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Software Engineering in the Networking Industry

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According to the Bureau of Labor Statistics, the job outlook for Software Developers for the years 2012 to 2022 shows an increase of 22 percent where the “average growth rate for all occupations is 11 percent” (2014). The Bureau of Labor Statistics also cites the job outlook for Computer Network Architects at 15 percent growth rate and Network and Computer Systems Administrators at 12 percent growth rate (2014), which are above the average rate of 11 percent. The field of Software Engineering is broad and touches areas such as operating systems, video games and, mobile-apps, and what ties them together is software. Software interfaces with many aspects of computer hardware such as networking equipment that allows computers to exchange data. When Google is looking for a Networking Software Engineer, they are looking for an engineer that can create products that “handle information at the scale of the web” (Google, 2014). Networking software engineers work with network management systems and are in charge of designing, implementing, simulating and ensuring the performance of these systems. Google is not the only company seeking these types of software engineers. Some of the other major companies in this field are HP, Cisco Systems, Microsoft, IBM, Aruba, Alcatel-Lucent and Juniper Networks. A career in Software Engineering with a degree and background in Computer Science and Information technology supplies the demand for engineers to support the growing software and network industries for companies like Google and Juniper Networks

The increasing need of technological and networking services has put a greater demand of Software Engineers in the technical industry. Alyson Shontell wrote that “[e]ngineering talent is scarce, so companies are willing to pay big bucks to keep them happy” (Shontell, 2013) in her article “The 25 Best-Paying Companies for Software Engineers” for Business Insider news website. According to Shontell, the top 5 paying companies are Juniper Networks, Google,

Twitter, Facebook, and Apple. All of these companies rely on networks to maintain their business and increase their social medial outreach. While the 5 companies maybe be “brand” name companies that provide many services, Juniper Networks specifically provides services in creating and implementing networking equipment along with their main competitor, Cisco Systems.

Juniper Networks employs more than 9,400 employees and, their main offices are located in Sunnyvale, California. The location is in the Silicon Valley of California where many technology start-ups were created to support a growing technological industry in the second half of the 20th century. The company holds international offices in Japan, Netherlands, Cayman Islands, Barbados, United Kingdom, Germany, France, Australia, Hong Kong, and India. In 2014, Fortune Magazine listed Juniper Networks on their Fortune 500 list. (“Fortune 500 2014,” 2014) The rise of Juniper Networks began in 1996 by Pradeep Sindhu, a Principle Scientist and Distinguished Engineer at Xerox’s Palo Alto Research Center (“Pradeep Sindhu,”2014), Dennis Ferguson from MCI Communications Corp., and Bjorn Liencre from Sun Microsystems. Venture capital firm Kleiner Perkins Caufield & Byers funded then startup Juniper Networks and by 1997 had received \$40 million from investors. (Heskett, 1997)

The products and services offered by Juniper Networks, according to their website, include:

- Identity and Policy Control
- Network Edge Services
- Network Management
- Network Operating System
- Routers

- Security
- Software Defined Networking
- Switches
- Wireless

In addition to the products, Juniper offers services in network implementation to “[a]ssess, design and plan your network” and, “[d]eploy your new or upgraded network and security system” or to just “[k]eep your network up and running.” (“Services”, 2014) Similarly to many of the competitors in the networking industry, Juniper offers training and certifications for professionals on Juniper technologies and also supports an “ongoing relationship between academic institutes and Juniper Networks to support a range of technology studies.” (“Training,” 2014) This type of alliance helps foster growth in academic institutes’ programs that specialize in engineering, software development and other technical fields as well as providing insight on the industry’s demands in the education of future software engineers. For example, the steering committee for the Computer Science curricula for 2013 was a joint task force of the Association for Computer Machinery and the IEEE-Computer Society, which held members from national and international academic institutes, companies such as Microsoft and ABB Corporation and also received input from companies including IBM, Google, NVIDIA, and Intel. Industry input into current computer science and information technology curriculums in accredited academic institutions is important in the training and learning of prospective software engineers. (Curricula, 2013)

The current executive leadership team of Juniper Network has a range of executives and engineers with a diverse set of backgrounds, experiences and, education. Shaygan Kheradpir, the CEO as of January 2014, previously served as Chief Information and Technical Officer at

Barclays PLC and Executive Vice President and Chief Information and Technical Officer at Verizon Communications. Kheradpir's experience at Barclay's included overseeing "all bank operations in retail, cards, corporate, wealth and investment banking across 50 countries, with a focus on transforming Barclays' cost structure and driving product innovation" ("Shaygan Kheradpir", 2014). At Verizon Communications he over saw the "development and implementation of national platforms for Verizon's all-fiber network (FiOS), arguably one of the largest infrastructure programs in U.S. history," ("Shaygan Kheradpir", 2014). Kheradpir attended Cornell University where he received his Bachelor's, Master's and Doctorate degrees.

The former CEO and founder of Juniper Networks, Pradeep Sindhu, is also still an active part of the executive leadership team where he serves as the Vice Chairman of the Board and Chief Technology Officer. Sindhu's main responsibility is to map out the future product development for Juniper Networks. As CEO after the establishment of Juniper Networks, he lead a team to design and development of the M40 Router, the first product released by Juniper and the product that brought notice to Juniper as a networking company alongside Cisco Systems. Sindhu, before Juniper Networks, was a Scientist and Engineer at Xerox where his work eventually lead to the successful products from Sun Microsystems. He holds a Bachelor's degree from the Indian Institute of Technology in electrical engineering, a Master's degree from University of Hawaii as well as a Master's and Doctorate's degree in Computer Science from Carnegie Mellon University. ("Pradeep Sindhu", 2014)

Juniper Networks entered the industry of networks and networking technology with the M40 router in 1998, this began the 'M-series' of routers which are primarily multiservice edge routers. Juniper Network's other products include the T-Series (large core routers), E-Series (broadband edge routers), MX-Series (Ethernet service routers), LN Series (mobile and military

applications) and J-Series Routers (enterprise routers) which provide a large market for routers for different uses. Juniper also offers products in service of network security, including VPN (virtual private network) services for companies and their employees. VPN, or virtual private network, is an extension of a private network into a public network. For example, employees may use VPN access to connect to their work email from home and maintain the same security standard as being in the office.

From 2006 to 2011 Juniper Networks was a continual winner of the Association of Support Profession's (ASP) ten best web support sites award. The ASP evaluated companies on various criteria including knowledgebase, customer experience, overall site usability and interactive features. (ASP, 2014) In 2009 Juniper Networks appeared on the Fortune 100 best companies to work for, (100 Best Companies to Work For, 2009) and Louis Columbus wrote in his article on Forbes website, "Ranking Glassdoor's 25 Highest Paying Companies for Software Engineers" that "Juniper Networks leads all 25 companies tracked in the study with an average base salary of \$159,999." (Columbus, 2013) The Juniper Networks job listing has over 355 open positions in the United States and internationally where 94 of them are in category of Software Engineering.

According to Juniper Network's website, "[t]he cloud isn't just big today. It's the next evolution of IT" (2014). The growing trend of cloud software to share data, to increase productivity, has put an increased need for networks to support to data transfer. Many companies use cloud or drop box software along with VPN so that their employees are not limited to their cubicle or office to complete their work. Software Engineers that can design, implement and maintain these systems are in demand.

Juniper Networks currently has a job listing for a Sr Software Engineer SSLVPN. SSLVPN is an acronym that stands for Secure Sockets Layer Virtual Private Network. While the qualifications for this position surpass a Junior CSIT College student, it does give insight to the experience and qualifications that would need to be achieved. . This type of network connection allows users to access a private network, such as a company intranet or work email, through a secure pathway. (Northwestern University Information Technology, n.d.) VPN software allows users to work from home or off-site, and have access to the network as if they were in the office. A SSLVPN Software Engineer's responsibility would be to have an understanding of internet protocols, or the rules of formatting data to be shared or sent to a destination, security protocols, or providing secure ways to transfer data, and also be up to date on the industry trends in web security and web applications. For example, the 2014 Cloud security breach caused many questions on the safety of Cloud software such as iCloud, Google Drive and Dropbox. (Murray, 2014) A SSLVPN Software Engineer would have to evaluate the safety of the company's products in terms of data and file sharing.

The job description posted by Juniper Networks requires proficiency in the programming languages of C, C++, and, Perl as well as knowledge of networking, SSL, IPSec, and TCP/IP which are internet security protocols, or how the data is encrypted and passed through secure channels. The educational requirements include “[a] Bachelor of Science Degree in Computer Science, Electrical / Electronics Engineering; or equivalent experience” (Juniper Career Site, n.d.).

The Computer Science and Information Technology program at California State University Monterey Bay is designed to give students “hands-on information technology practice.” (Carter, 2014) The curriculum includes classes in database systems, computer networks, internet

programming, software design, and projects such as Capstone and service learning that gives the student the ability to apply computer science theory and place it into practice by assisting the community with a technological need. The classes in this curriculum will add to a student's experience and development as a future Software Engineer, and hopefully a future SSLVPN Software Engineer at Juniper Networks. The CSIT curriculum is eleven classes to be taken over a period of 2 years and is designed for a transferring CSU student. However, there are certain classes that are not part of the curriculum but can be important in the field of computer science and can be taken separately and alongside the CSIT core classes. The planning of future classes must also take into account any previous classes and experience and whether additional instruction is needed in certain areas. At College of the Canyons I was able to complete C Programming, PHP Programming, Web Page Programming I & II, Web Page Design I & II and Microsoft Excel II. These classes are important because they are either pre-requisites to future classes or provide theory and understanding relating to other programming languages. C Programming is a language used to replace assembly language in some applications, it is a good starting language and has become a basis for other languages such as Objective-C, C++, C#, PHP and Java to name some examples. This class was important as an introduction to programming that was not web based and the concepts carried into C++ later on. PHP Programming is a programming language used in server-side web development. An example of server-side scripting is an HTML page that asks for user interaction, the requests are handled on the server-side instead of embedding scripts in the HTML page, this allows interaction of web pages with databases, for example. PHP was also a good introduction into object oriented programming, which is a dynamic way to program that allows for more features but also for data safety within the code. Examples of object oriented programming include C++, Java, JavaScript, C#, Perl and,

Python. Web Page Programming and Web Page Design were a great way to connect how simple web pages are built using HTML, CSS and graphics. The course used a combination of Adobe Photoshop, graphics editing, and Adobe Dreamweaver to create CSS style sheets to customize how the page looks and HTML to connect it all together. With Adobe Dreamweaver can also upload a finished website using FTP, or file transfer protocol, which is a way to upload files onto a host or server so that clients and customers can experience the finished website. At Los Angeles Mission College the computer science department has a better selection in the classes they offered and a better method of instruction for the more advanced languages. Java programming was my first introduction into an object-oriented program, and Java prepared me as well to apply the concepts learned to C++. Java and C++ can also support methods to read and write to text files, this allows for different types of programs to be written. For example, a program can read a text file and determine the word count by using string functions in Java and C++. Java also supports visual interfaces and is often used in mobile app development for Android. One of the early classes that computer science majors often take is Programming Logic, it is the basic breakdown and study of algorithms and applying logic to achieve a result. While it did not use an actual programming language and was concept based, pseudo code was used to simulate what a program might look like and Microsoft Visio was used to generate the flow charts of the algorithms. The key premise of the course was to teach problem solving, to break down a client request to pieces of a program, simulate the program in a flowchart and generate a pseudo code of a finished program. The logic based principles are key to learning any programming language and writing software. Another early programming course is Visual Basic and it is one of the easiest programs to learn. With any Visual Basic editing program, such as Microsoft Visual Studio, the visual interface can be quickly generated by dragging and dropping

objects on a screen such as text boxes and buttons, and the scripts associated with those objects can be simply written in. It is a step toward other programming languages and gaining practical experience of programming syntax and concepts.

Further classes were taken at Los Angeles Valley College such as Object Oriented C++ and Windows and Web Database Programming (in progress). Object Oriented C++ was a continuation of C++ but centered on more advanced topics such as classes and writing more advanced programs such as a simple ATM function where a user can deposit and withdraw money against their account balance or view their account balance. It is a course designed to use the advanced topics of C++ and classes such as inheritance and polymorphism to create a dynamic script. Windows and Web Database Programming is a course that uses C# or Visual Basic to create and program that can be run on an ASP.Net page. ASP, or action script pages, allows for HTML pages and websites to access and interact with databases using server-side scripting in C# or Visual Basic.

When I compared the courses I had completed, the courses I was going to complete and general job requirements for posted Software Engineering jobs, there were gaps in the learning. The courses that are in the curriculum will provide the training to be a successful Software Engineer, but in order to exceed the requirements and add to my knowledge base of software engineering, especially in networking, I will take additional courses such as Principles of Information Security can also be taken which focuses on a historical overview of security technology, current issues and how to implement information security systems. In the CSIT curriculum, CSIT 311 (Intro to Computer Networks, will cover the subjects of area networks, TCI/IP, network performance, high speed networking and internet and networking protocols. Additional classes to add to my programming language experience and knowledge base include C# at either LAVC or Foothill

College, and, JavaScript for Programmers at Foothill College where many computer science courses are offered as part of the distance learning (online) program. Foothill College also offers courses in Linux and Unix Shell programming and Perl Programming which are required for a network software engineer and very useful for a software engineer in general. Lastly, the place of the smartphone in the technical industry and the lives of many people increases the demand for app development and maintenance. Foothill College offers courses in Developing Applications for IOS and Writing Apps for the Android in Java which will provide the almost necessary experience and knowledge to create apps for today's popular smartphones. It does not take a Software Engineer or Computer Science major to create an idea for a mobile application, but the services of a Software Developer or Engineer will be needed for this growing industry.

Taking courses that provide programming experience and programming concepts builds on the programmer's ability to learn new languages and implement scripts successfully. Concept classes such as Algorithms or Programming Logic teach programmers how to apply logic to solve the problem and create a flow for the program so it can be implemented and used. To create a program without knowing why it will work is like using a math formula without knowing how it was derived. For example, the formula for the volume of a sphere is ($\frac{4}{3}\pi r^3$), as long as radius is given, the formula can be used. However, the derivation of this formula clearly shows why it works and how the variables interact with one another and this can be proven using basic calculus techniques and rotating a half-circle around the x-axis for form a three-dimensional sphere.

My career of a Business System's Analyst provides insight on how new systems are tested, implemented and maintained. When multiple systems interact with on another across multiple interfaces for reporting, inventory, calibration, and training records there is

troubleshooting involved when messages are not being processed successfully. Although this is not the career field I want, it is great experience to interact with a software development team and working together to find solutions to problems. These connections are important because a Software Developer can communicate to me recommendations and experiences in the industry so that preparations can be made to deal with new experiences.

College of the Canyons hosts a variety of workshops such as job interview training and resume writing to receive help from experts in those fields. The community colleges also host job fairs where you can meet and introduce yourself to small and large business in the Santa Clarita, San Fernando and North Hollywood areas and this will build connections within the industry in which a relationship can be built for the future. Various technical programs at the community college level such as STEM and MESA also help introduce STEM students to the industry, such as computer science, and give the students a chance to make connections through the programs as well.

The CSIT Service Learning and Capstone projects will provide the student a chance to apply what they have learned while helping the community at the same time. This is a way to create software to add to the student's portfolio as a demonstration of what the student knows and what the student has learned to apply. While I look forward to being employed as a Software Engineer after graduation from the CSIT program, I also plan to seek graduate programs to be competitive in the field of computer science and software engineering so that I can be a leader and create effective software solutions.

Juniper Networks is one example of a company that is seeking to employ Software Engineers. Software Engineers will typically need to have a background in computer science and information technology which can be achieved with a Computer Science or Computer Science

and Information Technology Degree. CSU Monterey Bay offers a comprehensive CSIT degree program that prepares students to become future software engineers with practical knowledge obtained in the curriculum courses and practical experience through service learning and capstone. The combination of a comprehensive CSIT Degree program and previous experience in programming will be important in the education and development of future software engineers to meet the demands of a growing technical industry.

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