



ADDING CONNECTED SENSORS TO YOUR PRODUCT FOR IOT

EPISODE 1 PODCAST TRANSCRIPT

What are the different ways to connect the product or an asset to the Internet?

We're hearing this from a lot from companies. The business guys understand that they need to be connected to the Internet to be competitive but networking is not something a lot of people had to be involved with open until now so it's a pretty foreign concept to people and they can be rather complicated. So that's kind of where we've come in to help people understand the networking piece and do it right because you can't just throw a WIFI module and call it done, it's a lot more complicated than that. What we're finding is for a lot of companies doing sort of a retrofitted add-on is a great way to get something to market quickly. Just an example, we work with somebody that does water shut-off valve for homes and businesses. They had a great product and it just had a relay output on the device and so we were able to get that hooked up to a modified version of our direct contacts sensors such that we're able to fully control their device from the Internet now. They have a product now that they can get out of the market that's just an add-on box that adds connectivity options and control to their current device. Meanwhile, we're working on a strategy with them to do a build-in on future generations of their product. It can kind of be a phased approach and it's going to be different for everybody, obviously not everybody has relay outputs like that and so you just got to see what makes sense to you but kind of an add-on is a great way to get something turned around really quick, we're doing projects like that in a month so that's a really great way to for people to stay competitive.

Maybe you could share few other example, what are some the other things that you're seeing for this add-on and I want to talk a little bit more embedded and so forth.

For some reason we seem to see a lot of water based stuff but we've also been working with a sump pump manufacturer kind of a battery back-up system and it's almost the same kind of situation. They want an add-on product to get something to market really quick. They're seeing a huge amount of demand of this and we're going to work on next generation's stuff with them as well.

I think that's something that makes sense in a lot of places and you just got to evaluate it for your business and what makes sense. We've had other customers where it made sense to go right into the build-in stage.

So that's what I want to talk to you. It does seem at a high level make a lot of sense to just do a retrofit or a bolt-on to an existing product that you have and then phase 2



maybe design it right into it but where does it make sense to maybe skip that or other different options for retrofitting or maybe paint a little bit more detail there.

10:00 What we're finding with the retrofitting now is that it's a little bit more expensive proposition, so sometimes it doesn't always make sense but in some of these, it's a good quick option to have a solution in the meantime. And it depends on what kind of connectivity and outputs they have on the current device that we can kind of tap in to. If it's a sealed product then there really isn't a good way to talk to it right now whether that's relay outputs or serial communications or something like that. If there's no good way to tie into it and there's not much we can do.

And that's what you're saying from expense point of view, I was going to ask you where the expense is but I supposed you can't connect to it in some easy way and that's going to make it, I guess potentially prohibitively expensive. So then the other option, let's say bolt-on works for certain circumstances, what's the criteria that you've seen where a bolt-on or retrofit make sense? What are the attributes of the product for this scenario to work? What is needed?

I would say a little bit of more higher-end product that can kind of demand the cost for us because the retrofit options we're seeing are over a hundred dollars in cost usually. That's very different than the embedded solution to which can be some ten dollars when you're just talking getting a WIFI modules. So that's a big range there but that involves redesign and that whole process. It really just comes down to having the quick and easy way to communicate and get some information out of the device. Unfortunately for a lot of manufacturers that's a decision that was probably made long ago. If you have a way to get some good data out of the device to make that retrofit work, then it's a good quick way otherwise we're starting to talk redesign or a custom or something like that.

That makes sense and to use these rough numbers, a hundred dollars or I think you said less than \$10, is that providing the same functionality notwithstanding of course what you implied there has to be the design work, basically a redesign of the product? Is that on par in terms of functionality for a bolt-on versus an embedded solution?

I would say yes and no, it will all depend on what kind you have on board with the product today. The sub \$10 is really just kind of a connectivity piece but we're finding some of the stuff we're doing really surprising of what we can get done in those little modules.

So you're having to going to get down and dirty and what is assembly program or something to access is microprocessor?

No, thankfully we work with some partners. We're partners with Marvel and they have a really great SDK on their WIFI chip so you can actually build an application on top of that. So there's some really great stuff you can do with that.



With respect to embedding a sensorship, we're shifting to embedding, I know this is I guess very complicated and convoluted but can you give us some broad strokes and what about high level steps that have to be done or that you've seen for if you're planning on doing, just to give business folks kind of a head space to what they need to be thinking about?

I think the important thing to think about sensors is sensors can really be anything but it's really the way that our devices get context to the world around them. If you think about machines and computers they don't know anything, we must tell it to them. So sensors is kind of their way of gaining that context to certain things whether that's temperature, motion, humidity or all different kinds of things. With each of those, you kind of just got to have to look at what's available in the market, what form factor works for your product, 15:00 if there's something available and reliable that you want to use versus kind of building your own. As we build ConnectSense we kind of made those decisions ourselves – temperature and humidity we found the solution in the market versus water we built our own sensor from the ground up. So, because it wasn't really that fit what we were looking for. Others, our customer is a large building owner in New York City and they wanted to manage gas levels and that's the sensor I'm not going to touch with the 10-foot pole; I want a certified, really robust, something I can find in the market because I'm sure it might go in there with the liability involved in gas measurement.

I can understand that. I guess this does start with what you're trying to sense and obviously that would be tied in some way or form to business value that you're trying to derive from the product. I guess I would imagine that would be the first step or is there even something a little bit before that if you're looking at sensors in general when starting to make your decisions there?

I think you just got to look at what you're trying to sense, what's available in the market, and what sort of fits your application and ultimately what's your business goal to that. So you got to look at the sensor piece, you're going to look at the connectivity piece; you go look at the cloud piece and a few more things along the way.

Just to bring up the next question and for me, I'm trying to understand what's the process that you go through with your customers to choose the right sensors? Are they going through a catalog, what are there constraints? I guess you did bring up connectivity could be a constraint, that maybe eliminate some other sensors, I don't know if cloud is in any way a constraint but what's the process that you go through to choose the right sensors whether it's a bolt-on or whether it's an embedded type of product?

Typically most of our customer that we work with kind of gives us the problem at hand and then we will do and go out and do that research and trying to find the right sensor or sensing



technology to solve their problem. We tried to pat customers from having to figure out stuff like that but then we will present them a couple options to see what they want to do.

So how would you fit in to this? I imagine that they would have some domain experience within their company, they would give you like you're saying their problem statement or what they're trying to sense then you're saying you go out, I don't know if source is the right word because obviously you manufacture as well but you'd find it, go back to them but how does that look? Are you working directly with the end user at this point? Are you working with the system integrator? Are you working with some design house? What's the typical scenario for you guys?

We do work with kind of all of the above but sometimes it's the end customer, sometimes it's the third party that's working with them. Using the example again of the gas sensor, the customer said that this is what their problem we would like to detect gas level. I think last year there was a big building explosion in New York City and obviously sent a scare though the building owners and so we immediately knew that wasn't something we were going to build so we went out into the market to look at the right solutions, to have proper certifications and kind of everything to meet their requirements.

Makes sense. What advice would you give to end customers if they're working through a third party? Is there any advice you could give them to make sure that they're making the right decision or making an efficient decision? Is there anything that they should be aware of when working through a third party?

I would say just make sure that you give as much information as possible on your requirements so that the right solution can come to your door and stay involved and active in the process so you don't end up with something that doesn't fit your needs.

That makes sense, so just a real clear 20:00 definition of what they're looking for, the clearer the better. Let's get a little bit techy. We have the sensors, we're going to have some sort of a sensor network. How are these connected? What is the actual interface between the networking component and the sensor? What has to be taken to account here?

I think this is something that's a little bit different for everybody, for us who we're just using a serial interface to talk to the sensors.

In all cases you're saying?

Yes, I think so. I guess not all cases. It's somewhere doing kind of like an analog to digital conversion, that kind of thing, depending on the sensors and what kind of data it's spitting out. So we'll have an interface for that and in ConnectSense we use embedded Linux so we have a process running embedded Linux that will take that data and then interface it up to



our cloud. We built our own cloud from scratch so we kind of have our own platform, there are a lot of other great cloud providers out there at varying price points so it's definitely something to take into account and they all going to work different ways but in general most of them have kind of their own base APIs which is how they're going to securely when get data up to the cloud. And everybody has their own philosophies on what goes to the cloud, some people are sending all their data into the cloud, some people are doing some processing in the end device and then sending more like summary data up to the cloud. I think that kind of depends on what your goals are and what you're trying to accomplish and kind of what your bandwidth is available and how heavy of a device do you want on the end points because obviously a device that is doing some analysis is going to need some more processing power and a little bit more higher end hardware versus something that just going to spit everything to the cloud you can off-load some of that processing power to the cloud.

Maybe it's too general of a question but you can have your smart end nodes or your smarter sensors and like you said maybe doing a little bit of heavy lifting versus having really a light end nodes and having all the lifting down in the cloud. Is it a clear cut case in terms of cost? Which is the better way to go?

I would say it's still very much the Wild Wild West and I would say in general, most things today, most people are sending all the data to the cloud but I think some of the people that are doing more the heavy lifting on the end point or thinking in more forward thinking of 5-10 years down the road where we're just not going to be able to handle that much data in the cloud so you're going to need to do some crunching before you send up and look at more aggregate data. So I think that make sense and this is going to be where the business cases drive it and I think the market will decide.

It does make sense and that's interesting, it still the Wild Wild West I suppose and I guess it would be very specific on the application of the product that you're doing and what you want to do with it. I can't get enough of the tech so let's circle back on your embedded Linux environment. This you're using to connect up some code that's in your sensors, that connect the sensor to your cloud and/o some other API, is that where it comes in? To zoom in to that connection there between the sensors and let's say the cloud I guess.

In our case we actually have another chip on the device which is it's called an MSP430, which is a low power processor. Our sensors also run on batteries so that's one of the ways that we operate in a low power mode is to allow that device to communicate with the sensor and then only wake up the heavier embedded Linux side of the device once there's an event or something happens. 25:00 For instance, our water sensor works this way. So in the event of water, it will be sitting in a low power sleep mode and if there's water then it will wake up the Linux, connect to Wi-Fi, and then report the data that there's flood in your basement.



This is done again with code that's running on the MSP430 chip?

That's right, we have code on MSP430 chip which is watching the sensors and then it will wake up the Linux environment and also pass the sensor data to it once it wakes up.

Going back to the sensor selection, the end user customers, are they silo into specific manufacturer or sensors yet, I guess standardized that you can maybe pick sensors from different manufacturers, is that a constraint that has to be taken into consideration or is it just temporal nature or is it just the way it's going to be?

No, speaking from somebody who's attended the Sensor Expo here in Chicago, there are a ton of different sensor manufacturers to sense anything you can dream of and they come in all kinds of different form factors and it's a whole huge industry so there's a lot to choose from.

And do they all work with each other? Or are you going to be kind of limited by protocols that they use, I guess power would be another limiting one but I do get the sensors, there's probably literally a thousands of thousands of different sensors out there but what I'm wondering is the state of interoperability between all these sensors - are they interoperable? Or does it have to be done with special code?

Interoperability really comes on a different level, most of the sensors are what I would call dumb and unconnected, they're just putting out an analog signal or digital signal, very low level stuff and it takes a platform like ours to really add intelligence on top of that sensor. Interoperability comes in more when you start to talk about different protocols or wireless standards, things like that. That's really where we're starting to see the interoperability more on the application layer than really the hardware layer.

And so do you take advantage of different application protocols? Mix and match?

Again, I'll go to the Wild Wild West here. As early as like February of this year, I give a lot of talks on this topic and I was saying we need people to solve this problem, we need interoperability and now here we are and it almost feels like there's too much going on in the space. Every week there's a new forum or association or group that's coming out with their own standards so I think a lot of progress is being made here but there now have to be some consolidation of standards. So we have things like Apple's Home Kit that was announced a few months ago, which is an interoperability standard for Apple devices in the home. We were just at Google last week to hear more about the Thread Alliance, which is Google, Samsung, Arm, Silicon Labs, Big Ass Fans, my favorite company name in IoT. They're solving things more on a network layer so that doesn't even really give you interoperability at the application layer either and they were not pretending that it did. Everybody is trying to solve those problems in different ways. I think there are some promising things going on there but I think it's something that will be more solved in 2015 and beyond. And there are guys like AllSeen and



Alljoyn that are doing some interesting stuff as well. I think the market will decide what they like and I think we'll see some consolidation of those standards and groups over the coming years.

30:00 Standardization of the standards, maybe? Let's talk about the market a little bit more and the cost. What are the costs associated with sensor selection? Is it just you run your finger down on a catalog, pick one and that's the cost? What are some other costs the people need to be thinking about?

There's the cost of sensors, there's the cost of connectivity. You need to have something to kind of run your application on. In some cases people might have some of this pieces baked into their product today and they might just need that connectivity piece or maybe they're going to need a whole new kind of set of things. Sensors could really range in cost from pennies to thoroughly expensive it depends on what you are sensing in the form factor and things like that. In terms of connectivity, the price is really going down. I would say the price of sensors are really going down to I think what has given us this explosion in IoT is really a couple things the price of connectivity going down, the price of sensor going down and then the cloud really coming in to play and those three things put together have really created this IoT market.

The cost of cloud is going down as well.

Yes definitely.

It's interesting. If you guys will do it again, would you rebuild your own cloud platform because you did say that you constructed it from the ground up?

I would say I wouldn't change a thing. It was expensive to do and time consuming but it has also a lot of some unique advantages, we're pretty unique in that we sort of have an end to end solution from hardware all the way to cloud. This really opened us up to some really unique opportunities. Looking at the cloud market some of the cloud providers are pretty expensive, some of them are talking \$50,000 before committing you could even get started. That's a huge upfront cost for some people but time would tell. I think it has given us some unique advantages so we have no regrets there. But obviously everybody is not going to want to do that and the time to market to do that, if you want to get to market quickly, you don't necessarily want to start from scratch so we were afforded that we started early and we're here now, so it's not going to make sense to everybody.

When you say \$50k before you even get started, you're talking about a company that is building their own cloud infrastructure versus using one like yours? Is that what you mean?

Right. Often with our customers we'll build in the cost of the cloud into the hardware but



obviously some of these pure cloud companies can't do that so you're paying for licensing and your own server that kind of stuff so that stuff adds up.

That has brought us to an interesting point. What is your business model? You just sort of hinted at it just a second ago and what are the business models in the market right now? And again looking at the front-end it could be for everything but what do are you seeing out there right now?

I would say there's a lot of different ways to cut it. We're a hardware company so our business model is around selling hardware so everything we do is really for that, even building our own cloud. We don't charge a customer for that cloud because our ultimate goal is to sell hardware and we don't want to put too many barriers in place to sell hardware. The cloud company they're in the business to sell cloud licenses so that's really how their business plan works. Even my end customers are charging for cloud services and I think it depends on your user base I would say in the consumer's face, consumers have expectations that cloud is sort of built-in, you can think Google and Apple, some of the people that set that precedence but I think early on customers, the one that really sticks in my mind was Kwikset or Schlage had a really early connected lock 35:00 but it came with this massive monthly fees that they wanted to charge. And it totally didn't go anywhere and so had they rethought that and include the cloud, I bet there would be a lot of connected locks out there. You would see these guys like August who have an awesome product that have emerged and are suddenly a threat to some of the lock guys that have been around for a long time. I think that's an important piece to it and you really have to think about what's important to your customer and what they're willing to pay

And so your business model is simply a line item? Is there any on-going cloud associated with it after the fact for your sensors?

Like I said, it was important to us to not have a recurring monthly fee but it was also important to us to have a reliable product. So there are on-going costs to maintain that cloud infrastructure but built out over many products and they're pretty nominal over the course of time. The one thing for us that does cost money was phone calls and text messages so to reliably send phone calls or place phone calls and send text messages it cost money. We use a telephony provider, I'm drawing blank on their name but I'll think of it. But anyways, we included 500 text messages and 60 phone calls with each of our devices. Our philosophy was we wanted to include weigh more than a normal user would ever need and if there's a power user that's going to need more of them, we'll just charge a nominal fee for it. So out of the box there's no extra cost but if you're using those regularly then you'll gladly pay a couple of bucks to add some more to your account.

Just to clarify the text messages in the calls, are these for support or for something different?



We actually have alerts built in to our platform so for using the water example you could say if there is water in my basement then I want to call to my cell phone. To reliably do that, there are some free ways to do that but it's not very guaranteed so to reliably do that we have to use a service, we use a service called Twilio. Twilio is a really nice telephony API that you can use but it does cost money so you kind of have to build that in.

So it's a one price except if you do go beyond I guess your plan, so to speak.

And that's definitely a business model I think people can use where there's no cost out the gate and you can kind of tiers to it. Everybody else slices it in different way it depends on what matters to you and your customers and what the market will tolerate.

If someone's approaching the connected product to the market for the first time, what do you see as being some of the friction points that they should consider? What are some of the unspoken advice that you can give them when approaching the project of connected product?

You kind of have to have a justification for it and you got to make sure that it's done well. I think you can't just throw a wireless into something and expect it to be IoT-enabled; you really have to build an application around it and use cases that make sense for the customer and provide value. So I think there's a lot of different ways to cut it from a manufacturer perspective and from a consumer perspective. It can't just be, "now you can control this with your mobile phone"; you really got to provide value. One of the great examples in my mind is thinking about like a washer and a dryer. On the consumer end they might be able to get alerts so when the washer or dryer is done and on the manufacturer level it can be things like knowing what functions they use on the washer to provide a better product going forward so if there's 20 functions on it but you can gather aggregate data and find out that really the user of the ten core functions that people usually use, 40:00 you can use that to build better products over time. Same thing you can monitor different parts in that washer to know when something is failing or you can know there's an issue here and we're seeing it across our entire line. Now you can provide proactive customer service so that becomes a better customer experience because you get a phone call before the washer breaks and you set it up to proactively do maintenance rather than have it fail. And then there's, for the manufacturers this is also what I called sawdust model, which is that you can use usage data to sell to other providers. In the washer example, you have to use detergent in a washer and so a Maytag or GE Could sell that information to like a P&G or somebody else that makes detergent and sell them usage data and aggregate of and they would be very interested in that. So that opens up a hole in business model that they never had is they now have a lot more data about those customers.

That's interesting the sawdust model. Just in generally those four different benefits for the connected washer/dryer, I think three of them are for the manufacturer and so for



me it kind of brings up the question, I'm interested in your opinion, the data. Who owns that data for that washer and dryer? I guess it's great I get a message when my washer is done. Cool. I guess it's great I get a message if it's about to break down and I could spend a bit more money. I guess that's good. But really what we are is like a little lavatory for these manufacturers who are getting these data. So who owns that data and what's the value of that data?

Again it's the Wild Wild West and that's some of the conversation that is going on. I attended a really great talk at SXSW in Austin this year and they kind of talk about the subject that if you own the sensors or you own the products, should it be your data? Right now most of the manufacturers are saying no. I think it needs to be manufacturers to be responsible with that data and make sure that it's used very cautiously and any time they're selling it or doing anything with it that is done in aggregate and take personal details out of it, things like that because that can be really sensitive data. You get away from a washer and dryer and start to talk about a motion sensor something like that you're starting to talk about when people are home or not and that really can be pretty risky. So I think it needs to be handled very carefully and anytime you're designing IoT projects, you have to do it with security and privacy in mind from the beginning and ensure that it's done right.

I agree and this is my opinion but I think the other dimension here is to consider the value of the data. For example, I use the Google products - I use maps, I use the emails, I am using an email client and I don't know how many years and I get an awesome product but in exchange and I make this conscious decision, I allow them to have my data. So perhaps one consideration for manufacturers is to value or quantify the value of the data they will get that's used in the washer and dryer example. Quantify the value of that data and maybe pass it on to the consumers. So when I go to Sears or when I go to wherever I'm buying my appliance and I see 2 prices, let's say one is \$500, the other one is \$300 but we're going to be using data. I don't know, maybe that could be a way at least that the consumer makes a conscious decision and trades value for value for the data. What do you think?

I think you're seeing that a little bit in the market. I know NEST is doing some of that kind of stuff in terms of their getting data to the energy providers and they're also doing some things were like you can sign up for program where during peak hours they can adjust your temperature to save brownouts and things like that. And that give you a \$100 off your energy bill. So I think you're getting there and I think there's some debate to that. I think Apple just came out and said we don't keep that data on you. 45:00 That's how they're responsible is they only keep the important data and they pass on the stuff that they don't want know and they don't want to be responsible for. So I would say the same to manufacturers, you don't want just to keep it everything, you want to think about it and really you will keep the stuff



that's valuable to you and then you need turn around and provide value to the customers. So I know you said that, most of my examples were benefits to the manufacturer but a responsible manufacturer would use that data to ultimately benefit the customer whether that's new features or better customer service and things like that. And I think when you give it that you're going to build a much better product which will in turn drive customers to that product. As part of what I guess that, that data provides a better customer experience and product in the long run.

Fair enough, that's good advice you have for I think these manufacturers. This has been great, can you provide our listeners with some coordinates? Where can people find out more about your company? Where can they connect with you on maybe Twitter or however you like to be connected? Just provide some contact information.

You can find us on the web at www.gridconnect.com and also www.connectsense.com for consumer line of things and products. On Twitter, @gridconnect or @connectsense or you can me personally at @adamjustice on Twitter.

We'll put all this on the show notes and I appreciate your time and we'll be talking to you soon.

Thanks for having me.