A. Overview of employer
Qualcomm is one of the leaders in telecommunication chip designer and the largest fabless semiconductor company in the world. It invented and commercialized the CDMA 2000/1x EVDO technology, which is widely used by Verizon and Sprint in the US and various carriers all over the world. Its snapdragon chip series are the central processors of a lot of commercial smartphones.

B. Co-op Work Assignment
I have been with Qualcomm for two terms in two different teams. I was with QCT CoreBSP: 6k stability team for the first term, and QCT SW Automation and Tools: HCI team for the second term.
1. 1st term with 6k stability team
The stability team is to maintain chipset stability over different builds and targets. Members of the team will look at crash dumps from internal test teams and customers, and determine the root cause of the crashes. After the cause is identified, the problem will then be propagated to responsible technical teams, and a change request will be filed for the scenarios to fix the problem and prevent further crashes. The job function requires basic understanding of ARM architecture, working knowledge of debugger, C, and ARM assembly, as well as conceptual understanding of threading, concurrency, priority inheritance, etc.
I was mainly working on analysis of crash dumps. On the side, I studied a specific type of crash called permanent bit flips, where random bits of various sections in memory has unexpected flips, resulting a system halt. I developed the tools to identify this situation, and investigated potential causes. I also worked on some scripts that parse emails containing crash reports, classify them, and put them into some storage and various tools that aid and automate the crash analysis.
I was assigned two mentors, and they were really helpful in getting me started and for general questions.
2. 2nd term with HCI team
HCI is the acronym for hierarchical continuous integration. HCI team maintains tools for tech teams to submit their work, databases to keep track of relations between works from different teams, and agents to automatically build and integrate work from tech teams to make a full build. The tools that HCI maintains are essential to management of a large scale codebase like the one Qualcomm has.
I was mainly working on a project that will evaluate metrics for some assets that technical teams could submit. The aim is to build a framework so that developers could easily submit assets and write custom metrics to be evaluated where the framework will efficiently perform the calculation. The tool is written in C# in compliance with HCI standards, with intensive usage of .NET technologies. On the
side I also worked on scripts that do various work in different part of the system, and participated in design of data models. I was assigned with a mentor. The teammates were really helpful in all kinds of questions regarding HCI toolsets, designs, and best programming practices.

C. Assessment of Learning and Development
The job content for two teams correlates with my curriculum very well. A lot of theories that I learned in Operating System are getting real life usage, and I also learned a lot of techniques in software engineering and best practices in writing software. This experience deepened my understanding in software engineering industry, and gave plenty hand-on experience on various aspects of industry.

D. Life Out-side of Co-op
Qualcomm provides a lot of intern events. Besides, there is a large base of interns during summer time, so one would rarely run out of events to attend. San Diego itself is a nice place but it can be quite weak on public transportation aspect. I shared a rental car with my roommate for the whole duration of my stay and I would recommend rental cars to everyone who comes to intern around southern California that does not access to a car, as one would certainly lose a lot without a car in the area. Qualcomm provides housing for all interns free of charge, and it was one of the best apartments I have stayed in. Most apartments are within 2 miles radius of office and are located in the nice neighborhood of La Jolla Village.

E. Evaluation
The well-established intern program of Qualcomm made my overall co-op experience very pleasant. I do not have to worry much outside of work, and will always be able to find someone for my administrative questions. On job content wise, since Qualcomm is a rather big corporation dealing with many aspects of different technologies, one will almost always be able to find the group he/she is interested in. Therefore, communication with recruiter is crucial in determining the matching team to be assigned to. I really enjoyed the job content which exposed me to two extremes of software development: the first team deals codes at very low level, where I have to worry a lot about details in implementation and careful examination of execution procedure, memory status, IO buses, etc.; the second team deals codes at high level, where I spent a lot of time discussing and fine-tuning the design and architecture of the framework for ease of usage. The teams are knowledgeable, nice, and extremely helpful and reachable in all aspects, which I really appreciated.
Qualcomm Co-op
Summer 2010

Co-op Work Assignment

The largest and main division of Qualcomm is called Qualcomm CDMA Technologies (QCT). I worked in the CoreBSP (board support package) group in QCT. More specifically, I was in the integration team in CoreBSP. Qualcomm makes a lot of the chipsets that go into smartphones and netbooks. As new chipsets get developed, the people in QCT have to write code and ensure that all functionality works on whatever devices the customers desire. The code goes through a constant cycle in which developers make fixes/changes to the code, integration teams merge changes from various development teams into a working build, and a product team test and releases this new build. Until the build is extremely stable, the cycle repeats. In the integration team, we get requests with code change requests from various different development teams that want their latest fixes mainlined into an official build as soon as possible. As a result, integrators are constantly facing deadlines to make the fixes, test them (which includes actually loading the builds onto netbooks/phones and testing functionality), and releasing them.

The target I was working on was more or less stable, so I never felt the same urgency of constantly having to release new builds that my fellow colleagues did. To keep busy, I also helped with some automation scripts.

I had a manager and a mentor. My manager was very busy most of the time, so I did not interact too much with him. However, some other interns had very frequent discussions with their managers. Most of the time, I got help from a fellow colleague who used to be in charge of my target before I arrived for the summer. My training mostly involved shadowing this colleague in work for the first few days of my internship.

Assessment of Learning and Development

I have to say that the work at Qualcomm is much better suited for people in ECE than for people in CS. I was very disappointed that I got to do no actual coding during my internship (except for some scripting in the last few weeks). Some other interns got more interesting projects - but for the most part, interns get assigned to automation, testing, or integration work. During the work you certainly feel a sense of importance since the effects of your work are immediately visible during testing. However, if you’re a CS major looking for some interesting development or coding experiences, this may not be the place for you. Before my next co-op session begins, I’m going to be communicating a lot with my mentor to try to find a team in which I’d get to do some actual development.

The part I liked most about working in the integration team was being able to interact and get to know so many people. There are lots of specific teams like Boot, JODEvices, Kernel, etc. that release changes to their parts of the code. Integrators have to communicate with all these teams because they are responsible for integrating changes from all groups. At first I was often hesitant
to keep “bothering” people about things that didn’t work or to ask for clarifications. However, after a few weeks, I became a lot more confident with talking to senior engineers and asking them questions.

**Life Outside of Co-op**

I did my internship at the main San Diego office. Wow – what an amazing place to be at. Even though the work I was doing wasn’t well aligned to my interests, the overall experience during the summer was absolutely amazing. Qualcomm takes care of its interns extremely well. The housing is provided by the company. All interns live within 5-10 minutes of each other in very nice and clean apartments. Qualcomm organizes lots of intern events including parasailing, tubing, bonfires, movie nights, bowling, Padres baseball games, a free surfing lesson, and a few others. There were about 400 Qualcomm interns in San Diego this summer, so there was no shortage of things to do on the weekends (or weekday nights).

The only problem I faced with living in San Diego was not having a car. There is a bus public transportation system, but it takes forever to get anywhere (although the bus ride from the intern housing to the Qualcomm campus is only about 15-20 minutes). If you have a car, I would recommend driving it to San Diego for the co-op.

**Evaluation**

Best feature of the job: interacting with so many people. Although most of the time the interactions were technical conversations about work, I also got to know a few colleagues quite well. It was very useful to get advice from them and listen to their stories about their time at Qualcomm. A lot of the people on my team were quite young (in their 20s).

Worst feature of the job: not being able to do any development. Also, there were periods of time where I didn’t have much work at all because my target was completely up to date. I would have liked to be busier with work.

**Additional Info**

Make sure you talk with you manager/mentor properly before beginning the internship so that you know exactly what you’ll be doing. Also, bring sunscreen.
Co-op Job Summary

Qualcomm has a group called the Qualcomm Innovation Center (QuIC) that focuses its efforts on open source work. I joined the kernel team at QuIC, which is responsible for helping to support the Linux kernel and making sure that Qualcomm’s chipsets function correctly with Linux/Android running on them. Examples of the type of work one might expect in this team include implementing new drivers that are sent upstream to be integrated into official Linux code and supporting customers with critical issues as phones get closer to their release dates.

During my four months in this team, I worked on two projects: an analysis of interrupt balancing and interrupt latencies on a phone with two CPUs, and an investigation into Android’s interprocess communication (IPC) mechanism. The first project on interrupts was a really good opportunity for me to pick up useful skills and get used to actual kernel code. I was encouraged to attend a three day training session on Embedded Linux Systems which turned out to be very helpful in my projects. During my first project, I mostly consulted the ‘interrupt specialist’ in the team whenever I had questions – he gave me readings and useful resources to get up to speed on the technology involved. The project involved a lot of data collection and analysis – ending with a presentation of my findings. The second project was a lot more open-ended than the first one. For this one, my official ‘mentor’ was my main point of contact. She gave me suggestions on things to investigate, and was always available for questions when I needed her. The IPC mechanism on Android is called Binder. It’s known to be a very messy chunk of code that most people don’t really understanding – meaning that debugging binder issues becomes quite a pain. At a high level, I was tasked with figuring out how binder works, developing some unit tests to make sure it’s functioning correctly, and do some profiling to measure its performance. The first few weeks involved me just digging through code and figuring out the best way to interact with binder’s kernel driver. Eventually, I developed a simple unit test, documented how the major components of binder work, and presented my findings to my team.

Just before joining this team, I took the operating systems course at Cornell. The timing for that was perfect because I got to work with real OS code immediately after learning about OS in a school environment. Though I’m still exploring different fields within computer science, working on the Linux kernel seems like a very important role. Especially with the explosion of smart phones these days, it’s exciting to know that my work would be reaching so many people.

I feel that one very important aspect of an internship is to get a feel for what working as a full-time employee would be like. I know that many times interns get assigned ‘busy work’ or things that are completely different from what the regular employees are doing. I was very happy to find that this was not the case at the kernel team in QuIC. Though
intern projects have to be shorter and more independent due to time restrictions, I always felt like I was part of the team and that others were interested in the work I was doing. A few times I was contacted by people outside the team so that I could discuss my results and help them out. This is a pretty satisfying feeling – it really convinces you that your work is being taken seriously.

Qualcomm makes very good arrangements for its interns. The experience during the summer and the spring are very different – the summer will bring in about 500 interns, whereas during the spring there were just around twenty of us. Qualcomm provides really nice housing in La Jolla for all of its interns – and the best part is that most interns are living within just a few minutes of each other. The apartment complexes have pools, gyms, hot tubs – it’s really great. Public transportation in San Diego isn’t that fantastic. I rented a car with my roommate this term, and that turned out to be really useful. We were able to see so many more parts of San Diego and do many more things on the weekends without constantly having to worry about how we’ll get there. There is a public bus system (about 15 - 20 minutes ride to work), but it’s not that reliable and not that fast. The campus team at Qualcomm arranges a lot of intern events, especially during the summer. Qualcomm also has a department called Qlife that is constantly organizing events for all Qualcomm employees (such as ski/snowboarding trips). You definitely won’t run out of things to do here in San Diego.

I would say my favorite aspect of the team was the people. Qualcomm always plays this orientation video for the interns on their first day in which they show about 20 people responding to the question ‘What do you like best about Qualcomm?’ – and the answer is always ‘the people.’ I didn’t really think much about it back then, but the people here really are great. Everyone is really friendly and helpful. It makes coming into work a lot more fun. I don’t really have too many complaints about this job – it went pretty smoothly. The only thing that might have been useful would be some more guidance on what tools and skills to make sure I learn in the beginning. I picked up knowledge about different technologies as a worked through my projects, but it would be nice to have a more structured overview of thing at the beginning of the internship.