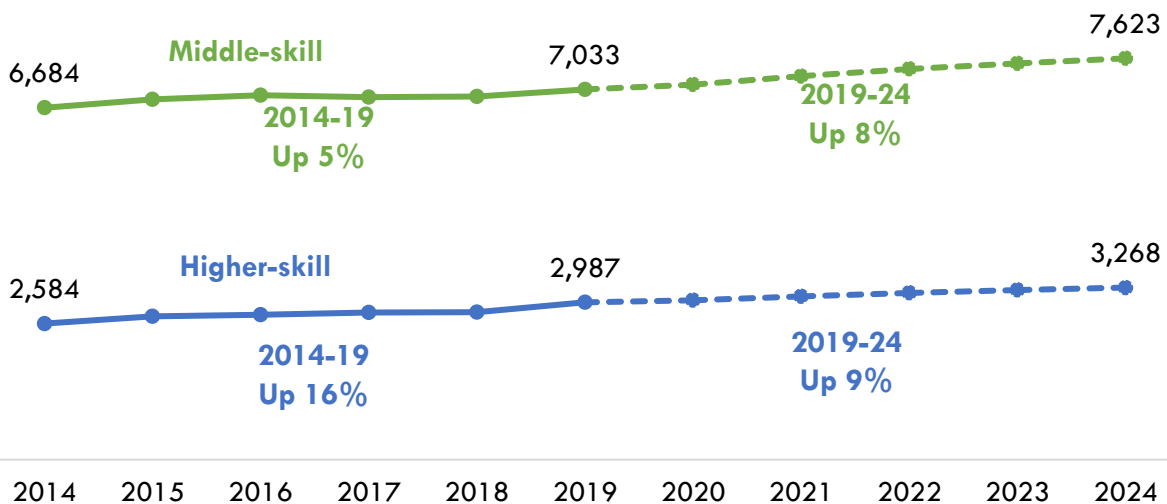
computer networking occupational group. Middle-skill occupations are displayed in green and higher-skill occupations are displayed in blue.

Exhibit 1: Five-year projections for each occupation in the computer networking occupational group

Occupation	2019 Jobs	2024 Jobs	5-Yr % Change (New Jobs)	5-Yr Openings (New + Replacement Jobs)	Annual Openings (New + Replacement Jobs)	% of workers age 55+
Computer User Support Specialists	3,561	3,916	10%	1,885	377	16%
Network and Computer Systems Administrators	1,733	1,849	7%	739	148	14%
Computer Network Support Specialists	1,059	1,148	8%	540	108	16%
Computer Network Architects	679	711	5%	276	55	13%
Middle-Skill Total	7,033	7,623	8%	3,439	688	15%
Computer Systems Analysts	2,126	2,293	8%	956	191	20%
Database Administrators and Architects	557	611	10%	260	52	20%
Information Security Analysts	304	364	20%	176	35	~13%
Higher-Skill Total	2,987	3,268	9%	1,393	278	19%
Total	10,020	10,891	9%	4,832	966	17%

Source: EMSI 2020.4

Exhibit 2: Historical and projected jobs for the middle-skill (green) and higher-skill (blue) computer networking occupational groups, 2014 – 2024



Source: EMSI 2020.4

Job Advertisements

Exhibit 3 displays the number of job ads posted during the last 12 months, along with the regional and statewide average time to fill for the computer networking occupational group. On average, local employers fill online job advertisements for the computer networking occupational group within 51 days. This regional average is one day longer than the statewide average of 50 days, indicating that local employers may face similar challenges as other employers in California as a whole. Middle-skill occupations are displayed in green, and higher-skill occupations are displayed in blue.

Exhibit 3: Job ads and time to fill

Occupation	Job Ads	Regional Average Time to Fill (Days)	California Average Time to Fill (Days)
Computer User Support Specialists	1,672	47	46
Network and Computer Systems Administrators	486	51	48
Computer Network Architects	259	-	51
Computer Network Support Specialists	80	-	49
Computer Systems Analysts	684	52	49
Database Administrators	385	57	52
Information Security Analysts	310	59	51
Total	3,876	51	50

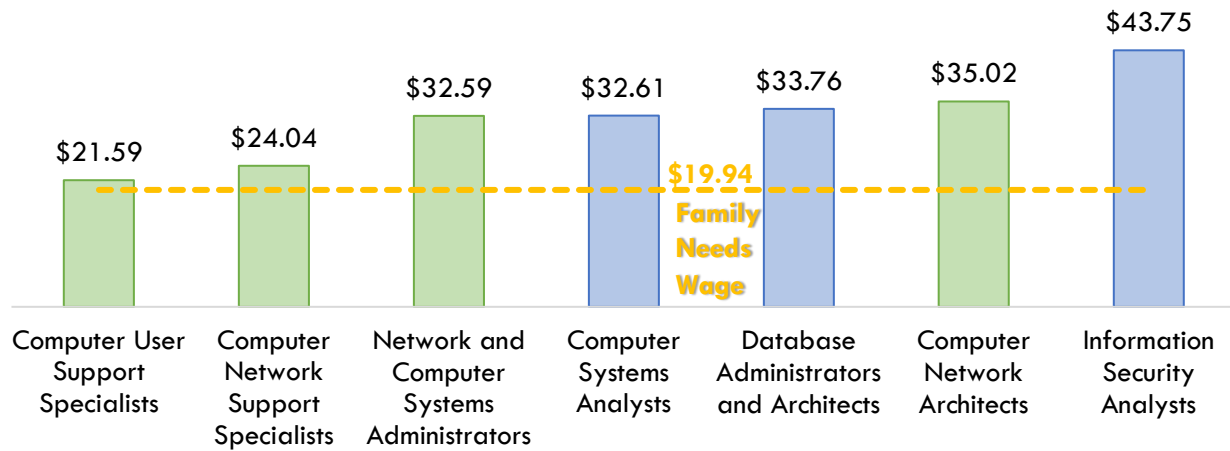
Source: Burning Glass – Labor Insights

Earnings and Benefits

Community colleges should ensure their training programs lead to employment opportunities that provide a self-sustainable level of income. The Family Needs Calculator estimates that a self-sustainable wage for a single adult with one school-age child is \$19.94 per hour or \$41,475 annually in Riverside County, \$19.49 per hour, or \$40,539 annually, in San Bernardino County (Pearce & Manzer, 2018). For this study, the higher hourly wage requirement in Riverside County is adopted as the self-sufficiently standard for the two-county region.

The computer networking occupational group's 25th percentile wages exceed the Family Needs Calculator self-sustainability rate in the IEDR. Exhibit 4 displays the 25th percentile hourly earnings for each occupation in the IEDR, with middle-skill occupations displayed in green and higher-skill occupations displayed in blue.

Exhibit 4: 25th percentile hourly earnings for the computer networking occupational group



Source: EMSI 2020.4

According to the California Labor Market Information Division’s occupational guides, the computer networking occupational group’s benefits typically include medical, dental, and life insurance (Detailed Occupational Guides, 2020).

Employers, Skills, Education, Work Experience, and Salary

Exhibit 5 displays the employers posting the most job ads for the computer networking occupational group during the last 12 months in the IEDR. Middle-skill occupations are displayed in green, and higher-skill occupations are displayed in blue, below the black line.

Exhibit 5: Employers posting the most job ads for computer networking occupations

Occupation	Employers
Computer User Support Specialists (n=1,206)	<ul style="list-style-type: none"> Best Buy XPO Logistics Riverside County Amazon
Network and Computer Systems Administrators (n=367)	<ul style="list-style-type: none"> University of California, Riverside Esri KaiHonua
Computer Network Architects (n=202)	<ul style="list-style-type: none"> Esri Riverside County San Bernardino County Co-Op Financial Services
Computer Network Support Specialists (n=62)	<ul style="list-style-type: none"> Anthem Blue Cross H&R Block CONEX Technical

Occupation	Employers
Computer Systems Analysts (n=684)	<ul style="list-style-type: none"> Esri Riverside County Anthem Blue Cross Inland Empire Health Plans California State University, San Bernardino Prime Healthcare Services University of California, Riverside
Database Administrators (n=260)	<ul style="list-style-type: none"> VSolvit, LLC. University of California, Riverside Madiba, Inc. Esri
Information Security Analysts (n=264)	<ul style="list-style-type: none"> Esri University of California, Riverside San Bernardino Community College District San Manuel Band of Mission Indians

Source: Burning Glass – Labor Insights

Exhibit 6 displays a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill positions in the computer networking occupational group. Specialized skills are occupation-specific skills that employers are requesting for industry or job competency.

Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job advertisements may be utilized as a helpful guide for curriculum development.

Exhibit 6: Sample of in-demand skills from employer job ads

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Computer User Support Specialists (n=1,574)	<ul style="list-style-type: none"> Technical Support Repair Customer Service Hardware and Software Installation 	<ul style="list-style-type: none"> Troubleshooting Communication Skills Problem Solving Detail-Oriented 	<ul style="list-style-type: none"> Microsoft Office Microsoft Operating System SQL Linux
Network and Computer Systems Administrators (n=468)	<ul style="list-style-type: none"> Repair Hardware and Software Configuration Information Systems Project Management 	<ul style="list-style-type: none"> Troubleshooting Communication Skills Problem Solving Planning 	<ul style="list-style-type: none"> Windows Server VMware Linux SQL
Computer Network Architects (n=249)	<ul style="list-style-type: none"> Telecommunications Networking Engineering Repair Information Systems 	<ul style="list-style-type: none"> Communication Skills Troubleshooting Teamwork/Collaboration Planning 	<ul style="list-style-type: none"> Cisco Voice over IP (VoIP) Microsoft Office Python
Computer Network Support	<ul style="list-style-type: none"> Technical Support Network Troubleshooting 	<ul style="list-style-type: none"> Troubleshooting Communication Skills Problem Solving 	<ul style="list-style-type: none"> Microsoft Windows Microsoft Office Teradata DBA

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Specialists (n=72)	<ul style="list-style-type: none"> Customer Service System/Network Configuration 	<ul style="list-style-type: none"> Teamwork/Collaboration 	<ul style="list-style-type: none"> VMware
Computer Systems Analysts (n=645)	<ul style="list-style-type: none"> Project Management Systems Analysis Business Systems Analysis Customer Service 	<ul style="list-style-type: none"> Communication Skills Problem Solving Teamwork/Collaboration Planning 	<ul style="list-style-type: none"> SQL Microsoft Office SAP Software Development
Database Administrators (n=368)	<ul style="list-style-type: none"> Data Warehousing Relational Databases Database Design Performance Tuning 	<ul style="list-style-type: none"> Communication Skills Planning Problem Solving Troubleshooting 	<ul style="list-style-type: none"> SQL Oracle Teradata DBA Microsoft Office
Information Security Analysts (n=285)	<ul style="list-style-type: none"> Information Systems Network Security Customer Service Project Management 	<ul style="list-style-type: none"> Communication Skills Teamwork/Collaboration Planning Research 	<ul style="list-style-type: none"> Linux Vulnerability Assessment Control Objectives for Information and Related Technology (COBIT)

Source: Burning Glass – Labor Insights

Exhibit 7 displays the entry-level education typically required to enter each occupation according to the Bureau of Labor Statistics (BLS), educational attainment for incumbent workers with "some college, no degree" and an "associate degree" according to the U.S. Census (2016-17) and the real-time minimum advertised education requirement from employer job ads. Job advertisement data indicates that some employers are willing to hire *computer networking* workers with less than a Bachelor's degree.

Exhibit 7: Typical entry-level education, educational attainment, and minimum advertised education requirements for the computer networking occupational group

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Computer User Support Specialists	Some college, no degree	41%	811	55%	19%	26%
Network and Computer Systems Administrators	Bachelor's degree	37%	313	21%	8%	71%
Computer Network Architects	Bachelor's degree	37%	152	28%	7%	65%
Computer Network Support Specialists	Associate degree	41%	45	49%	4%	47%

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Computer Systems Analysts	Bachelor's degree	21%	488	17%	10%	73%
Database Administrators	Bachelor's degree	22%	264	16%	10%	74%
Information Security Analysts	Bachelor's degree	27%	234	21%	8%	71%

Source: EMSI 2020.4, Burning Glass – Labor Insights

*Percentage of incumbent workers with a Community College Award or Some Postsecondary Coursework

Exhibit 8 displays the work experience typically required to enter each occupation and the real-time work experience requirements from employer job ads.

Exhibit 8: Work experience required and real-time work experience requirements

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of Job Ads	0 – 2 years	3 – 5 years	6+ years
Computer User Support Specialists	None	1,047	62%	32%	6%
Network and Computer Systems Administrators	None	339	21%	54%	25%
Computer Network Architects	5 years or more	201	24%	51%	25%
Computer Network Support Specialists	None	49	45%	41%	14%
Computer Systems Analysts	None	528	33%	52%	15%
Database Administrators	None	277	23%	51%	26%
Information Security Analysts	Less than 5 years	231	19%	36%	45%

Source: EMSI 2020.4, Burning Glass – Labor Insights

Exhibit 9 displays advertised salary data from computer networking online job ads. The average advertised salaries for the occupations in the computer networking occupational group are above the \$42,475 (\$19.94 hourly) required annually for a family of one adult with a school-age child to meet the regional self-sufficiency standard in the region. Consider the salary information with caution since only 31% (1,186 out of 3,876) online job advertisements for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status.

Exhibit 9: Online job ads and salary information for computer networking jobs

Occupation	Number of job Advertisements	Real-Time Salary Information				Average Annual Salary
		Less than \$35,000	\$35,000 to \$49,999	\$50,000 to \$74,999	More than \$75,000	
Computer User Support Specialists	623	19%	46%	20%	15%	\$51,000
Network and Computer Systems Administrators	140	1%	11%	31%	57%	\$85,000
Computer Network Architects	60	5%	6%	27%	62%	\$86,000
Computer Network Support Specialists	31	7%	48%	19%	26%	\$61,000
Computer Systems Analysts	186	4%	8%	39%	49%	\$79,000
Database Administrators	82	7%	14%	23%	56%	\$83,000
Information Security Analysts	64	16%	9%	11%	64%	\$85,000

Source: Burning Glass – Labor Insights

Cisco Networking Job Advertisements

This section of the report analyzes computer networking job advertisements that require Cisco certifications. Cisco develops, manufactures, and sells networking hardware, software, and telecommunications equipment. Cisco provides certifications and training programs related to their networking products that ensure networking workers have a comprehensive understanding of products and solutions. This job advertisement search contains only the computer networking job advertisements that included Cisco networking certifications. The following displays the definitions of the Cisco networking certifications included in this job advertisement search:

- **Cisco Certified Network Associate (CCNA):** Validates your skills and knowledge in network fundamentals, network access, IP connectivity, IP services, security fundamentals, and automation and programmability (Cisco, 2020).
- **Cisco Certified Network Professional (CCNP):** Validates knowledge of enterprise infrastructure, including dual-stack architecture, virtualization, infrastructure, network assurance, security, and automation. This certification requires a focus on emerging and industry-specific topics such as network design, SD-WAN, wireless, and automation (Cisco, 2020a).

Exhibit 10 displays the number of job ads posted during the last 12 months for computer networking occupations with Cisco networking certifications. Middle-skill occupations are displayed in green, and higher-skill occupations are displayed in blue. There were 191 advertisements for middle-skill occupations

with these certifications, more than the 23 advertisements for higher-skill occupations. Cisco computer networking job advertisement information is displayed by middle-skill (green) and higher-skill (blue) occupational groups.

Exhibit 10: Job ads for computer networking occupations with Cisco networking certifications

Occupation	Job Ads
Computer Network Architects	67
Computer User Support Specialists	64
Network and Computer Systems Administrators	49
Computer Network Support Specialists	11
Middle-Skill Subtotal	191
Information Security Analysts	15
Database Administrators	5
Computer Systems Analysts	3
Higher-Skill Subtotal	23
Total	214

Source: Burning Glass – Labor Insights

Certifications

Exhibit 11 displays the certifications most frequently required for computer networking occupations with Cisco networking certifications. The Cisco Certified Network Associate (CCNA) certification was included in 176 middle-skill job advertisements and in 16 higher-skill job advertisements. The Cisco Certified Network Professional (CCNP) certification was included in 56 middle-skill job advertisements and in 15 higher-skill job advertisements.

Exhibit 11: Certifications required by employer job ads

Occupational Group	Certifications
Middle-Skill Occupational Group (n=191)	<ul style="list-style-type: none"> • Cisco Certified Network Associate (CCNA) (176 job ads) • Cisco Certified Network Professional (CCNP) (56 ads) • CompTIA Network+ (53 ads)
Higher-Skill Occupational Group (n=23)	<ul style="list-style-type: none"> • Cisco Certified Network Associate (CCNA) (16 job ads) • SANS/GIAC Certification (15 ads) • Cisco Certified Network Professional (CCNP) (15 ads) • Certified Information Systems Security Professional (CISSP) (15 ads)

Source: Burning Glass – Labor Insights

Employers, Skills, Education, Work Experience, and Salary

Exhibit 12 displays the employers posting the most job ads for the computer networking occupations with Cisco networking certifications in the IEDR.

Exhibit 12: Employers posting the most job ads for Cisco computer networking occupations

Occupational Group	Employers
Middle-Skill Occupational Group (n=134)	<ul style="list-style-type: none"> Leidos Sekon Motorola Solutions Cherokee Nation Operational Solutions Amazon San Manuel Band of Mission Indians
Higher-Skill Occupational Group (n=22)	<ul style="list-style-type: none"> VSolvit, LLC Eastern Municipal Water District

Source: Burning Glass – Labor Insights

Exhibit 13 displays a sample of specialized, employability, and software and programming skills that employers seek when looking for workers to fill positions in the computer networking occupational group that requires Cisco certifications. Specialized skills are occupation-specific skills that employers are requesting for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job advertisements may be utilized as a helpful guide for curriculum development.

Exhibit 13: Sample of in-demand skills from employer job ads

Occupational Group	Specialized Skills	Employability Skills	Software and Programming Skills
Middle-Skill Occupational Group (n=134)	<ul style="list-style-type: none"> Information Systems Network Engineering Repair System Administration 	<ul style="list-style-type: none"> Troubleshooting Communication Skills Teamwork/Collaboration Writing 	<ul style="list-style-type: none"> TCP/IP Microsoft Active Directory Wide Area Network (WAN) VMware
Higher-Skill Occupational Group (n=23)	<ul style="list-style-type: none"> Information Systems Network Security Threat Intelligence and Analysis Information Security 	<ul style="list-style-type: none"> Troubleshooting Planning Writing Research 	<ul style="list-style-type: none"> Windows Server SQL Microsoft Windows Oracle Linux

Source: Burning Glass – Labor Insights

Exhibit 14 displays the real-time minimum advertised education requirement from employer job ads for Cisco networking positions.

Exhibit 14: Minimum advertised education requirements for Cisco computer networking occupations

Occupational Group	Real-Time Minimum Advertised Education Requirement			
	Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Middle-Skill Occupational Group	134	26%	10%	64%
Higher-Skill Occupational Group	20	15%	-	85%

Source: EMSI 2020.4, Burning Glass – Labor Insights

Exhibit 15 displays the real-time work experience requirements from employer job ads.

Exhibit 15: Work experience required and real-time work experience requirements

Occupation	Real-Time Work Experience			
	Number of Job Ads	0 – 2 years	3 – 5 years	6+ years
Middle-Skill Occupational Group	165	29%	46%	25%
Higher-Skill Occupational Group	16	12%	44%	44%

Source: EMSI 2020.4, Burning Glass – Labor Insights

Exhibit 16 displays advertised salary data from Cisco computer networking online job ads. Consider the salary information with caution since only 17% (37 out of 214) online job advertisements for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status.

Exhibit 16: Online job ads and salary information for Cisco computer networking jobs

Occupations	Number of job Advertisements	Real-Time Salary Information				Average Annual Salary
		Less than \$35,000	\$35,000 to \$49,999	\$50,000 to \$74,999	More than \$75,000	
Middle-Skill Occupational Group	33	6%	9%	30%	55%	\$85,000
Higher-Skill Occupational Group	4	-	-	25%	75%	-

Source: Burning Glass – Labor Insights

Student Completions and Program Outcomes

Exhibit 17 displays annual average completion data for the California Community College computer networking program, based on the most recent three academic years.

Exhibit 17: 2016-19, Annual average community college awards for the computer networking programs in the IEDR

0708.10 – Computer Networking	Certificate requiring 30< 60-semester units	Certificate requiring 18< 30-semester units	Certificate requiring 12< 18-semester units	Certificate requiring 6< 18-semester units	CCC Annual Average Awards, Academic Years 2016-19
Chaffey	15	54	8	0	77
Copper Mountain	-	1	-	-	1
Mt. San Jacinto	2	-	-	-	2
Riverside	-	1	4	28	33
Total	17	56	12	28	113

Source: MIS Data Mart

California program outcome data may provide a useful insight into the likelihood of success for the proposed program. Community college student outcome information based on the selected TOP codes and region is provided in Exhibit 18. The outcome methodology is available in the appendix section of this report.

Exhibit 18: 0708.10 – Computer networking strong workforce program outcomes

Strong Workforce Program Metrics: 0708.10 – Computer Networking Academic Year 2017-18, unless noted otherwise	Inland Empire/Desert Region	California
Unduplicated count of enrolled students (2018-19)	363	7,988
Completed 9+ career education units in one year (2018-19)	56%	39%
Perkins Economically disadvantaged students (2018-19)	88%	75%
Students who attained a noncredit workforce milestone in a year (2018-19)	-	24%
Students who earned a degree, certificate, or attained apprenticeship (2018-19)	47	543
Transferred to a four-year institution (transfers)	19	332
Job closely related to the field of study (2016-17)	91%	71%
Median annual earnings (all exiters)	\$37,020	\$47,840
Median change in earnings (all exiters)	24%	22%
Attained a living wage (completers and skills-builders)	71%	66%

Sources: LaunchBoard Community College Pipeline and Strong Workforce Program Metrics

Awards granted from private educational institutions are displayed in Exhibit 19 along with the relevant CIP code.

Exhibit 19: Annual average private educational institution awards from network and system administration/administrator programs in the Inland Empire/Desert region

11.1001 – Network and System Administration/Administrator	Award < 1 year	Private Educational Institutions Annual Average Certificates or Other Credit Awards (2014-17)
California Technical Academy	34	34
Total Annual Average Awards	34	34

Source: IPEDS

Recommendation

Instruction provided by community college computer networking programs prepares students for employment in four middle-skill occupations in the computer networking occupation group. These occupations combined are expected to have 688 annual job openings over the next five years, increasing employment by 15%. Computer user support will have the most annual job openings, 377 annual job openings, and computer network architects will have the fewest, 55 annual openings. The Middle-skill computer networking occupation group 25th percentile hourly wages range between \$21.59 per hour (computer user support specialists) and \$35.02 per hour (computer network architects), exceeding the \$19.94 per hour self-sustainability standard for a single adult with one child.

Four regional community colleges offer computer networking programs (TOP 0708.10), conferring 113 annual average awards over the last three years. The median wages for all exiters was \$37,020 annually, and 71% attained a living wage. One private institution conferred 34 annual average awards over the last three academic years available.

The COE recommends creating new computer networking programs based on the projected demand for more workers and the high wages offered by the middle-skill occupations in this group. Colleges should partner with relevant employers to document the required knowledge, skills, abilities, and certifications needed to secure employment in this field.

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Appendix:

Occupation definitions, sample job titles, five-year projections for computer networking occupations

Network and Computer Systems Administrators (15-1244)

Install, configure, and maintain an organization's local area network (LAN), wide area network (WAN), data communications network, operating systems, and physical and virtual servers. Perform system monitoring and verify the integrity and availability of hardware, network, and server resources and systems. Review system and application logs and verify completion of scheduled jobs, including system backups. Analyze network and server resource consumption and control user access. Install and upgrade software and maintain software licenses. May assist in network modeling, analysis, planning, and coordination between network and data communications hardware and software.

Sample job titles: Server Administrator, Network Manager, Wide Area Network Administrator (WAN Administrator), Systems Administrator, Network Coordinator, Network Administrator, Local Area Network Administrator (LAN Administrator), IT Systems Administrator (Information Technology Systems Administrator), Telecommunications Analyst, Technical Support Specialist

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 37%

Computer Network Support Specialists (15-1231)

Analyze, test, troubleshoot, and evaluate existing network systems, such as local area networks (LAN), wide area networks (WAN), cloud networks, servers, and other data communications networks. Perform network maintenance to ensure networks operate correctly with minimal interruption.

Sample job titles: Network Specialist, Network Technician, Technical Support Specialist, Systems Support Specialist, Network Support Specialist, Network Engineer, Network Analyst, Systems Specialist, Senior IT Assistant (Senior Information Technology Assistant), Personal Computer Network Analyst

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 37%

Computer User Support Specialists (15-1232)

Provide technical assistance to computer users. Answer questions or resolve computer problems for clients in person, via telephone, or electronically. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems.

Sample job titles: Help Desk Technician, Desktop Support Specialist, Technical Support Specialist, Technical Support Representative, Computer Specialist, PC Tech (Personal Computer Technician), Information Technology Technician (IT Technician), Information Technology Specialist (IT Specialist), Help Desk Analyst, Information Technology Support Specialist (IT Support Specialist)

Entry-Level Educational Requirement: Some college, no degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 41%

Computer Network Architects (15-1241)

Design and implement computer and information networks, such as local area networks (LAN), wide area networks (WAN), intranets, extranets, and other data communications networks. Perform network modeling, analysis, and planning, including analysis of capacity needs for network infrastructures. May also design network and computer security measures. May research and recommend network and data communications hardware and software.

Sample job titles: Network Analyst, Network Engineer, Network Consultant, Telecommunications Analyst, Solutions Architect, Telecommunication Engineer (Telecom Engineer), Communications Engineer, Telecommunications Consultant (Telecom Consultant), Telecommunication Systems Designer (Telecom Systems Designer)

Entry-Level Educational Requirement: Associate degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 41%

Computer Systems Analysts (15-1211)

Analyze science, engineering, business, and other data processing problems to develop and implement solutions to complex applications problems, system administration issues, or network concerns. Perform systems management and integration functions, improve existing computer systems, and review computer system capabilities, workflow, and schedule limitations. May analyze or recommend commercially available software.

Sample job titles: Business Systems Analyst, Computer Analyst, Information Technology Consultant (IT Consultant), Information Technology Analyst (IT Analyst), Information Systems Analyst (ISA), Nursing Informatics Specialist, Registered Nurse Clinical Information Systems Educator (RN Clinical Information

Systems Educator), Registered Nurse Clinical Information Systems Coordinator (RN Clinical Information Systems Coordinator), Nursing Information Systems Coordinator, Nursing Informatics Officer

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 21%

Database Administrators and Architects (15-1245)

Administer, test, and implement computer databases, applying knowledge of database management systems. Coordinate changes to computer databases. Identify, investigate, and resolve database performance issues, database capacity, and database scalability. May plan, coordinate, and implement security measures to safeguard computer databases. Design strategies for enterprise databases, data warehouse systems, and multidimensional networks. Set standards for database operations, programming, query processes, and security. Model, design, and construct large relational databases or data warehouses. Create and optimize data models for warehouse infrastructure and workflow. Integrate new systems with existing warehouse structure and refine system performance and functionality.

Sample job titles: Database Administrator (DBA), Data Architect, Database Developer, Database Analyst, Database Coordinator, Database Programmer, Database Administration Manager, System Administrator, Management Information Systems Director (MIS Director), Information Systems Manager

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 22%

Information Security Analysts (15-1212)

Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information. Assess system vulnerabilities for security risks and propose and implement risk mitigation strategies. May ensure appropriate security controls are in place that will safeguard digital files and vital electronic infrastructure. May respond to computer security breaches and viruses.

Sample job titles: Computer Security Specialist, Information Systems Security Officer (ISSO), Security Engineer, Security Analyst, Network Security Analyst, Information Security Analyst, Security Specialist, Network Security Engineer, Information Technology Security Analyst (IT Security Analyst), Information Systems Security Analyst

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 27%

Program Completion and Outcome Methodology

Exhibit 17 displays the average annual California Community College (CCC) awards conferred during the three academic years between 2016 and 2019, from the California Community Colleges Chancellor's Office Management Information Systems (MIS) Data Mart. Awards are the combined total of associate degrees and certificates issued during the timeframe, divided by three in this case to calculate an annual average. This is done to minimize the effect of atypical variation that might be present in a single year.

Community college student outcome information is from LaunchBoard and based on the selected TOP code and region. These metrics are based on records submitted to the California Community Colleges Chancellor's Office Management Information Systems (MIS) by community colleges, which come from self-reported student information from CCC Apply and the National Student Clearinghouse. Employment and earnings metrics are sourced from records provided by California's Employment Development Department's Unemployment Insurance database. When available, outcomes for completers are reported to demonstrate the impact that earning a degree or certificate can have on employment and earnings. For more information on the types of students included for each metric, please see the web link for LaunchBoard's Strong Workforce Program Metrics Data Element Dictionary in the References section (LaunchBoard, 2020a). Finally, employment in a job closely related to the field of study comes from self-reported student responses on the CTE Employment Outcomes Survey (CTEOS), administered by Santa Rosa Junior College (LaunchBoard, 2020a).

Job advertisement data is limited to the information provided by employers and the ability of artificial intelligence search engines to identify this information. Additionally, preliminary calculations by Georgetown Center on Education and the Workforce found that "just 30 to 40 percent of openings for candidates with some college or an associate degree, and only 40 to 60 percent of openings for high school diploma holders appear online" (Carnevale et al., 2014). Online job advertisements often do not reveal the hiring intentions of employers; it is unknown if employers plan to hire one or multiple workers from a single online job advertisement, or if they are collecting resumes for future hiring needs. A closed job advertisement may not be the result of a hired worker.

Table 1: 2019 to 2024 job growth, wages, education, training, and work experience required for the computer networking occupational group, IEDR

Occupation (SOC)	2019 Jobs	5-Yr Change	5-Yr % Change	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage Range (25 th to 75 th percentile)	Median Hourly Wage (50 th percentile)	Average Annual Earnings	Typical Entry-Level Education & On-The-Job Training Required	Work Experience Required
Computer User Support Specialists (15-1232)	3,561	355	10%	377	\$21.59 to \$36.62	\$27.81	\$62,700	Some college, no degree & None	None
Network and Computer Systems Administrators (15-1244)	1,733	116	7%	148	\$32.59 to \$50.85	\$41.00	\$87,100	Bachelor's degree & None	None
Computer Network Support Specialists (15-1231)	1,059	89	8%	108	\$24.04 to \$36.45	\$28.68	\$66,600	Associate's degree & None	None
Computer Network Architects (15-1241)	679	32	5%	55	\$35.02 to \$66.39	\$52.82	\$107,300	Bachelor's degree & None	5 years or more
Middle-Skill Subtotal	7,033	592	8%	688	-	-	-	-	-
Computer Systems Analysts (15-1211)	2,126	167	8%	191	\$32.61 to \$52.10	\$41.22	\$91,600	Bachelor's degree & None	None
Database Administrators and Architects (15-1245)	557	54	10%	52	\$33.76 to \$61.27	\$46.69	\$98,700	Bachelor's degree & None	None
Information Security Analysts (15-1212)	304	60	20%	35	\$43.75 to \$69.34	\$55.72	\$114,700	Bachelor's degree & None	Less than 5 years
Higher-Skill Subtotal	2,987	281	9%	278	-	-	-	-	-
Total	10,020	871	9%	966	-	-	-	-	-

Source: EMSI 2020.4