

Career Pathways in System Administration

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Abstract

A Systems Administrator holds the responsibility of keeping an organization's systems and servers safe from hackers and viruses, while also keeping the network up-to-date and running efficiently. Additionally, a Systems Administrator provides support for an organization's user base. This paper will examine the in-depth specifics of a Systems Administrator and the industry, as well as the job qualifications and responsibilities.

Introduction

In the Information Technology (IT) field, a systems (or server) administrator is primarily responsible for creating and maintaining the computer systems that run the organization's information systems. In the research literature, systems administration is defined as the "design, running, and maintenance of human-computer communities" (Burgess, 2003, p. 1). These systems can range from smaller PC-based (x-86, x64, etc.) computers running MS Windows or Linux, to mainframes running specialized operating systems.

Responsibilities of Systems Administrators

Server (or System) Administrators include a group of individuals that are considered to be technical experts, responsible for large-scale, complex and high-risk environments requiring a vast understanding of general and specific networking information (Forsgren et al. 2016). According to Forsgren (2016), "Sysadmins have relied on direct communication with the servers and networks they are responsible for by using cryptic—but powerful and informative—command-line interfaces." Therefore, an organization's computer servers and networks are under their supervision, making them responsible for maintaining efficiency and safety, in addition to tracking information entering or exiting a secure network. Such responsibilities are done by performing daily tasks of upgrading and maintaining hardware and software, solving technical issues, overseeing activity levels, providing server security, and developing new system structures as needed (Field Engineer, 2021).

Server Administrators can obtain an associate's or bachelor's degree; however a bachelor's is preferred, along with a professional certification. The bachelor's degree can be in any of the following fields: Computer Science, Web Technology, Information Technology, or Network Administration (Bateman, 2013). There are further qualifications that can be beneficial when searching for employment in the field, such as Cisco Certified Network Professional or Cisco Certified Network Associate, Server+, Red Hat RHCE, and Microsoft Certified System Administrator (MCSA) (Bateman, 2013). Depending on the particular job at hand, it is not uncommon for an employer to require a minimum of three to five years of experience to be a qualified applicant (Bateman, 2013). Due to the daily inter-collaboration with various

departments and individuals, further personal attributes are also valuable within the field. For instance, analytical thinking, efficient problem solving and communication skills, multi-tasking abilities, and high quality professionalism (Field Engineer, 2021). In addition, physical fitness is also important due to the need to potentially work outdoors, at heights, or having to relocate equipment (Field Engineer, 2021).

Although Server Administrators can be employed at any job with servers or networks, they need to acquire knowledge in virtualization owing to the evolution of cloud computing (Field Engineer, 2021). According to Field Engineer (2021), the core concepts of PowerShell or DevOps, specifically, are of importance to those pursuing System Administration.

Atlassian (2016) defines DevOps as a “set of practices, tools, and a cultural philosophy that automate and integrate the processes between software development and IT teams.” Therefore, it is a software development and operations approach that helps make the development of new products faster and more efficient, while also easily maintaining existing deployments (*Why DevOps is Important? Benefits & Challenges Explained*, 2021). When a system administrator wishes to pursue the role of a DevOps professional, it is often doable and enjoyable due to the overlap of responsibilities and requirements. However, there is a set of crucial skills necessary in order to obtain roles in both such as, cloud computing, coding and scripting shells, continuous integration, configuration management, and forward-thinking deployment strategies (DevopsCurry, 2020).

Cloud administration is a new opportunity for system administrators because it allows businesses to outsource information technology necessities. Which in turn, leads to savings in cost of capital and ensures speed, performance, security and scalability (*What Is Cloud Computing? A Beginner's Guide | Microsoft Azure*. n.d.). Rather than eradicating system administrators, cloud services create new opportunities because companies still need them in order to manage the computer systems within the company. Therefore, cloud system administrators are responsible for managing and facilitating cloud services. The management of cloud services can fall either under the description of a system administrator, or under an entirely separate position (Frank, 2021). The development of cloud administration and similar jobs may allow for future system administrators to focus on more specific skills, leading to more productivity and less stress.

Current and Future Trends in Systems Administration

As previously discussed, DevOps is a practice that will alter the way system administrators operate in the future. DevOps is a combination of application development and IT operations. Where development is made up of software developers and IT operations are made up of system administrators. In turn, DevOps aims to bridge the gap between these two domains by utilizing an inter collaboration approach. By doing so, the communication between development and operations is improved, as well as productivity realization of up to 30% (Hussaini, 2014). In addition, there are higher efficiencies in the releases and there is reduced time to market (Hussaini, 2014). With that being said, many job postings for system administrators include DevOps in the description or list of desired skills. The prevalence of DevOps in the field suggests that future system administrators will work closer with development teams.

Automation is another aspect that seems to be supporting rather than threatening system administration. According to Gulenko et al (2020), Artificial Intelligence for IT Operations (AIOps) is the use of artificial intelligence to handle simple IT management tasks often performed by system administrators. For example, it can be used for automated anomaly detection, root cause analysis, and automated self-stabilizing. Automating some management has become increasingly necessary as businesses expand and the complexity of systems increases. System administrators and other IT professionals often have to resolve repetitive issues, wasting their time and productivity when automation could resolve the issue instead. In addition, some urgent issues can be solved immediately with AIOps rather than waiting on a system administrator to be available.

Despite the numerous advantages, AIOps may increase complexity for the system administrator, who now has to manage the AI as well as the systems themselves. When AI-supported administration fails, the system administrator must recognize the new issue, roll back the AI's attempted fixes, then address the original issue. Gulenko et al (2020) identifies levels to AIOps that provide the system administrator with varying amounts of control. At level 1, the human administrator handles issues and only uses the AI for implementation. At level 2, the AI helps suggest solutions, and the human administrator makes the final decision. At higher levels, the computer can select and implement solutions itself with some input from the human administrator. As AI improves, higher levels of AIOps can be implemented with less concern. However, AI is still faulty and not effective at higher levels (Gulneko et al., 2020). With that being said, AIOps is still being developed and it will still be some time before system administrators will need to manage AI more than they manage systems themselves.

Pay and Benefits

According to the U.S. Bureau of Labor Statistics (2019), system administration is a stable career with a median wage of \$84,810 as of 2020. Providing nearly \$40,000 above the average median wage. The median annual wages for network and computer systems administrators in the top industries fell within the higher end of \$80,000 for finance and insurance, information, management of companies and enterprises, and computer systems and design and related services. Relatedly, educational services wages were ranked at \$75,230.

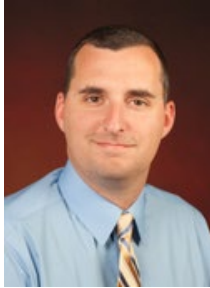
Job Outlook

The technological industry is a continuously growing field with consistent advancements. The U.S. Bureau of Labor Statistics (2019) estimates Server Administration job opportunities will increase a total of five percent from 2018 to 2028, offering an increase of more than 18,000 jobs. According to Hess (2020), that number doesn't include replacement jobs for more than 383,000 current system administrators. It is recommended for individuals to cross-train with an organization on additional aspects of IT such as, database administration, network administration, virtualization, cloud, project management, software development or management (Hess, 2020). Doing so increases the chances of employment outside of System Administration if necessary, as well as make the individual a more valuable and competent professional.

Interview with Chris Cahoe at Ball State University, Muncie, Indiana

Figure 1

Chris Cahoe, Director of UCS, Ball State



Chris Cahoe is the Director of Unified Communications at Ball State University. He assumed this position in 2019. Prior to that, he worked as the Assistant Director of Unified Communications Technology for seven years, and as the Enterprise Network Engineer for 8 years before that. He has a Bachelor of Science in Computer Technology/Computer Systems Technology from Ball State University. He was a Cisco Certified Design Professional, as well as a Cisco Certified Network Professional. Chris Cahoe was interviewed by graduate student researcher Brianna Bowles, B.S., and undergraduate researchers Jayci Wimmer and Dan Chepkwony on January 19, 2022. The following section presents the questions Mr. Cahoe was asked regarding his career and experiences in system administration.

1. What previous experiences prepared you for your current position?

“I started out working on computers as a hobby and then getting into desktop support, as a high school and a young college kid, while working for what was UCS (University Computing Services) back in the day. We dealt with the random issues of patching and backups. Everything related to modern system administration” (C.Cahoe, personal communication, January 19, 2022).

“I spent a few days as a student computer room operator, and about a week and a half as a help desk operator. That brief experience helped me throughout my whole career seeing what someone goes through at the help desk and from other perspectives within IT. It’s certainly a different perspective over what I do today. Help desk is interesting for the fact that you’re talking with customers who may not be comfortable with technology, and you’re trying to translate their issues to engineers. They need more details other than, “my application’s not working.” Can you not sign in? Is it not loading data? Help desk is a good middle position to translate from non-techies to techies. It’s an interesting spot to be in.” (C.Cahoe, personal communication, January 19, 2022).

2. What does a typical workday look like for you?

“The first responsibility is to review e-mails that might have come in overnight. Do I have any major issues that I have been notified about or any major issues that have come up? We have numerous monitoring systems that we will take a look through, do we see any major issues, do we see any minor issues, did something reboot unexpectedly. Reboots can happen so fast that we might not see an outage notification, so we’ll look specifically for those. And then, from a system administrator, are there any major patches or security issues we’ve been notified about, that sort of stuff. It’s a pretty quick daily check to make sure nothing is wrong and then it’s onto projects such as building or upgrading a server or building a new network. That’s a pretty typical day.” (C.Cahoe, personal communication, January 19, 2022).

“We have 24/7 operators in what would typically be considered a NOC. They have screens up where they’re constantly watching for issues after hours. If systems go down, or there is major alerts, they’ll submit tickets and direct it to the administrators or the engineers, that say ‘Hey, this popped up can you take care of it?’ That’s the typical day.” (C.Cahoe, personal communication, January 19, 2022).

“I would say fifty to sixty percent of my time is just spent coordinating what my staff is doing, answering their questions because sometimes they’re working on a project and they’ll need me to either provide feedback or I’ll have to get approval to purchase something. We can’t just say ‘Hey boss, I need \$5,000.’ It’s a write up that says why we need that \$5,000. What is it going to do? What are we going to gain from it? Will it save us more money down the road? I am still a hands-on administrator even though I’m managing people. I still manage the firewall, I still manage routers, and I still manage servers because I enjoy it. I legitimately enjoy doing that part. It’s just I don’t get to do as much of it like I used to” (C.Cahoe, personal communication, January 19, 2022).

3. What is your favorite part about your position?

“We have a large variety of systems in our group. We’re managing everything from unified communications which you would consider telephones, voicemails, contact center software to routers and switches and general server administration stuff. If you like server administration you can fit into our group. If you like networking, you could fit into our group. We also manage the video security cameras on campus. If you like those types of things, if you like video, if you like photography type stuff, that would hit home with you because you’re thinking through ‘Where do I place the camera best to get the best lighting and get the best shot,’. Just the variety I guess. The variety of what you could do in systems administration would be pretty incredible” (C.Cahoe, personal communication, January 19, 2022).

4. Are there any incentives, such as compensation, provided in your position?

“Nothing beyond what a typical Ball State employee gets. There’s no additional compensation. I am on call 24/7, so I do have a cell phone. I don’t know if that’s always

considered extra compensation because when you're woken up at three in the morning with an emergency, it doesn't feel like extra compensation. If you are considered on call 24/7, then you would have a cell phone. Again, not always considered a good thing" (C.Cahoe, personal communication, January 19, 2022).

5. What challenges do you encounter?

"Well, in my opinion the number one challenge right now is the IT security battle between keeping your system up and keeping users happy, and then protecting it from people who are interested in exploiting you. One of our vendors, Kronos, was essentially attacked with ransomware and was compromised. It took them a long time to get all of their customers back up. I think that really goes for most of IT. You have to keep systems patched. You have to stay on top of firewall entries and auditing. It's a constant battle, we are always under attack. One random person gets a backdoor on their computer. We had an issue last March where one device was compromised and then that was a jump off point for a group to start trying to exploit us. Thankfully, it was caught early. It's just one of those things where it's nonstop, and it's not just Ball State, it's everybody," (C.Cahoe, personal communication, January 19, 2022)

"I know this from my more networking-focused role: when you do maintenance to patch systems, we can't always keep the systems up. There are things we do where we have to take systems down briefly. It becomes a matter of scheduling. So what we've found historically is to notify users: 'Hey, we have to take the system down at this time,' and they're typically more understanding of the work that has to be done. Instead of just randomly upgrading systems and hoping no one notices an outage. You can't do that; we never want to potentially risk an outage during or close to school or work hours. We aim to do them over a break or you do it at two in the morning or six in the morning. What we have, for the most part, is a scheduled maintenance window from 9:00 PM on Saturday until noon on Sunday where a lot of the general patches for systems get done. The thing I've noticed is that [customers] are not always tied to the common work hours. You know something like 7:00 AM to 7:00 PM. For the most part there's always someone doing something. Especially at a place as large as Ball State. Some professor is in a classroom, and they're working on something important. And you don't want to disrupt that if you don't have to. So that's why you wait until these change windows or after hours if it's an emergency. We take it very seriously. We don't like causing issues for people," (C.Cahoe, personal communication, January 19, 2022).

6. What kinds of technology do you get to use as a System Administrator?

"From general IT monitoring, [redacted] is a primary product and there's different pieces of [redacted] we use. There's some that are more focused on servers and applications and others that are more networking type focused. We have a fairly large virtualization environment, so it's getting into the virtualized hosts, looking at them for their health and monitoring different virtual machines within the hosts and it's checking all of those, monitoring CPU, memory usage, disk storage usage" (C.Cahoe, personal communication, January 19, 2022)

“We use some other tools, like something called [redacted], which is from the network side. We use it to map our network usage across our major links. So we can just pull up a webpage at any time and monitor traffic throughput. We went away from MRTG but the product that we found that was best to replace it is called [redacted]. It’s a Solar Winds, Nagios type system. It does more than just graphing, it does SNMP monitoring, ping monitoring, and all that stuff” (C.Cahoe, personal communication, January 19, 2022).

“So we have monitoring tools: what’s up, what’s down, what needs to be addressed? We have systems administration tools to manage devices. Whether you’re pushing out images, patching, or doing backups. Obviously when you have hundreds of things to do, we try to be efficient with it, so you have all of these different tools that help you manage it faster” (C.Cahoe, personal communication, January 19, 2022).

“Teams is typically the team communication tool. For minor stuff it’s just email, but if there is some ongoing thread that we talk about then it’s going to be on Teams” (C.Cahoe, personal communication, January 19, 2022).

“One good thing to touch on is password management tools. We have a password management system where passwords can get stored and that way you have strong passwords that people don’t necessarily remember by heart. Also security analysis tools, I won’t disclose the tool, but we do have tools that are constantly doing threat assessments across all our systems. It’s going out, it’s scanning systems, it’s alerting if it detects a new vulnerability. If there’s a new vulnerability against Java, Apache, etc., the system will recognize that it’s vulnerable and let us know.” (C.Cahoe, personal communication, January 19, 2022).

7. What advice would you give someone who is interested in pursuing this career path?

“The biggest advice I would say is: learn. Try and figure out what you like, what you enjoy. Yeah-- obviously, in any career-- it doesn't matter what your career is. If you don't enjoy what you're doing, it's going to feel like work, and it's going to suck after a while. If you pick a career and you stay in that career for thirty or forty years, you better enjoy it. So if you like the phone side and the conferencing side, then maybe you should try and gravitate towards a position that focuses more on that. If you like staying in the background and patching servers and doing backups and then just a routine systems administration gig, just try and find that. This really goes for any career. Find that little niche in the field that you enjoy” (C.Cahoe, personal communication, January 19, 2022).

Conclusion

As the demand for IT workers increases, the field of systems administration becomes more attractive to students and potential workers. To compete in this field, a worker needs specialized training which can include a Bachelor's degree in Computer Science or Information Technology as well as some certifications such as Cisco or Microsoft. There are a number of subcategories for systems administration employment including computing server administration and Cloud administration. Additionally, there exists

many opportunities to cross-train and expand administration skills to include database administration, network administration and project management.

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