A Reflection of the IPconfigure Assembly Internship

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CYSE 368: Cybersecurity Internship

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Abstract

Cybersecurity as an industry has had an explosion in internship and career opportunities, from network administration to help desk representatives. Norfolk in particular has several unique cybersecurity internships opportunities, being positioned around several ports, banks, and learning institutions. IPconfigure, a global camera security company, is one of these organizations, having headquartered itself right next to the Old Dominion University's campus. One opportunity they provide is a Steelfin assembly internship, where interns build, configure, and troubleshoot servers that are utilized across the United States, as well as around the world.

Keywords: internship, cybersecurity, ipconfigure

Introduction

My IPconfigure internship has been an excellent experience, being my first time getting into a job that works within my field. To preface, I've lived in Norfolk for only 6 years. Being an Army brat, I've moved across the country. My family have always been avid bikers, taking the local trails to shopping centers and downtown areas. Norfolk has a main biking route, the Elizabeth River Trail, which takes travelers from the Naval Base all the way to Norfolk's baseball stadium. It was on this trail I first saw IPconfigure. The building stuck out, as it was surrounded by abandoned lots and warehouses. I immediately became curious, as at the time I was just getting into computer science and cybersecurity and recognized the ipconfig command plastered on their building. It was five years later I saw more than just their building. IPconfigure had a table at an ODU org fair, searching for those with skills in software development and hardware. After brief conversation, they implored me to try and get a job as a 'Steelfin' assembler. During a surprisingly short interview process, I got the job. My manager and I discussed what tasks I should try to accomplish during the internship program and settled upon four student learning outcomes. Those were:

- Learn how to assembler surveillance servers from scratch.
- Troubleshoot CPU, RAM, disk, and power supply issues.
- Work in all aspects of the hardware production cycle, including imaging and configuration.
- Learn about software production cycles, exposure to QA testing.

The first student learning outcome, or SLO, as my manager explained, would be my first and most important task. I would need to be able to be able to recognize hardware, understand it's

purpose, and properly install it into a server. On top of this, different wiring and ethernet standards, hardware generations, and RAID levels were topics that would require self-study to properly complete the job. The second SLO, as my manager explained, would build upon the first. Servers and their parts were bound to go awry, and it was up to me to ensure all corrective options were exhausted before the problem would be escalated to management. This involved tons of manual reading and having to understand various FAQs for different brands. After a while, troubleshooting becomes a 'sixth sense', where you're able to quickly isolate the problem and remedy the situation. Unironically, turning most off and on again fixes tons of issues.

Working in all aspects of the hardware production cycle involves more than just building servers. Not only do you have to build the servers, but rack them, set the right configurations, install the customers decided OS, but also box and pallet the order to be shipped to distributors nationwide. Lastly, learning about production cycles and QA testing. Quality assurance is mainly done by those in the support department, with there being a separation of powers to ensure assemblers aren't approving their own work. There are times, however, when support will teach assemblers how to doublecheck configurations and settings within the command line interface of both Linux and Windows servers respectively. In tandem with this, software developers will sometimes display how their work is completed, and how the underlying hardware effects the software. IPconfigure's Steelfin assembler internship has been a one-of-a-kind experience, providing me with skills and knowledge that I can and will carry into the cyber security field. This paper aims to cover the organization, the skills they have instilled within me, and some unique aspects of the business itself.

History and Initial Orientation

The history of IPconfigure is a fascinating one and is detailed during a lengthy but orderly orientation. Being founded in Norfolk in 2003, IPconfigure's founders sought to create a centralized camera solution, competing against clunky and unfriendly video monitoring solutions. The logo, an Orchid flower, was drawn on a napkin at the bar while deliberating the mission and goals of the company. The orchid they drew twenty-one years ago serves as the name of IPconfigure's main product line, Orchid VMS. VMS, or video management software, centralizes wireless and wired camera connection alike onto one platform. Selling itself as "Video Made Simple", Orchid VMS comes in a wide variety of different "flavors". There are different variants of the product, with enterprise, small business, and cloud options. More recently, IPconfigure has released a new version, Orchid Alto, which operates on a subscription-based model. Executives at the company believe that this is the future for most of the products, as subscription-based services lend themselves to a more consistent revenue stream. Not only does IPconfigure develop VMS software, but it also builds a wide variety of servers to meet the needs of end users. Maximizing compatibility, IPconfigure builds a wide variety of servers to integrate with legacy systems and new technology alike, having options for Windows, Linux, Unix, and CentOS operating systems. IPconfigure aims to be the "one stop shop" for not only VMS software needs, but for hardware as well. Originally, IPconfigure resided within the Innovation Research Center at Old Dominion University, where they operated for over a decade. Rapid growth and expansion forced the company to search for a larger facility, gaining gigantic new contracts with companies like Rite aid, McDonalds, and Family Dollar. Working with the City of Norfolk, IPconfigure began a renovation of the 20th century Linde Gas Factory on

Bowden's Ferry Road, which had sat abandoned for years. In the spring of 2020, IPconfigure officially moved locations into the new office, and has been headquartered there ever since.

Onboarding for IPconfigure was unlike any process I'd seen in the past. Normally, I would be introduced immediately into the work environment, and be given training first and foremost. IPconfigure first provided me with training manuals and videos to view before even stepping onto their campus. On my first day, I was introduced to human resources, who had a myriad of forms and paperwork for me to sign up front. Never before had I received things from a company I worked for, but the HR department had my uniform and other various orchid branded items, like books and pencils as an onboarding gifts. From there, I was taken to the support department, and given a few sensitive manuals pertaining to construction specifications and conduct while working the warehouse. Only after reading the material was I allowed to proceed into the warehouse and get be introduced to the assembly room. During the shift, I didn't build a server, I was instead introduced to all the materials I would be working with, their purpose, and how they fit into the server writ large.

Managerial Environment

The managerial culture has shifted since beginning my time at IPconfigure. Initially, the management team was very lackadaisical, not too concerned about pace or progress on server ticket orders. My supervisor, Mark Geraghty, was in charge of all assemblers; he ensured daily and weekly assembler tasks were completed, would document progress of orders, and placed requests for new tools or new parts. Mark was designated as the only line of communication between the assemblers and support, if an assembler had a question, comment, or request, it would be handled by Mark. There was very little stress about completion of orders, as the

assembler's pace kept up with order demand at the time. As time went on, the number of clients increased, and with it a greater demand from assembly. Mark required assistance as orders began stacking up, and he couldn't handle his support duties and assembly management simultaneously. To alleviate the pressure from Mark, a hardware specialist was tasked to assembly; the goal being to enhance production and streamline troubleshooting. The hardware specialist's name is Stephen Freedman, who had worked previously as an assembler, and has vast knowledge of troubleshooting hardware. He was placed not underneath Mark as a subordinate, but rather as first in line for questions. Being placed in the warehouse, Stephen would handle most of the issues, instead of directly going to Mark first for problems. If unable to remedy an issue, it would then be escalated to Mark. Stephen has been an invaluable asset to assembly, being witty, technically savvy, and able to fix any hardware problem in seconds due to his experience.

Management on a department level is handled by Ben Turner, head of support. Throughout the internship, there was very little interaction with Ben. He only met with assemblers during progress reports, where he would sit in on the meetings between Mark and the assembler. Ben would only step into the warehouse when things went awry, such as continuous mistakes on one issue, or multiple infractions of the dress code. Seldom being around, he left most of the enforcement and delivery of announcements to Mark and Stephen.

Major Work Duties

As a Steelfin Assembler, the main work duty is the entire server production cycle. This production cycle can be broken down into three distinct subdomains. Prepwork and assembly, racking and imaging, and boxing and 'palleting'. Prior to doing any of this, however, it is

important when getting into the warehouse to ask the supervisor or hardware specialist if there are any extraneous tasks that need to be completed on top of production. On a normal day, orders are prepared by the warehouse manager and his team, giving assemblers order sheets with all parts and customer information, called “bombs”. I have no idea why they’re called bombs. After being given our tickets for the day, we begin the production cycle.

Before assembling, the pallets containing all the parts are broken down and placed onto the table. Depending on how many assemblers work, the order is divided equally between the assemblers. For example, if five assemblers are currently working, an order of twenty-five servers will be broken up by fives. The ‘bomb’ is placed in a centralized location to ensure everyone knows what we’re working on. Prepwork for the servers now begins. It usually starts with unboxing of motherboards, hard drives, solid state drives, RAM, and cables. This process really puts into perspective, for me at least, how much waste and unnecessary trash is created through packaging. Motherboards, RAM, and drives all come with their separate boxes, paperwork, and plastic bags, which are all instantly thrown out, as we don’t have any use for them. Once all parts are placed on the worktable, we first start by assembling the motherboards. Each assembler has his own unique process. My way of doing it was learned from the senior assemblers who left for other jobs when my internship started. I first begin by opening two of the DIMM slots on the motherboard to insert the RAM. With the RAM inserted, I then move onto the solid-state drive, or SSD, screwing in the mounting screws and carefully placing the SSD into the slot. After the SSD, I open the CPU module carefully. There’s a small pressure lever that keeps the CPU mount in place on the motherboard. The CPU is the part I pay closest attention to, as the pins that connect with the CPU are extremely delicate. Lastly, I place the SATA cable, which plugs into the hard drive, into the motherboard. With the motherboard completed, I take

the chassis, open it, and bend all the wires protruding from the power supply outside the chassis. This is done to make space for the motherboard, as if a wire gets caught or pinched, it can be janky to remove the cable from under the motherboard. Using specialized screws, the motherboard is fastened to the chassis. From here, the cables are carefully plugged into the motherboard. They're done in a special order to avoid collision with the CPU and power supply fans. Zip ties are used to keep clumps of cables in place, and in some cases, I use the space underneath the Network Interface Card to pin the power supply and audio cables down. Once all the cables are in place, the feet are placed on the bottom of hte chassis, the cover is placed on top, screwed into place, and a last check to make sure the server turns on is done. Once completed, the server received an assembler's stickering, starting a chain of server custody.


Top Right: A complete pallet, before unboxing. Can see the 'bomb' sheet attached. Top Left: Unboxing procedure, you can see RAM, SSD, CPUS, Motherboards, and HDDs. Middle: A semi-completed server. cables are kept far away from CPU fans and that huge fan wall. Specific server designed for distribution site, a lot larger than normal servers. (Still not the largest we've built though!)

After beginning the chain of custody, servers would be placed onto a centralized table waiting to be racked. An essential step must take place before racking. A power supply has two voltage settings, 115 or 230 volts. If a server is plugged into a 230-volt rack whilst set to 115, it

explodes. If set to 230 when plugged into a 115-volt outlet, it doesn't receive enough power. Each server must not only be switched to 230 volts, but double checked by another assembler to ensure the server doesn't explode, as the replacement process is very tedious and time consuming. I've personally blown up a server, flames shoot out of the power supply unit, it's not a pleasant sound, to say the least. After this vital step, servers are placed on large server racks. The next step? More cabling! Each rack has a KVM, or Kernal Based Virtual Machine. Essentially, it acts as a physical switch that allows users to interface with multiple servers with one keyboard, mouse, and monitor. The cables from the KVM are labeled from 1-14. Each server is given a number, ascending from one. Power cables, network cables, USB and HDMI cables are connected, allowing for full functionality while on the rack. One of the most satisfying things about this job is turning all the servers on, one at a time, seeing the flickering blue and orange lights and hearing the symphony of fans come to life. It starts very quiet, but once all servers are on, it's a little loud.

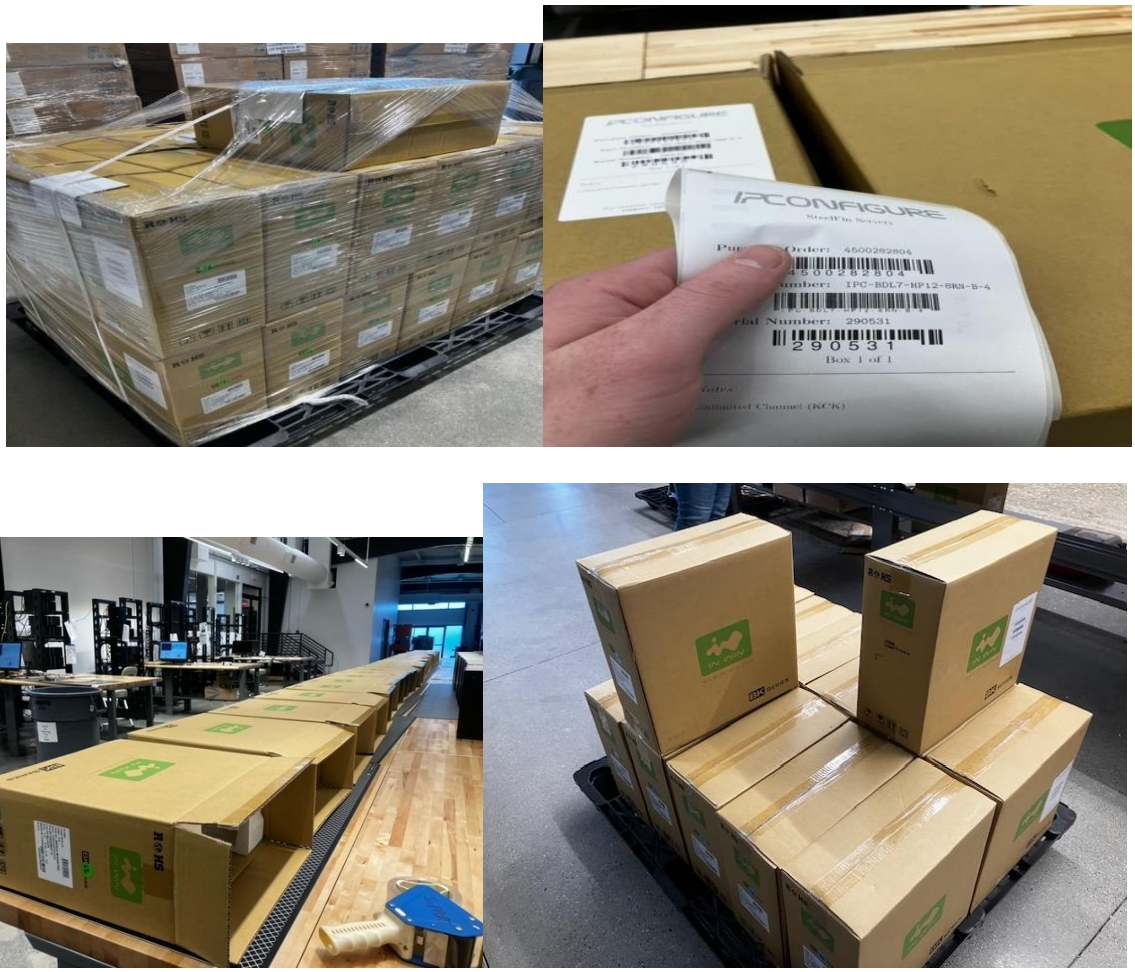
The servers don't have an operating system yet, so they boot to BIOS, waiting for configurations. First, many of the motherboards received by IPconfigure have outdated BIOS firmware, so we enter into a program built into the motherboard known as Microstar-Flash, or M-Flash. Using a USB with the updated firmware, we 'flash' the new BIOS onto the board. Time varies; some newer boards won't take more than a minute with older boards exceeding five minutes. Once this is done, we re-enter the BIOS and change some specific settings to enhance performance of the server. Setting the fans to max speed, turning on the network stack, small tweaks here and there. With all of this done, we leave BIOS, and enter a special program known as pixie. It is a network booting program that hosts a multitude of operating systems for us to choose from, allowing us to quickly select the OS that the customer wants. After install, serial

number stickers and channel stickers, which identify the number of cameras the server can handle, are placed onto the server. With this, the final step of production commences.

Left side: A rack with 10 servers on it before power on. Right side: Netboot being used to install a specific OS onto the server, there are many options to choose from.

When I said initially there were three steps to production, I mean there were three steps that assemblers have direct impact on. There is a step in between imaging and boxing, that of quality control. Support staff double check the work of assemblers, ensuring stickers are correct, network settings were properly set, and that the OS functions. After this, servers are then turned off, taken from the racks, and placed onto the central tables. They are then switched back to 115 volts, so they can operate at stores and warehouses. Boxing is a relatively simple process; the boxes are given serial numbers that match the stickers on the server. It's a matter of matching the numbers, placing antennas, power cables, and any other peripherals necessary into the box. Lastly, the server receives a quality control sheet, containing a list of parts and other basic information for the customer. This is placed into the box, which is then taped up and put onto a pallet. The 'palleting' process is also simple. Boxes go in an organized fashion onto the pallet,

saran wrap bundles the boxes together, and they get strapped down, so as to not slide off the pallet itself. Proper paperwork is added to the finished order, with barcodes including information on travel, destination, and location. This concludes all the tasks of a Steelfin assembler.



Top left: A completed pallet. Stretch wrap and straps included. Top right: Stickering of an individual server, with its own product number and SSN. Bottom left: All the boxes lined up to get their stickers. You can see in the background the racks. Bottom right: A half completed pallet.

Specific Skills Used

There were a myriad of skills I used during the internship. When coming into the internship, I already had fairly advanced knowledge of hardware. That hardware knowledge came in handy when having conversations with my supervisors and coworkers when trying to either troubleshoot a server or just having casual conversations about our computer specs. This knowledge came mainly from self-study and a stint working as a computer technician for the Tidewater Community College computer club. Operating installation, assembly, troubleshooting, repairing or finding to work around problems came naturally. There was more software based and operating system-based skills that were new to me though. One skill I did learn directly from the internship was the ability to use the command line interface, or CLI, more efficiently. Prior to this internship, I had a general understanding of the Linux and Unix CLI and how it worked. Over the course of the internship, I grew very close with the shortcuts while using the command line. In the main support room, there were many monitors on the walls displaying heatmaps, logs of servers, and general system health checks. Using a System Information Event Manager, or a SIEM, the support team would aggregate all these various logs into a readable format. My supervisors taught me how to configure filters to better read and analyze the traffic, being able to predict behaviors of servers. Most times, there wasn't a fancy graphical interface, so I had to use the command line, which gave me another way to practice my CLI skills. One more minute skill I learned while working wasn't directly related to cybersecurity or information technology, and that was mailing. Support would mail out replacement parts, servers, and statements to organizations globally. Stephen would show me how they procured packing slips, how they were organized, and how you would properly pack and label packages for global shipment. This

internship not only allowed me to practice skills I already knew, but forced me to adapt and learn new information to grow into my position.

Preparation from ODU

Old Dominion University prides itself in its school of cybersecurity, as it is one of the few universities to have a dedicated cybersecurity degree in the country. Personally, I feel as though ODU's cybersecurity curriculum barely prepared me for my internship. As a Junior, I've taken a wide variety of core, principle, and application courses, getting a wide variety of different topics. When it came to applying those topics in a practical setting, they didn't help. I believe this stems from a lack of certification driven classes. The Steelfin internship required various hard skills I learned through self-teaching, not through the classroom. Certifications are seldom discussed within the 200 level courses at ODU, with abstract security concepts taking precedent over tangible cyber techniques and processes. I credit my employment to the assembly position itself not as much to ODU, but more so to my dedication to self-study. Before working at IPconfigure, I spent a majority of my time during the 2022-2023 semester studying networking and certifications. With this knowledge, I was able to answer the technical interview questions and maintain a dialogue with the interviewers about hardware. After getting into the job, I continued studying the CompTIA Security+ exam, which I was able to pass over the summer of 2023. Though there is invaluable knowledge within the current cyber coursework, I believe it gets lost on students who don't even know the difference between cables or can't identify basic parts of a computer. There was one class, however, where I was able to use the skills as a foundation while working. CYSE 270: Introduction to Linux, was the only class I found to be useful in my scenario. IPconfigure utilizes systems like Linux and Unix, so having a

general understanding of the filesystem and the command line interface was very valuable, especially while imaging servers and verifying system functionality. Though ODU's cybersecurity program didn't prepare me for my internship, I still believe the information is invaluable, and as the program grows and matures, will include more hard skills and certifications.

Fulfillment of the Student Learning Outcomes

As previously mentioned, there were four student learning outcomes regarding this internship. Those four SLOs were; learn how to assemble surveillance servers from scratch, troubleshoot CPU, RAM, disk, and power supply issues, work in all aspects of the hardware production cycle, including imaging and configuration whilst learning about software production cycles, and exposure to QA testing. Before delving into the first three SLOs, I would like to briefly talk about the last one. During my internship, the last SLO wasn't completed "thoroughly". Meaning, I did get to spend a little time understanding the quality assurance process, and the steps, but I didn't get to put my skills into practice. However, the first SLO I was able to complete rather quickly. Learning to assemble servers wasn't that difficult, as I previously mentioned, I had previous experience with hardware and the full-time support staff were able to provide quick directions on server specifications. As for the second SLO, that came shortly after the first. Through intuition and lots of questions, I was able to discern the most probable causes of server malfunctions and remedy them. It got to the point where I wouldn't need to reference any documentation, if I knew what wasn't working, be it network or booting procedures, I would quickly go through a mental checklist of issues. The third SLO took the longest of the four. It required not only assembly, troubleshooting, imaging, and racking, but also

an understanding of how IPconfigure went about developing its software. An understanding of software and how they go about it took the entire internship, and was mainly done through the IPconfigure training videos, and discussions with support and orchid engineers.

Aspects of the Internship

There were many aspects of the internship I discovered, with some being motivating, discouraging, and challenging. One of the most motivating parts of the internship was the environment. The supervisors and managers were extremely friendly and forgiving. If you were forthcoming with mistakes and honest, they were more than happy to understand your mistakes, and use them as a teaching moment. Culture is essential in a large organization like IPconfigure, and their full-time staff understand this. The CEO, Chris Uterwick, would come in and check on the assemblers, talk with us, and make jokes. (The hilarity of these jokes would differ) That human interaction between the lowest rung and highest positions at IPconfigure really stuck out to me. One of the most challenging aspects of the internships involved specific server orders. Normally, we would do monotonous server production; same specifications, same BIOS settings, and same stickering process. There would be some servers, as seen in the photo above, that would be enormous, requiring extreme attention to detail. Other than those servers, there really weren't challenging aspects per se. To build on this, there weren't that many discouraging parts of the internship too. I can't stress this enough, but the staff were always motivating and never putting the interns down. One could consider the breaking of hardware was the most discouraging part of the internship. It would always be when least expected, and it would require a complete disassembly of the server, leaving assemblers irked. As said previously, though, the full-time support staff were very understanding of mistakes.

Recommendations for Future Interns

For those considering an internship as a Steelfin assembler at IPconfigure, I have three vital pieces of advice that will be essential to your success. Firstly, your initial contact with the company means everything. First impressions in any industry are important, and IPconfigure is no different. Make sure your resume is unique and clean, not just a Microsoft word template. The people looking at your resume get dozens of the same monotonous templates, when your resume is unique, or preferably, homemade, it sticks out. Resumes must contain tangible skills. The support department has employees with decades of experience, if there are white lies or fluff in the work experience section, they will recognize it immediately. For the interview, wear a suit and tie. It sounds silly, especially when applying for an assembly job, but it shows that you are serious about the position. With a professional look as well as a structured resume, you have an excellent chance of catching the ire of employers.

Secondly, you must have a basic understanding of computer components and networking. During the interview itself, the department heads want to see if potential employees know what the pieces of a computer are. This helps with training, as if you have a solid foundation, it's easy to build upon. Understanding the differences between solid state drives and hard disk drives, knowing the voltages on the power supply, and identifying key pieces on a motherboard are just a few of the essential domains IPconfigure employers want to see. Better initial understanding of equipment leads to less mistakes and faster mastery of assembly techniques. To get a grasp on these subjects, building a computer, joining the local information technology club, or even volunteering at the Tidewater Community College's computer club are excellent ways of obtaining this knowledge. IP ranges, ethernet cable standards, are also areas aspiring assemblers would need to be knowledgeable in on top of the already vast hardware knowledge.

The last piece of advice is less tangible and more of a mindset IPconfigure employers are looking for. Be a lifelong learner. Lifelong learners thrive at IPconfigure. The mindset of continuous learning, and that there's always something new to learn lends itself to great success not only at IPconfigure, but in the industry itself. Constant evolution in cybersecurity and IT standards, hardware, software, and networking require those within the field to be continually self-teaching. The ability to distill and understand information rapidly is a skill that those in the IT and cybersecurity field desperately seek in others.

Conclusion

This internship has been an exciting way to enter the information technology and cyber security field. I've gained great relationships with fellow interns and full-time staff and IPconfigure, which I plan to carry on throughout my collegiate and profession career. One huge takeaway from my internship is that cybersecurity and hardware can be fun. In the midst of papers, quizzes, labs, I feel like it gets lost that the actual work is enjoyable and challenging. The internship was a constant reminder that though the papers aren't fun, and the material seems drab, the practical work is worth the wait. The internship has given me enhanced hardware, networking, and software knowledge, which I'll hopefully be able to apply in more advanced senior level courses. As for professional planning, though hardware is fun, it doesn't seem like something I would like to do the rest of my life. I would like to find work in a SOC or server farm, working network administration and monitoring. The IPconfigure Steelfin internship has been an incredible experience, and will definitely become an integral part of my cybersecurity career.