Cybersecurity

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

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 Infrastructure and Support** (TOP 0708.00)
  - **-Computer Networking** (0708.10)
  - **-Computer Support** (0708.20)

Programs

Provides training for
- **Computer Network Support Specialists**
- **Computer User Support Specialists**
- **Network and Computer Systems Administrators**

Community College-level Occupations

Over the next five years (2021-2026), community college-level cybersecurity employment is projected to

Increase Employment
8%

523
Annual Job Openings

Median Hourly Earnings
$27.85-$41.63
above the $21.82 hourly Living Wage Standard

104 Total Annual Awards
In Programs Related to Cybersecurity

104
Program Awards from Community College Programs

0
Program Awards from Other Postsecondary Education Providers

The Inland Empire/Desert Centers of Excellence

Recommends

Cybersecurity Program Expansion
to meet the need for more workers in the region

Introduction

This report provides labor market occupational demand and wage research and postsecondary program outcomes related to cybersecurity. According to the Cybersecurity & Infrastructure Security Agency (CISA), cybersecurity is the protection of networks, devices, and data from unauthorized access or criminal use and

the practice of ensuring confidentiality, integrity, and availability of information (CISA, 2019). Employer demand for cyber professionals is consistently high, and the outlook over the next is extremely promising. There is a wide range of positions within cybersecurity spanning every industry sector, allowing candidates to match their skills and experience to the position that best suits them (CyberSeek, 2022).

The National Initiative for Cybersecurity Education (NICE) developed a framework to classify cybersecurity employment into general categories based on work roles, tasks, knowledge, skills, and abilities. The NICE framework categorizes cybersecurity work roles in the following way (CISA, 2021):

- **Analyze**: Performs highly-specialized review and evaluation of incoming cybersecurity information to determine its usefulness for intelligence.
- **Collect and Operate**: Provides specialized denial and deception operations and collection of cybersecurity information that may be used to develop intelligence.
- **Investigate**: Investigates cybersecurity events or crimes related to information technology (IT) systems, networks, and digital evidence.
- **Operate and Maintain**: Provides the support, administration, and maintenance necessary to ensure effective and efficient information technology (IT) system performance and security.
- **Oversee and Govern**: Provides leadership, management, direction, or development and advocacy so the organization may effectively conduct cybersecurity work.
- **Protect and Defend**: Identifies, analyzes, and mitigates threats to internal information technology (IT) systems and/or networks.
- **Securely Provision**: Conceptualizes, designs, procures, and/or builds secure information technology (IT) systems, with responsibility for aspects of system and/or network development.

The majority of regional program offerings utilize the computer infrastructure and support (TOP 0708) program codes. However, given the broad application of cybersecurity principles, individuals entering the field may receive training from the various regional community college programs listed below. Descriptions for these programs are available in this report's student completions and program outcomes section.

- Information Technology, General (TOP 0701.00)
- Computer Information Systems (0702.00)
- Computer Infrastructure and Support (0708.00)
    - Computer Networking (0708.10)
    - Computer Support (0708.20)
- Industrial and Transportation Security (2105.30)
- Forensics, Evidence, and Investigation (2105.40)

Cybersecurity knowledge, skills, and abilities span multiple occupations. The amount of time spent on cybersecurity tasks depends on the hiring employer's primary function, the worker's skill level, or the employee's daily assignments. Skills trained by cybersecurity programs lead to eight distinct occupations, collectively called the cybersecurity occupational group in this report. Each of these unique occupations plays a role in securing computers and networks against nefarious attacks. This classification of workers should possess at least some cybersecurity skills training to be proficient in their role. The cybersecurity occupational group is separated into community college-level and bachelor's degree-level occupations to illuminate job opportunities for individuals with varying levels of educational attainment.

The **community college-level occupations** in this report require either some college, no degree, an associate degree, or a bachelor's degree. Between 39% and 40% of incumbent workers in these occupations have a community college-level education, some college or an associate degree, as their highest educational attainment. The community college-level occupations included in the cybersecurity occupational group are:

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

This report's **bachelor's degree-level occupations** typically require workers to obtain a four-year degree before entering employment. Between 12% and 37% of workers in these occupations have a community college-level education, some college or an associate degree, as their highest educational attainment. The bachelor's degree-level occupations included in the cybersecurity occupational group are:

- Computer Network Architects (SOC 15-1241)
- Computer Systems Analysts (15-1211)
- Database Administrators and Architects (15-1245)
- Information Security Analysts (15-1212)
- Software Developers and Software Quality Assurance Analysts and Testers (15-1256)

This report's educational supply and employment demand portions focus solely on the community college-level jobs students will likely obtain after completing a community college cybersecurity program in the region.

Job Counts and Projections

In 2021, there were 15,589 total cybersecurity jobs in the region. Employment for the community college-level cybersecurity occupational group is projected to increase by 8% through 2026; 523 job openings are projected annually. The bachelor's degree-level occupations are expected to have 952 annual job openings, increasing employment by 12% over the next five years. Exhibit 1 displays the job counts, five-year projected job growth, job openings, and the share of incumbent workers aged 55 years and greater in the region.

Exhibit 1: Five-year projections for the cybersecurity occupational group, 2021-2026

Occupation	2021 Jobs	2026 Jobs	5-Yr % Change	5-Yr Openings (New + Replacement Jobs)	Annual Openings (New + Replacement Jobs)	% of workers age 55+
Software Developers and Software Quality Assurance Analysts and Testers	5,283	6,128	16%	2,882	576	15%
Computer Systems Analysts	2,405	2,577	7%	1,031	206	21%
Computer Network Architects	985	1,017	3%	330	66	14%
Database Administrators and Architects	571	630	10%	275	55	21%
Information Security Analysts	440	516	17%	244	49	15%
Bachelor's Degree-level Total	**9,683**	**10,867**	**12%**	**4,762**	**952**	**17%**
Computer User Support Specialists	3,305	3,590	9%	1,524	305	17%
Network and Computer Systems Administrators	1,727	1,834	6%	678	136	15%
Computer Network Support Specialists	874	956	9%	410	82	16%
Community College-level Total	**5,906**	**6,380**	**8%**	**2,613**	**523**	**16%**
Total	**15,589**	**17,248**	**11%**	**7,375**	**1,475**	**16%**

Source: Emsi 2022.2

Traditional labor market information for the cybersecurity occupational group likely captures employment for workers who may never engage in cybersecurity work activities. Reviewing traditional labor market data alone may overstate the demand for cybersecurity workers.

A job advertisement search was conducted to determine the real-time regional demand for cybersecurity workers. The Burning Glass cybersecurity filter was applied to this job search to ensure job ads are specific to cybersecurity. The cybersecurity filter is defined using common titles, in-demand skills, and certifications required for cybersecurity roles, such as CISSP. The cybersecurity filter uses the same definition/ approach used on the CyberSeek website. This filter provides the ability to understand the scope of cyber demand across industries (Burning Glass, 2022).

The Centers of Excellence typically seeks to report job advertisement information for occupations with at least 100 job ads over the last 12 months in the region to ensure that the job ad information in this report is reliable and actionable. Over the last 12 months, there were fewer than 100 job ads posted in the region for the following occupations: computer network architects (75 ads), computer systems analysts (61 ads),

database administrators and architects (23 ads), and computer network support specialists (14 ads). To gain insight into employer demand for these occupations, the job ad search was expanded to include all advertisements posted in California.

Over the previous 12 months, there were 1,017 job ads posted for the cybersecurity occupational group in the region, 301 ads for community college-level occupations, and 716 ads for bachelor's degree-level occupations. This report analyzes information from 7,746 job ads, combining regional and statewide data. On average, regional employers fill online job advertisements for cybersecurity workers in 38 days, one day shorter than the statewide average, indicating that regional employers face similar challenges filling open positions as other employers in California. Exhibit 2 displays the number of cybersecurity job ads posted over the last twelve months and the regional and statewide average time to fill.

Exhibit 2: Job ads and time to fill, Inland Empire/Desert Region (includes all of California)*

Occupation	Job Ads	Regional Average Time to Fill (Days)	Statewide Average Time to Fill (Days)
Information Security Analysts	456	39	40
Software Developers and Software Quality Assurance Analysts and Testers	101	37	39
Computer Network Architects*	3,411	-	40
Computer Systems Analysts*	1,983	-	40
Database Administrators and Architects*	874	-	41
Bachelor's Degree-level Total	**6,825**	**39**	**40**
Computer User Support Specialists	152	37	36
Network and Computer Systems Administrators	135	37	36
Computer Network Support Specialists*	634	-	36
Community College-level Total	**921**	**37**	**36**
Total	**7,746**	**38**	**39**

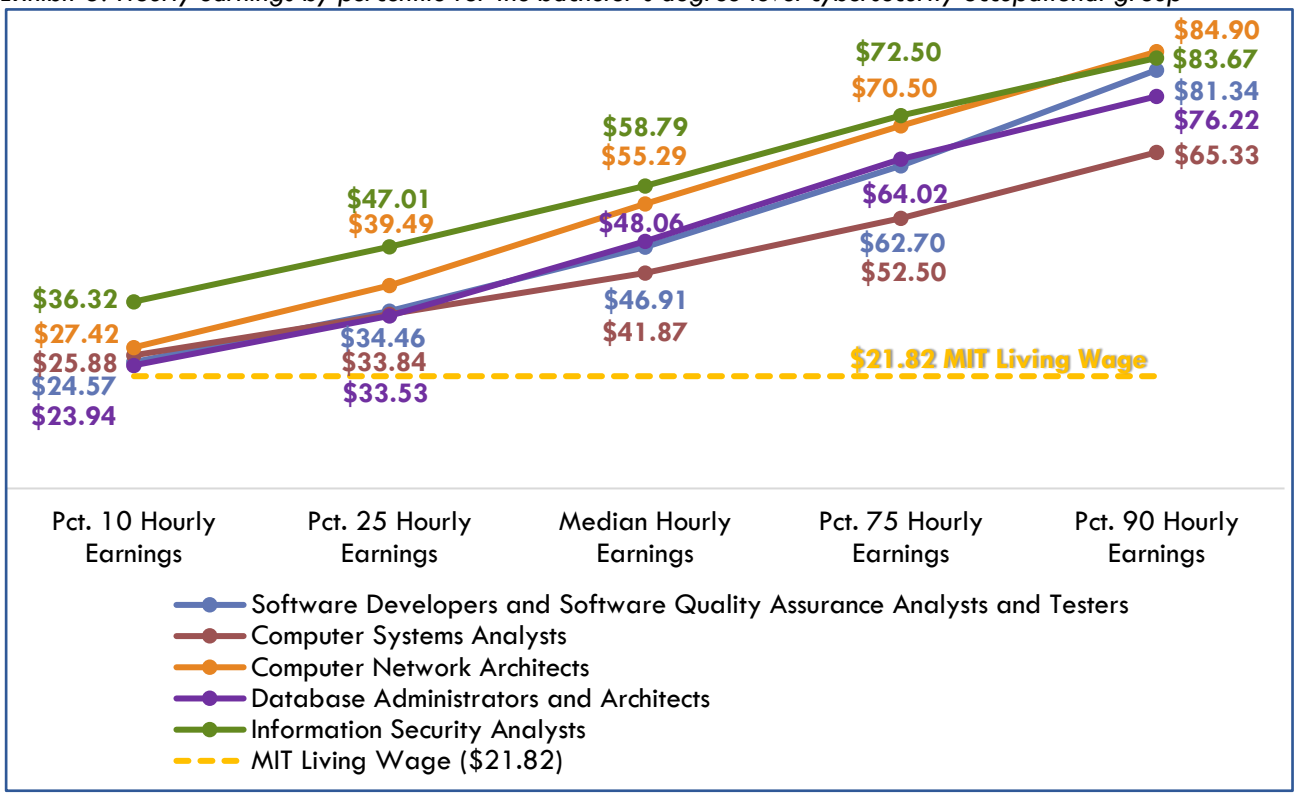
Source: Burning Glass – Labor Insights
*California job ad information

Earnings and Benefits

Community colleges should ensure their training programs lead to employment opportunities that provide a living wage. The MIT living wage calculator estimates that an individual must earn $21.82 per or $45,386 annually in California (Glasmeier, 2022).

Exhibit 3 displays the hourly earnings for the bachelor's degree-level cybersecurity occupational group. The hourly earnings for the bachelor's degree-level cybersecurity occupational group are strong, with each occupation's hourly earnings surpassing the regional living wage standard at the 10th percentile, indicating that at least 90% of workers in this occupational group earn a living wage.

Exhibit 3: Hourly earnings by percentile for the bachelor's degree-level cybersecurity occupational group

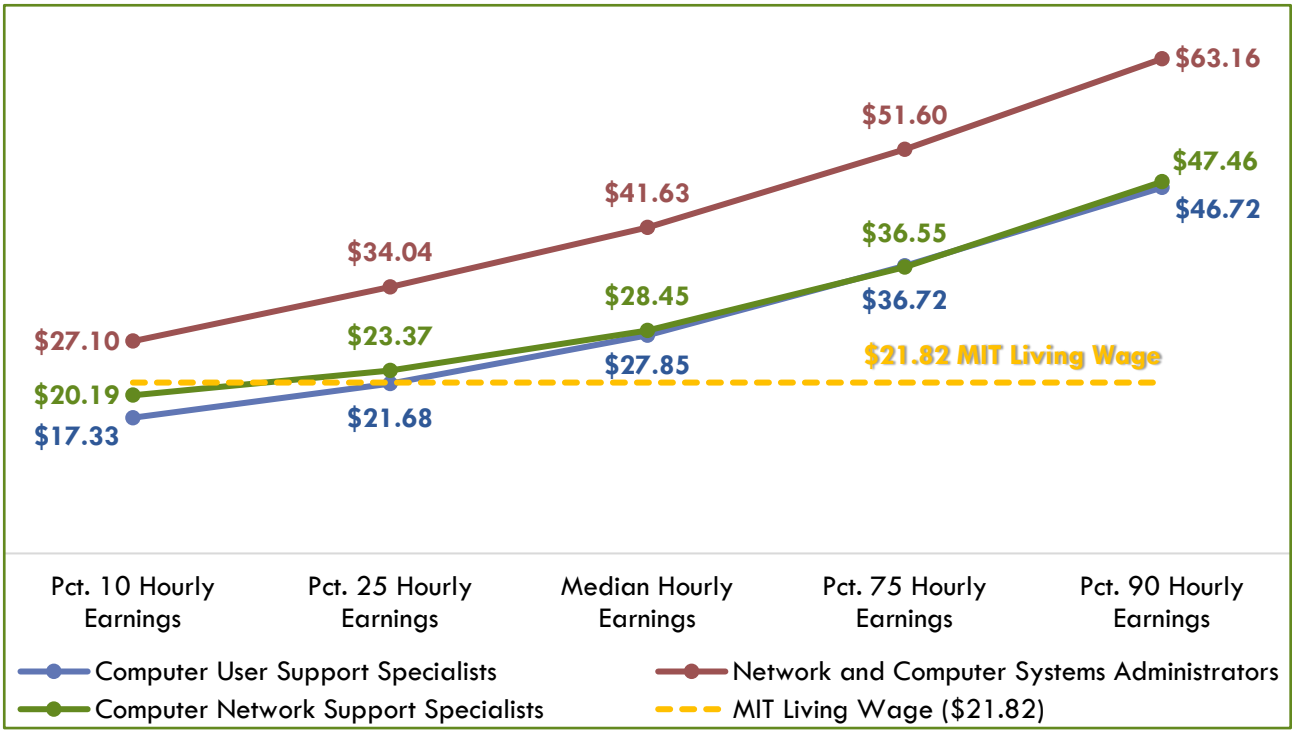


Source: Emsi 2022.2

Benefits information, provided by the occupational guides developed by the California Labor Market Information Division, reveals that employers frequently provide workers in the bachelor's degree-level cybersecurity occupational group benefits packages that include health, dental, and vision insurance, holidays, vacation, and retirement plans (Detailed Occupational Guides, 2022).

Exhibit 4 displays the hourly earnings for the community college-level cybersecurity occupational group. The median hourly earnings for the community college-level cybersecurity occupations are above the MIT living wage estimate, indicating that at least 50% of workers in this occupational group earn a living wage.

Exhibit 4: Hourly earnings by percentile for the community college-level cybersecurity occupational group



Source: Emsi 2022.2

Benefits information, typically provided by the occupational guides developed by the California Labor Market Information Division, is unavailable for computer network support specialists. Benefits for computer user support specialists and network and computer systems administrators generally include medical, dental, and life insurance, as well as vacation, sick leave, and retirement plans (Detailed Occupational Guides, 2022).

Advertised Salary from Online Job Ads

Exhibit 5 displays online job ad salary data for the cybersecurity occupational group over the last 12 months. Online job ad salary information reveals that employers are willing to pay the bachelor's degree-level cybersecurity occupational group between $103,000 and $125,000 annually, above the state's $45,386 annual ($21.82 hourly) living wage standard. Job ad information reveals that employers are willing to pay the community college-level cybersecurity occupational group between $57,000 and $94,000 annually, above the living wage standard. Consider the salary information with caution since only 28% (2,176 out of 7,746) of online job ads for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status.

Exhibit 5: Advertised salary information, Inland Empire/Desert Region (includes all of California)*

Occupation	Real-Time Salary Information					
	Number of job ads	Less than $35,000	$35,000 to $49,999	$50,000 to $74,999	More than $75,000	Average Annual Salary
Bachelor's Degree-level						
Information Security Analysts	*133*	4%	10%	5%	81%	$103,000
Software Developers and Software Quality Assurance Analysts and Testers	*23*	-	-	4%	96%	$125,000
Computer Network Architects*	*701*	8%	1%	7%	84%	$114,000
Computer Systems Analysts*	*857*	3%	1%	13%	83%	$121,000
Database Administrators and Architects*	*172*	4%	5%	14%	77%	$109,000
Community College-level						
Computer User Support Specialists	*66*	1%	49%	30%	20%	$57,000
Network and Computer Systems Administrators	*41*	12%	5%	29%	54%	$79,000
Computer Network Support Specialists*	*183*	3%	12%	21%	64%	$94,000

Source: Burning Glass – Labor Insights
*California job advertisement information

Employers, Skills, Education, and Work Experience

Approximately 2% of statewide employer demand for the cybersecurity occupational group is located in the Inland Empire/Desert Region. More than 36% of statewide job advertisements for the cybersecurity occupational group were posted in the Los Angeles/Orange County Metropolitan Statistical Area (MSA). Job advertisements indicate that regional cybersecurity workers willing to commute out of the local region may find greater employment opportunities.

Exhibit 6 displays the employers that posted the most job ads during the last 12 months. Showing employer names provides insight into where students may find employment after completing a program. The Boeing Company posted the most job advertisements for the bachelor's degree-level occupational group in California. Northrop Grumman posted the most job advertisements for the community college-level occupational group in the state. In the Inland Empire/Desert Region, CACI posted the most job advertisements for the community college-level cybersecurity occupational group, primarily seeking Linux administrators.

Exhibit 6: Employers posting the most job ads for the cybersecurity occupational group, Inland Empire/Desert Region (includes all of California)*

Occupation	Top Employers	
Bachelor's Degree-level		
Information Security Analysts *(n=342)*	• Anthem Blue Cross • San Manuel Band of Mission Indians • National Security Agency • Riverside Community College District	• Dell • Lockheed • The Boeing Company • Apple, Inc. • Accenture
Software Developers and Software Quality Assurance Analysts and Testers *(n=86)*	• Esri • The Boeing Company • General Dynamics • First American Financial Corporation	• National Security Agency • Anthem Blue Cross • San Manuel Band of Mission Indians
Computer Network Architects* *(n=2,582)*	• The Boeing Company • General Atomics • Banner Health System • Leidos • Calance	• Anthem Blue Cross • Northrop Grumman • Amazon • General Dynamics • Disney • Booz Allen Hamilton
Computer Systems Analysts* *(n=1,696)*	• National Security Agency • The Boeing Company • Northrop Grumman	• Deloitte • First American Corporation
Database Administrators and Architects* *(n=709)*	• The Boeing Company • Microsoft • Dell • Capgemini	• Shopify • Massachusetts Institute of Technology • Albertsons
Community College-level		
Computer User Support Specialists *(n=101)*	• Kaiser Permanente • Ovation Workplace Services • State of California	• Vsolvit, LLC • San Manuel Band of Mission Indians
Network and Computer Systems Administrators *(n=106)*	• KaiHonua • CACI • National Security Agency • General Dynamics	• First American Corporation • Dignity Health • Agility Solutions
Computer Network Support Specialists* *(n=542)*	• Northrop Grumman • Iron Systems Incorporated • Microsoft • Palo Alto Networks	• Senior Resource Group • Raytheon • Cisco Systems Incorporated • The Boeing Company

Source: Burning Glass – Labor Insights
*California job advertisement information

Exhibit 7 lists a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill positions in the cybersecurity occupational group. Specialized skills are

occupation-specific skills that employers request 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 ads may be utilized to guide curriculum development.

Exhibit 7: Sample of in-demand skills from employer job ads, Inland Empire/Desert Region (includes all of California)*

Occupation	Specialized skills	Employability skills	Software and Programming Skills
Bachelor's Degree-level			
Information Security Analysts *(n=422)*	• Information Systems • Network Security • Penetration Testing • Authentication • Cryptography	• Communication Skills • Problem Solving • Teamwork/Collaboration • Planning • Troubleshooting	• Microsoft Office • Python • Linux
Software Developers and Software Quality Assurance Analysts and Testers *(n=101)*	• Software Engineering • Cryptography • Information Security • Software Architecture • Agile Development	• Problem Solving • Communication Skills • Teamwork/Collaboration • Planning • Troubleshooting	• Java • SQL • Python • Microsoft C#
Computer Network Architects* *(n=3,385)*	• Networking Engineering • Network Security • System/Network Configuration • Network Troubleshooting	• Communication Skills • Teamwork/Collaboration • Planning • Problem Solving • Research	• Border Gateway Protocol • Cisco • Wide Area Network (WAN) • Linux • Python
Computer Systems Analysts* *(n=1,973)*	• Information Security • Information Systems • Network Engineering • Software Development • Information Assurance	• Communication Skills • Problem Solving • Teamwork/Collaboration • Troubleshooting • Research	• Python • SQL • Java • Linux • Microsoft Office
Database Administrators and Architects* *(n=868)*	• Information Security • Data Warehousing • Big Data • Cryptography • Software Development	• Communication Skills • Teamwork/Collaboration • Troubleshooting • Planning • Problem Solving	• SQL • Python • Linux • Teradata DBA • Java

Occupation	Specialized skills	Employability skills	Software and Programming Skills
Community College-level			
Computer User Support Specialists *(n=152)*	• Technical Support • Customer Service • Hardware and Software Installation • Repair • Network Troubleshooting	• Troubleshooting • Problem Solving • Communication Skills • Teamwork/Collaboration • Detail-Oriented	• Microsoft Office
Network and Computer Systems Administrators *(n=135)*	• Network Security • Network Troubleshooting • Repair • System/Network Configuration • Technical Support	• Problem Solving • Planning • Communication Skills • Research • Writing	• Linux • Cisco • VMware • Windows Server • Voice over IP (VoIP)
Computer Network Support Specialists* *(n=625)*	• System Administration • Technical Support • Customer Service • Information Security • Hardware and Software Configuration	• Troubleshooting • Communication Skills • Problem Solving • Planning • Teamwork/Collaboration • Multi-Tasking	• Linux • VMware • Microsoft Office • SQL • UNIX

Source: Burning Glass – Labor Insights
*California job advertisement information

Exhibit 8 displays the typical entry-level education, educational attainment, and minimum advertised education requirements for the cybersecurity occupational group. According to the Bureau of Labor Statistics, between 12%-40% of incumbent workers in this field hold a community college-level of educational attainment; "some college, no degree," and an "associate degree."

*Exhibit 8: Typical entry-level education, educational attainment, and minimum advertised education requirements, , Inland Empire/Desert Region (** includes all of California)*

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school or vocational training	Associate degree	Bachelor's degree or higher
Bachelor's Degree-level						
Information Security Analysts	Bachelor's degree	27%	*365*	24%	9%	67%
Software Developers and Software Quality Assurance Analysts and Testers	Bachelor's degree	12%	*92*	2%	9%	89%

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school or vocational training	Associate degree	Bachelor's degree or higher
Computer Network Architects**	Bachelor's degree	37%	*2,258*	5%	5%	90%
Computer Systems Analysts**	Bachelor's degree	21%	*1,634*	5%	27%	68%
Database Administrators and Architects**	Bachelor's degree	19%	*589*	9%	4%	87%
Community College-level						
Computer User Support Specialists	Some college, no degree	40%	*104*	43%	26%	31%
Network and Computer Systems Administrators	Bachelor's degree	39%	*104*	11%	6%	83%
Computer Network Support Specialists**	Associate degree	40%	*419*	16%	19%	65%

Source: Emsi 2022.2, Burning Glass – Labor Insights
*Percentage of incumbent workers with a Community College Award or Some Postsecondary Coursework
**California job advertisement information

Exhibit 9 displays the work experience typically required to enter each occupation and the real-time work experience requirements from employer job ads. Job ads reveal that employers value previous work experience; between 24% and 58% of employers sought cybersecurity workers with three to five years of work experience.

Exhibit 9: Work experience required and real-time work experience requirements, Inland Empire/Desert Region (includes all of California)*

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of job ads	0 – 2 years	3 – 5 years	6+ years
Bachelor's Degree-level					
Information Security Analysts	Less than five years	333	19%	39%	42%
Software Developers and Software Quality Assurance Analysts and Testers	None	*94*	21%	36%	43%
Computer Network Architects*	Five years or more	*2,467*	6%	43%	51%
Computer Systems Analysts*	None	*1,696*	37%	39%	24%
Database Administrators and Architects*	None	*671*	11%	41%	48%

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of job ads	0 – 2 years	3 – 5 years	6+ years
Community College-level					
Computer User Support Specialists	None	*127*	68%	24%	8%
Network and Computer Systems Administrators	None	*100*	19%	58%	23%
Computer Network Support Specialists*	None	*477*	18%	50%	32%

Source: Emsi 2022.2, Burning Glass – Labor Insights
*California job advertisement information

Certifications

Exhibit 10 displays the certifications most frequently required or requested by employers in job advertisements. The Certified Information Systems Security Professional (CISSP) certification was the most frequently requested certification for cybersecurity occupational group throughout the state over the last twelve months. The CISSP, issued by the nonprofit membership association for cybersecurity professionals, ISC², verifies that professionals can effectively design, implement, and manage a cybersecurity program (ISC², 2022). For more information about this certification, please visit the ISC² website (ISC², 2022).

Exhibit 10: Certifications most frequently required by employers, Inland Empire/Desert Region (includes all of California)*

Occupation	Certification
Bachelor's Degree-level	
Information Security Analysts *(n=273)*	• Certified Information Systems Security Professional (CISSP) • Certified Information Security Manager (CISM) • The SANS Institute Global Information Assurance Certification (GIAC) • Certified Information Systems Auditor (CISA) • Security Clearance • CompTIA Security+
Software Developers and Software Quality Assurance Analysts and Testers *(n=40)*	• Security Clearance • Certified Secure Software Lifecycle Professional (CSSLP) • Microsoft Certified Solutions Developer (MCSD) • Cisco Certified Network Associate (CCNA)
Computer Network Architects* *(n=2,428)*	• Cisco Certified Network Professional (CCNP) • Cisco Certified Network Associate (CCNA) • Cisco Certified Internetwork Expert (CCIE) • Security Clearance • Certified Information Systems Security Professional (CISSP) • CompTIA Security+

Occupation	Certification
Computer Systems Analysts* *(n=827)*	• Certified Information Systems Security Professional (CISSP) • Security Clearance • Certified Information Systems Auditor (CISA) • IT Infrastructure Library (ITIL) Certification • CompTIA Security+
Database Administrators and Architects* *(n=267)*	• Security Clearance • The SANS Institute Global Information Assurance Certification (GIAC) • CompTIA Security+ • Certified Information Systems Security Professional (CISSP) • Cisco Certified Network Associate (CCNA)
Community College-level	
Computer User Support Specialists *(n=81)*	• Microsoft Certified Professional (MCP) • Certified A+ Technician • Certified Information Systems Security Professional (CISSP) • CompTIA Security+ • CompTIA Network +
Network and Computer Systems Administrators *(n=90)*	• Cisco Certified Network Associate (CCNA) • Security Clearance • CompTIA Security+ • Cisco Certified Network Professional (CCNP)
Computer Network Support Specialists* *(n=393)*	• Security Clearance • Cisco Certified Network Associate (CCNA) • CompTIA Security+ • Cisco Certified Network Professional (CCNP) • CompTIA Network+

Source: Burning Glass – Labor Insights
*California job advertisement information

Student Completions and Programs Outcomes

Due to the broad application of cybersecurity principles, individuals entering the field may receive training from various regional community college programs. This section contains completion data from regional cybersecurity programs, which currently utilize the following program codes: information technology, general (TOP 0701.00), computer information systems (0702.00), computer infrastructure and support (0708.00), computer networking (0708.10), computer support (0708.20), industrial and transportation security (2105.30), and forensics, evidence, and investigation (2105.40). Combined, regional programs generated a potential supply of 104 cybersecurity-trained workers annually.

Information Technology, General (0701.00): Information technology concepts, theories, principles, methods, and related computer capabilities and applications related to business, technical, and scientific problems (Taxonomy of Programs, 2012).

Computer Information Systems (0702.00): General programs in data and information storage and processing, including hardware, software, basic design principles, and user requirements (Taxonomy of Programs, 2012).

Computer Infrastructure and Support (0708.00): Network and operation system design and administration, including certification preparation (Taxonomy of Programs, 2012).

Computer Networking (0708.10): Principles of local, metropolitan, and wide area computer networking design, installation, maintenance, and troubleshooting (Taxonomy of Programs, 2012).

Computer Support (0708.20): Preparation to provide technical assistance to computer system users. May include use of computer hardware and software, printing, installation, word processing, electronic mail, and operating systems (Taxonomy of Programs, 2012).

Industrial and Transportation Security (2105.30): Techniques involved in providing security services to institutions, government entities, and the general public. Includes instruction related to airport and airline security (Taxonomy of Programs, 2012).

Forensics, Evidence, and Investigation (2105.40): Theories, principles, and techniques of forensic science and investigation in the justice system (Taxonomy of Programs, 2012).

For a complete analysis of cybersecurity educational supply in the region, programs similar in nature to cybersecurity but assigned to different TOP codes were analyzed. The programs included in the supply analysis have been limited to those that directly lead to cybersecurity employment opportunities. Exhibit 11 displays the cybersecurity-related program titles, TOP codes, and the types of awards offered by the colleges in the region.

Exhibit 11: Regional cybersecurity programs

College	Program Title	Program Code (TOP Code)	Award Offered
Barstow	Computer and Cyber Security Specialist	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
	Computer and Network Specialist (Network+)	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
Chaffey	Cybersecurity Analyst	Computer Infrastructure and Support (0708.00)	Certificate (16<30 semester units)
	Cybersecurity Defender	Computer Infrastructure and Support (0708.00)	Certificate (16<30 semester units)

College	Program Title	Program Code (TOP Code)	Award Offered
	Cybersecurity Professional	Computer Infrastructure and Support (0708.00)	Associate Degree
	Computer Support Technician (A+ Certification Preparation)	Computer Support (0708.20)	Certificate (8<16 semester units)
Copper Mountain	Computer Security Specialist	N/A	Certificate of Proficiency
Crafton Hills	Cybersecurity Specialist	Computer Infrastructure and Support (0708.00)	Certificate (16<30 semester units)
	Cisco Certified Network Associate	Computer Networking (0780.10)	Certificate (16<30 semester units)
Moreno Valley	Information Technology (IT) Cybersecurity	Computer Infrastructure and Support (0708.00)	Associate Degree
	IT Technician Pathway: Cybersecurity Analyst	Computer Infrastructure and Support (0708.00)	Certificate (16<30 semester units)
	IT Technician Pathway: Cybersecurity Healthcare Specialist	Computer Infrastructure and Support (0708.00)	Certificate (16<30 semester units)
	IT Technician Pathway: Cybersecurity Specialist	Computer Infrastructure and Support (0708.00)	Certificate (8<16 semester units)
	Computer Maintenance and Security	Computer Support (0708.20)	Noncredit Program
	Emergency Management and Homeland Security - Cybersecurity	Industrial and Transportation Security (2105.30)	Associate Degree, Certificate (30<60 semester units)
Riverside	Cyber Defense	Computer Infrastructure and Support (0708.00)	Associate Degree
	Information Security and Cyber Defense	Computer Networking (0708.10)	Certificate (30<60 semester units)
	Cisco Networking	Computer Networking (0708.10)	Certificate (16<30 semester units)
	Amazon Web Services (AWS) Cloud Computing	Computer Networking (0708.10)	Certificate (16<30 semester units)
	Information Systems: Cyber-Skills	Computer Networking (0708.10)	Noncredit Program
	Digital Forensic Investigations	Forensics, Evidence, and Investigation (2105.40)	Certificate (16<30 semester units)
San Bernardino	Digital Forensics	Information Technology, General (0701.00)	Certificate (16<30 semester units)
	Android Application Security Support Specialist	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
	Information Security and Cyber Defense	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
	iOS Application Security Support Specialist	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
	Web Application Security Support Specialist	Computer Information Systems (0702.00)	Certificate (16<30 semester units)
	Computer Support Specialist	Computer Support (0708.20)	Certificate (16<30 semester units)

Source: COCI, Community College Catalogs 2021-22/2022-23

Exhibit 12 displays the average annual credentials conferred from cybersecurity training programs in the Inland Empire/Desert Region. Please note that the combination of completions from various training programs is intended to help assess the potential supply of cybersecurity workers and does not provide an exact measure of trained cybersecurity workers. These completion numbers do not reflect all completions for each TOP code included, just the programs related to cybersecurity within each TOP code.

Exhibit 12: Annual average community college credentials for programs related to cybersecurity

Programs Related to Cybersecurity	CCC Annual Average Credentials, Academic Years 2018-21
0702.00 – Computer Information Systems	
San Bernardino	
Certificate (16<30 semester units)	0
Computer Information Systems Total	**0***
0708.00 – Computer Infrastructure and Support	
Chaffey	
Associate Degree	7
Certificate (16<30 semester units)	13
Riverside	
Associate Degree	3
Computer Infrastructure and Support Total	**23**
0708.10 – Computer Networking	
Chaffey	
Certificate (16<30 semester units)	19
Riverside	
Certificate (16<30 semester units)	32
Noncredit	17
Computer Networking Total	**49**
0708.20 – Computer Support	
Chaffey	
Certificate (8<16 semester units)	8
Moreno Valley	
Noncredit	4
San Bernardino	
Certificate (16<30 semester units)	1
Computer Support Total	**13**
Cybersecurity Programs Total	**104**

Source: LaunchBoard, MIS Data Mart, COCI
*San Bernardino Valley College issues one 16 to <30 semester unit certificate in the 2019-20 academic year.

The Classification of Instructional Programs (CIP) computer and information systems security (CIP 11.1003) program provides the training most closely related to cybersecurity. The computer and information systems security program prepares individuals to assess the security needs of computer and network systems, recommend safeguard solutions, and manage the implementation and maintenance of security devices,

systems, and procedures. This includes instruction in computer architecture, programming, and system analysis; networking; telecommunications; cryptography; security system design; applicable law and regulations; risk assessment and policy analysis; contingency planning; user access issues; investigation techniques; and troubleshooting (CIP, 2022). While California Baptist University offers a bachelor's degree program that utilizes this program code, zero awards have been issued from this program over the last three academic years.

Recommendation

The seven community college programs that may prepare students for cybersecurity employment include information technology, general (TOP 0701.00), computer information systems (0702.00), computer infrastructure and support (0708.00), computer networking (0708.10), computer support (0708.20), industrial and transportation security (2105.30), and forensics, evidence, and investigation (2105.40). These programs provide the knowledge, skills, and abilities that prepare students for employment in three community college-level occupations and five bachelor's degree-level occupations. This report's educational supply and employment demand portions focus solely on the community college-level jobs students will likely obtain after completing a community college cybersecurity program in the Inland Empire/Desert Region.

The community college-level cybersecurity occupational group is expected to have 523 annual job openings and increase employment by 8% over the next five years. The median hourly earnings for the community college-level cybersecurity occupations are above the statewide living wage standard ($21.82 per hour), indicating that at least 50% of workers in this occupational group earn a living wage. Over the last twelve months, 301 community college-level cybersecurity job ads were posted in the region. Job advertisements indicate that regional cybersecurity workers willing to commute out of the local region may find greater employment opportunities.

Combined, programs that prepare students for employment as cybersecurity workers have issued 104 awards annually over the last three academic years. Non-community college postsecondary education providers in the region have not issued awards in programs related to cybersecurity over the previous three academic years.

The Centers of Excellence recommends expanding community college cybersecurity programs to meet the regional need for more workers. Any college considering cybersecurity programs should partner with local four-year universities to ensure their programs are transferable. Students holding a bachelor's degree, in addition to an associate degree and certificates, will have increased access to in-demand and high-wage cybersecurity employment opportunities in the region.

Contact
Michael Goss
Paul Vaccher

Centers of Excellence, Inland Empire/Desert Region
michael.goss@chaffey.edu
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References

Burning Glass Technologies. (2022). *Labor Insights/Jobs*. Retrieved from https://www.burning-glass.com/

Burning Glass Technologies. (2022). *Labor Insights (US) – Burning Glass Filters*. Retrieved from https://help.burning-glass.com/en/articles/4419839-labor-insight-us-burning-glass-filters

California Community Colleges Chancellor's Office. (2022). *Chancellor's Office Curriculum Inventory (COCI), version 3.0*. Retrieved from https://coci2.ccctechcenter.org/programs

California Community Colleges Chancellor's Office Management Information Systems (MIS) Data Mart. (2022). *Data Mart*. Retrieved from https://datamart.cccco.edu/datamart.aspx

California Community Colleges Chancellor's Office, Curriculum and Instructional Unit, Academic Affairs Division. (2012). *Taxonomy of Programs, 6th Edition, Corrected Version*. Retrieved from https://www.cccco.edu/-/media/CCCCO-Website/About-Us/Divisions/Digital-Innovation-and-Infrastructure/Research/Files/TOPmanual6200909corrected12513.ashx?la=en&hash=94C709CA83C0380828415579395A5F536736C7C1

Carnevale, A. P., Jayasundera, T., & Repnikov, D. (n.d.). Understanding Online Job Ads Data. Retrieved from https://cew.georgetown.edu/wp-content/uploads/2014/11/OCLM.Tech .Web .pdf

Cybersecurity & Infrastructure Security Agency (CISA). (2019). *What is cybersecurity?* Retrieved from https://www.cisa.gov/uscert/ncas/tips/ST04-001

CyberSeek (2022). *What is cybersecurity?* Retrieved from https://www.cyberseek.org/index.html

Economic Modeling Specialists International (Emsi). (2022). *Datarun 2022.2*. Retrieved from https://www.economicmodeling.com/

Glasmeier, A. K. (2022). Massachusetts Institute of Technology. Living Wage Calculator. *Living Wage Calculation for California*. Retrieved from https://livingwage.mit.edu/states/06

(ISC²). (2022). *Become a CISSP – Certified Information Systems Security Professional*. Retrieved from https://www.isc2.org/Certifications/CISSP

Labor Market Information Division. Employment Development Department of California. (2022). *Detailed Occupational Guides*. Retrieved from https://www.labormarketinfo.edd.ca.gov/OccGuides/Search.aspx

National Center for O*NET Development. (2022). *O*NET OnLine*. Retrieved from https://www.onetonline.org/

National Center for Education Statistics (NCES). The Classification of Instructional Programs (CIP). (2022). *Detail for CIP Code 11.1003*. Retrieved from https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cip=11.1003

National Initiative for Cybersecurity Careers and Studies (NICCS). Cybersecurity and Information Security Agency (CISA). (2021). *Workforce Framework for Cybersecurity (NICE Framework)*. Retrieved from https://niccs.cisa.gov/workforce-development/cyber-security-workforce-framework

Appendix: Occupation definitions, sample job titles, five-year projections, and earnings for cybersecurity occupations

Occupation Definitions* (SOC code), *Education and Training Requirement, Community College Education Attainment

Bachelor's Degree-level

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: Applications Analyst, Business Systems Analyst, Computer Analyst, Computer Systems Analyst, Computer Systems Consultant, Information Systems Analyst (ISA), Information Technology Analyst (IT Analyst), System Analyst, Systems Analyst

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 21%

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: Information Security Officer, Information Security Specialist, Information Systems Security Analyst, Information Systems Security Officer (ISSO), Information Technology Security Analyst (IT Security Analyst), Network Security Analyst, Security Analyst, Systems Analyst

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: Less than five years
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 27%

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: Design Engineer, Network Analyst, Network and Security Engineer, Network Consultant, Network Systems Consultant, Networking Systems and Distributed Systems Engineer, Solutions Architect, Telecommunications Analyst

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: Five years or more
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 37%

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 Administration Manager, Database Administrator (DBA), Database Analyst, Database Coordinator, Information Systems Manager, System Administrator, Data Officer, Database Analyst, Database Architect, Database Consultant, Database Developer, Database Programmer, Information Architect, Information Modeling Engineer Specialist, Information Technology Architect (IT Architect), System Engineer

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 19%

Software Developers and Software Quality Assurance Analysts and Testers (15-1256)

Research, design, and develop computer and network software or specialized utility programs. Analyze user needs and develop software solutions, applying principles and techniques of computer science, engineering, and mathematical analysis. Update software or enhance existing software capabilities. May work with

computer hardware engineers to integrate hardware and software systems, and develop specifications and performance requirements. May maintain databases within an application area, working individually or coordinating database development as part of a team. Develop and execute software tests to identify software problems and their causes. Test system modifications to prepare for implementation. Document software and application defects using a bug tracking system and report defects to software or web developers. Create and maintain databases of known defects. May participate in software design reviews to provide input on functional requirements, operational characteristics, product designs, and schedules.

Sample job titles: Application Developer, Application Integration Engineer, Developer, Infrastructure Engineer, Network Engineer, Software Architect, Software Developer, Software Development Engineer, Software Engineer, Systems Engineer, Application Integration Engineer, Computer Consultant, Information Technology Analyst (IT Analyst), Product Assurance Engineer, Quality Assurance Analyst (QA Analyst), Software Quality Assurance Engineer (SQA Engineer), Software Quality Engineer, Software Test Engineer, Systems Engineer, Test Engineer

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 12%

Community College-level

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: Computer Network Specialist, IT Consultant (Information Technology Consultant), Network Specialist, Network Support Specialist, Network Technical Analyst, Network Technician, Personal Computer Network Analyst, Systems Specialist

Entry-Level Educational Requirement: Associate degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 40%

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: Computer Specialist, Computer Support Specialist, Computer Technician, Desktop Support Technician, Help Desk Analyst, Help Desk Technician, Information Technology Specialist (IT Specialist), Support Specialist, Technical Support Specialist

Entry-Level Educational Requirement: Some college, no degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 40%

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: Information Analyst, Information Systems Manager (IS Manager), Information Technology Specialist (IT Specialist), LAN Specialist (Local Area Network Specialist), Local Area Network Administrator (LAN Administrator), Network Administrator, Network Coordinator, Network Manager, Systems Administrator

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Work Experience: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 39%

Appendix: Methodology

Exhibit 12 displays the average annual California Community College (CCC) awards conferred during the three academic years between 2018 and 2021 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 variations that might be present in a single year.

Job ad 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 ads often do not reveal employers' hiring intentions; it is unknown if employers plan to hire one or multiple workers from a single online job posting or collecting resumes for future hiring needs. A closed job ad may not be the result of a hired worker.

Table 1. 2021 to 2026 job growth, wages, entry-level education, training, and work experience required for the cybersecurity occupational group in the Inland Empire/Desert Region (Riverside and San Bernardino Counties combined)

Occupation (SOC)	2021 Jobs	5-Year Change (New Jobs)	5-Year % Change (New Jobs)	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage (10th to 90th percentile)	Median Hourly Wage (50th percentile)	Average Annual Earnings	Entry-Level Education & On-The-Job-Training	Work Experience Required
Software Developers and Software Quality Assurance Analysts and Testers (15-1256)	5,283	844	16%	576	$24.57 to $81.34	$46.91	$104,300	Bachelor's degree & None	None
Computer Systems Analysts (15-1211)	2,405	172	7%	206	$25.88 to $65.33	$41.87	$92,700	Bachelor's degree & None	None
Computer Network Architects (15-1241)	985	33	3%	66	$27.42 to $84.90	$55.29	$115,100	Bachelor's degree & None	5 years or more
Database Administrators and Architects (15-1245)	571	59	10%	55	$23.94 to $76.22	$48.06	$101,100	Bachelor's degree & None	None
Information Security Analysts (15-1212)	440	76	17%	49	$36.32 to $83.67	$58.79	$123,200	Bachelor's degree & None	Less than 5 years
Bachelor's Degree-level Total	**9,683**	**1,184**	**12%**	**952**	**-**	**-**	**-**	**-**	**-**
Computer User Support Specialists (15-1232)	3,305	286	9%	305	$17.33 to $46.72	$27.85	$63,000	Some college, no degree & None	None
Network and Computer Systems Administrators (15-1244)	1,727	107	6%	136	$27.10 to $63.16	$41.63	$89,500	Bachelor's degree & None	None
Computer Network Support Specialists (15-231)	874	82	9%	82	$20.19 to $47.46	$28.45	$66,400	Associate's degree & None	None
Community College-level Total	**5,906**	**475**	**8%**	**523**	**-**	**-**	**-**	**-**	**-**
Total	**15,589**	**1,659**	**11%**	**1,475**	**-**	**-**	**-**	**-**	**-**

Source: Emsi 2022.2