Software for Smartphones on the Frontlines
featuring Edwin Morris interviewed by Shane McGraw

Shane McGraw: Hello and welcome to the SEI Podcast Series, a production of the Carnegie Mellon Software Engineering Institute. The SEI is a federally-funded research and development center at Carnegie Mellon University in Pittsburgh, Pennsylvania. To learn more about the SEI, please visit our website at www.sei.cmu.edu. A transcript of today's podcast is posted at sei.cmu.edu/podcasts. My name is Shane McGraw, and today I'm pleased to introduce you to Ed Morris who is currently a senior member of the technical staff in the Research, Technology, and Systems Solutions initiative at SEI. In today's podcast, Ed will be discussing software that his team is working on for soldiers who carry handheld devices to support their mission needs in the field. Welcome, Ed.

Ed Morris: Thank you, Shane. Thanks for the opportunity to be here.

Shane: What communication needs or capabilities do soldiers have while deployed, and how do they differ from the average smartphone user?

Ed: First of all, while it's great for us to know where the local coffee shop is and things like that, clearly soldiers have different concerns. They have concerns about where IEDs [improvised explosive devices] have been found in the past and concerns about the people they're meeting in the streets, whether it be Iraq or some other place, or Afghanistan. In addition to the fact that they have different needs that way, they also have different limitations on what they can do with their cell phones or their handheld devices. For example, they don't have the bandwidth available to them such that they can get a huge stream of data like we can get as we travel around Pittsburgh or any other city in the U.S. In addition to that they have security concerns that you and I probably don't have with our cell phones. They also have a problem with batteries. We can sit around and go to the nearest charger, almost anytime there's always a plug nearby. That may not be available to them all the time when they're in the field and wherever they're deployed.

Shane: Please tell me about the exploratory research that you are conducting to help develop software applications for soldiers who are in these situations, and how can it be tailored to a specific mission or situation?

Edwin: One of the key challenges they face is they're often doing different things. So one day they may be clearing a route, in other words, looking for dangers along a route where a convoy is going to pass through. The next day they may be looking for weapons caches. Another day they may be responding to a humanitarian disaster, whether it be something like a tsunami or an earthquake in Haiti, or whatever the case may be. So they have all these widely diverse needs. The military is developing really sophisticated systems to address parts of those needs, but there will always be these new things that they need.

I'll give you an interesting example. When soldiers are in the field in a place like Afghanistan they often get feedback from intel [intelligence] analysts who say, "It would be great if we could find out a certain piece of information." Well, that piece of information may not easily fit into or with the systems they're currently using. So it would be great if they had the capability to custom tailor themselves a system for that particular need. What we're trying to provide them is what we call "edge programming," which is effectively a way for soldiers deployed in the field—so this may not be while they're walking around in a town in Afghanistan, but perhaps before they go out to the town—to custom tailor the interfaces that they see on their phones, and also the type of data they receive and can capture into the phone to bring back to their base or whatever the case may be. So that's what we're trying to achieve.

Shane: So what type of smartphones are these soldiers using today? Are they Androids or iPhones?

Edwin: All of the above. The interesting thing is the military, the Army, but also other branches of the military, that are doing this, are experimenting with your standard iPhone, with various Android devices, and there are some manufacturers or some typical defense contractors I should say that have "rugged-ized" phones, Android devices or other types, already. You have to understand that it makes no sense for the military nowadays to go out and buy a specialized device, when they can go out and spend a couple hundred bucks and you have a phone.

Shane: Ed, please tell me how your team got involved in this work; how did you learn there was a need for this type of capability?

Edwin: A couple years ago—even before Android came out, the iPhone was out at that point—it became very clear to us that one of the just great opportunities but also great challenges in the future would be providing access to individual soldiers while they're in the field using light-weight devices. You could read that as something similar to our handheld smartphones. So when we saw that happening, we recognized that unless the SEI began to gain some experience in the area, we would soon be behind the technological times as well. So it was important for us to begin to understand what could be done and what couldn't be done with these phones.

So we wrote what we call an IRAD, an Internal Research and Development effort, for a relatively small amount of money. We did some experimenting with handheld Android devices using service-oriented architecture (SOA) techniques to find out how much could be done using a SOA strategy to get information from back-end sources to the phone and from the phone back to those back-end sources. So that got us working in the area, and we've kind of expanded since then.

Shane: Thanks, Ed. Now take a minute to walk us through an example of a soldier walking into a village in Afghanistan. What times of information would they be able to access on their smartphone?

Edwin: Well, just think about what the phone can tell you as you're driving along the turnpike, okay? You can find out where the coffee shops are, where the ATMs are, perhaps where some of your friends are, and many other things. A lot of that is based on your physical location, and that's what we use the GPS for, to identify that physical location. And that's how they can capture information relevant to our situation.

Now imagine you're walking into a village in Afghanistan. There may be some people that you or your colleagues have made contact with before that you know are friendly. It would be very useful to know about those people. In addition, it would be very useful to know about where there are potential threats. Those threats could be in the form of places where IEDs [improvised explosive devices] have been found in the past or could be in terms of choke points where it would be very likely to set up an ambush. So you can imagine a lot of things. Or, you may want to get access to data that's streaming from a UAV [unmanned aerial vehicle] flying overhead that's supporting your mission. All of those things can be received, accessed on these smartphones.

Now, while you're in the village, you may talk to a village elder and you might find out, for example, that he has three children, and these are their ages, a particular age.

Shane: Translation would obviously come into play there.

Ed: Absolutely, and people are working on that. I do not for a minute believe that translation capabilities are perfect today, but I do know that is a very active area of research. So it may be very useful, for example, to know that there is a person in the village who speaks English and can translate for you. Assuming you don't have the translation capability right on the phone or reachable through the phone. So going back to the village elder with three children, well, it would be nice to know when their birthdays are so you can bring them presents, and all the things you have to do to establish personal relationships.

In addition, if that analyst we talked about earlier wanted you to find out a particular information instead of carrying a scrap of paper, it would be nice to be able to enter that information very

quickly and efficiently while you're there. Now, I hope we'll talk more about why it's so important to be efficient and have a good user interface for soldiers to use.

Shane: Now, tell us a little bit about the user interface that you're developing for these soldiers.

Edwin: When you and I travel about with our phone, it's not likely we're in highly threatening environments, although we may be driving, and it's a bad thing. We all know how bad that is. On the other hand, soldiers have to have all of their senses focused on the area around them.

Shane: Right. They're in a battlefield.

Edwin: The last thing they want is to be paying attention to their phone, fumbling through a set of screens that's not customized to what they need to enter. So you want to be able to present information to them in a way that's clear and allows them to quickly grasp it and also to enter information in that way. And so our goal is to provide a user interface that can provide that capability. We're working with Brad Myers from the CMU campus, who is just a world-renowned expert on user interface type of things, and it's been a very fruitful relationship with him because we've gotten some new ideas about how to present the information on the phone and hopefully those things will be very useful to soldiers.

Shane: What do you envision as the end result of your research?

Edwin: I think I mentioned earlier that we've kind of expanded out beyond our initial SOA, situational awareness SOA app. We started from there, and then we moved into the kind of end user edge programming, as we call it. But we're also looking at some of the other concerns.

You know, for example, we talked a bit about context awareness in the sense of your phone knows where you are, and it can provide information based on that location. But we always have to keep in mind that soldiers, when they go out into a situation, are with a set of colleagues, and they're performing a mission. So part of their context is the fact that they have that mission and the fact that they have a group of people that they're cooperating with to solve the problem, or achieve the mission. So if we can begin to pull that information in and use that to have a better idea of what information is appropriate to them or for them to use, that would be great.

You could also use that information to control or to optimize the use of resources across the group. And that's where we're headed in the future.

Shane: Ed, you mentioned service-oriented architecture. How does SOA play a role in your research?

Ed: Well, our interest in SOA is primarily as a strategy to allow relatively straight forward interconnection with other components. That's the advantage of SOA, or one of the advantages of SOA.

So we got into it, to say well, "How far can we push SOA?" because there are limitations. SOA is relatively resource-intensive, because you're transmitting large blocks of information.

So we think, based on our earlier work, that SOA makes sense at some points, and perhaps doesn't make as much sense in others. For example, we started with an XML SOA strategy for message transmission, and eventually we said, "Well, this is not going to work when you have reduced bandwidth." For example, you're in the field and you don't have a great 3G network or whatever the case may be, so then we went to a binary strategy for pushing messages through the air. And our take on SOA now is use it where it's possible and where it's appropriate, but keep some of the design concepts in mind even when you're not using it all the time. So there is an advantage there.

Shane: Ed, how will you user test the software as it is being developed? Since it cannot be tested by the warfighter on the battlefield?

Edwin: Well, first you have to understand our role. We are not competing against the fabulous system developers out there; that's not what we're trying to do. We're trying to do early proofs of concept. We want to understand the technological limitations, and we want to push those limitations with some of our work. What we do to make sure we're doing things that are viable is we start locally. We've assembled a small but hopefully growing group of soldiers who can give us very rapid feedback: "Does this make sense? Does it even make sense to provide end-user programming capability in the field, or can you use this capability we've built?" That's the first step.

Then after that you start looking at places where you can run experiments that are closer to field environments, but they're still a long way away from there. We've worked with the naval postgraduate school to do some tests of various technologies, not just mobile technology—I'm talking about other technologies from the SEI—in that environment. And the good thing there is not only do they have an infrastructure we can use, and good support from their organization to do these things, but you also have access to soldiers who can once again give you more feedback on what's good and what's not good. [That's the] second step.

The third step is then to take it out to a more realistic field environment. We haven't done that yet. We're looking for opportunities. In fact, we're exploring opportunities. There are some exercises that we hopefully can get involved in in the future. And that would be, from our perspective, the step before actually taking it out into the field to do more extensive trials or whatever. We also have to keep in mind that whatever we do, we have no intent to commercialize. So we're going to make it freely available…whoever sees an opportunity can use the ideas and make it useful.

Shane: Ed, a little while ago you mentioned battery life. Are you or any of the colleagues here at the SEI working on the issue of battery life? I know on my cell phone, I have issues. I'd like that taken care of.

Edwin: Yeah, and you can imagine how much more extreme those issues are when you're in Afghanistan, for example. As a matter of fact, our group is actively focused there as well. We have for next year submitted a proposal effectively that's been accepted, and one of the areas we're going to be focused on is how to use software strategies to optimize battery usage: first, within a single phone, and then beyond that, within a unit that's operating together to once again achieve the mission. And so yes, we are focused in that area. And there are lots of things that have potential that we can do there, and we're attacking it on several fronts.

Shane: Okay, Ed, thank you very much for joining us. This is great information. Where can people go to get more information? I know there's a recent blog post.

Edwin: There's a blog post. We're putting up a webpage so people can come to that. And we'll make that available to you. In addition, we have several published papers, and people should be expecting more in the near future.

And they can also call me as well, or send an email or whatever. [To contact Ed, please send an email to info@sei.cmu.edu.]

Shane: Excellent. Thank you. Thank you for joining us. This recording and a downloadable transcript are available at sei.cmu.edu/podcasts. If you have any questions, please email us at info@sei.cmu.edu.