NWX-DOC-NTIA-OTIA (US)

Moderator: Don Williams
June 20, 2018
1:00pm CT

Coordinator: Welcome and thank you for standing by. At this time, all lines will be open and interactive for the duration of today's conference. To avoid any background noise during the call, please press star 6 to mute and unmute your line.

This call is being recorded. If you have any objections, please disconnect at this time.

Now I'd like to turn…

Woman: Excuse me, (Victor).

Coordinator: the call over to your host - yes, Ma'am?

Woman: The lines should be listen-only except for the speakers.

Coordinator: Okay. My apologies.

Woman: Thank you.

Coordinator: Yes, so that lines will be muted for the duration. The call is being recorded. If you have any objections, please disconnect at this time.

I would now like to turn the call over to your host, Don Williams. Thank you, sir. You may begin.

Don Williams: Good afternoon everyone. Thanks for joining us today from Broadband USA's monthly webinar on broadband topics of interest to policy makers, decision makers, practitioners, and pretty much everyone.

I'm Don Williams, the Senior Specialist for Broadband Development with NTIA's BroadbandUSA. I'll be moderating today's webinar. This webinar will be focusing on smart agriculture, increasing productivity through technologies.

Before we begin, I just want to review some of the logistics for the call. We'll open up the webinar for questions after the completion of the presentations. You can use the question box on the right-hand side of the screen to submit questions or comments.

Second, the presentations along with the transcript and recording of today's session will be available on the BroadbandUSA website within seven days of this webinar under the tab Events -- Past Events.

Finally, I want to mention that our BroadbandUSA website provides information about our technical assistance program, guides, products, publications, and toolkits that can assist you with planning, funding, implementing, and sustaining your broadband project.

A little bit about smart technology generally -- it engages technology such as big data, GPS, the Internet of Things, connected devices to help farmers and ranchers better manage their production. Using these technologies, farmers and ranchers can improve their use of water to make it more efficient, produce higher quality crops, and raise healthier livestock. And reliable and robust rural connectivity is fundamental to helping farmers gain benefits of this technology.

Today's discussion will cover advances in smart agriculture equipment and sensors, the use of big data analytics for decision making, and highlight new innovation hubs, entrepreneurial support, and test beds.

The webinar will also feature the work of NTIA and NIST jointly facilitated Global Cities Team Challenge Smart Agriculture and Rural Supercluster in developing best practices for smooth agriculture.

To help us navigate this discussion, represented today are Mark Lewellen, Manager of Spectrum Advocacy for John Deere, Aaron Ault, Senior Research Engineer for the Open Ag Technology and Systems Center at Purdue University, John Selep, President of Ag Tech Innovation Alliance.

As we begin, our first speaker is Mark Lewellen. Mark's position as Manager of Spectrum Advocacy serves the needs of the company as it relates to regulatory, technical, and government affairs and issues concerning Spectrum. Rural broadband is a key enabler to John Deere's self-propelled large machines all come with data modems installed as a standard device.

Mark is a key participant in the Agricultural Broadband Coalition and a member of NTIA's Commerce Spectrum Management Advisory Committee. As precision agriculture is today driven more and more through deployment

of technology, Mark plays a lead role for John Deere to ensure the telecommunication policies reflect the growing importance of GPS satellite spectrum and rural broadband to all John Deere's customers. Please welcome Mark Lewellen. Mark, take it away please.

Mark Lewellen: Thank you, Don. Good afternoon everyone. We have a whole lot of information to cover and then we have two more speakers who have tons of good information as well. So keep your seat belts on and stay tuned. We're going to go pretty quick. All right, next slide.

So a little bit about agriculture -- I'm sure everyone actually is a participant in our industry, since you all love and need to eat -- probably just did so not too long ago at lunchtime. But in case you don't know, the world is adding more and more mouths every hour of every day so we've got about 7 billion people on the planet now and around 9 billion predicted by 2050. So we don't have a whole lot more arable land to use.

So if you do the math, we need to increase yields by about 3% year after year to be able to feed all those new mouths. And if you do that math, it turns out that all those mouths that get added every year would on an hourly basis if you thought about it, it would fill up Washington Nationals Park two and a half times in a day. So that's a bit.

We're talking about environmental sustainability and compliance, and we'll get more into that in some other slides. And all of this leads to precision agriculture. So, next slide, please.

So why precision agriculture? Well, the two things that the farmers like to hear most are increased yields and a reduction in costs and we can help out on both sides of the that ledger. It also leads to a much smarter use of resources,

and we'll give you more examples about that as we get more into the presentation. And it also helps with government regulations in terms of being able to prove that you only put the correct amount of fertilizer or insecticide or pesticide on a particular field. Next slide, please.

So this slide starts in the early 2000s but I really kind of want to go even farther to the left. Think about when we went from mules and horses and plows to mechanization, to tractors. That was an automatic increase in yield production of about 30% because tractors didn't need to eat the oats or the wheat or the corn that you grew.

But now we're predicting that the confluence of GPS with connectivity -- and we'll get more into that -- is going to have even more of an impact on yields than the mechanization did. So the first kind of wave of this was early guidance systems as this slide shows in the early 2000s, but now we're into heavy duty precision GPS so we can control your machines down to about an inch. And we'll see the benefits of that as we go forward. Next slide.

So I kind of like to think about - I'm not a farmer. I didn't grow up raising crops like a lot of my colleagues did at Deere. I'm a Spectrum Management Expert but my dad was a ham radio operator so the word megahertz has been in my vocabulary since I was five years old or probably before that. So I was raised on antenna farms and building antennas with him on the East Coast. I wouldn't be here without that background.

So I kind of need to keep things simple as a farmer or thinking about farming. So I think about it in terms of like five Ps. So the first one is prepare -- so think about what you're going to do, buy seeds, think about what happened last year and we'll get to see how that feeds back on itself.

Plant thing happened not too long ago. So precision planting and we'll see examples of that.

Third one here is protect -- so that's the sprayers come out and spray insecticide, pesticides, or perhaps other fertilizer.

I don't have a P for harvest but at least in this neck of the woods the fall means football and Halloween and pumpkins. So there's my P.

And then lastly is analyze and plan -- did I make the right decisions? My farming friends tell me now that contrary to the way things were done in the past, there is no guess work. We don't guess about how much fertilizer goes on this field -- we know. We know how much it needs. We know how much to put on there. And we know how much it increased the yield and we can do better or not somewhere else.

All right. So on next slide. All right. So this is the only advertising for John Deere. If you've ever seen the back of one of our cabs, look for this about a football sized device. It's green and yellow, of course. But that's the high precision GPS receiver. It's also on a lot of our construction and forestry vehicles. So this is what gets your accuracy down to about an inch in everything we do now is predicated on extreme accuracy and location. Next, please.

So this slide shows you a few things. So there's going to be a planting example but this can apply to other jobs in the field. So think about the harvest. When we came out with the combines last fall and we have sensors in those machines that measure the amount of material that move through the combine.

So combining that with the location of the machine we can provide for you a yield map of your field. And it comes to you yellow, green, and red. So green is where you've got your best yields, yellow not so much, and red is the worst. Maybe there's a reason that part of your field is not so good and you don't really care about it, or maybe you didn't realize it and you need to address it or do something about it.

So in areas where you've got the best yield, the planter in the spring has that same field map uploaded to it so it knows to max out seed placement in areas of green. It pulls back on that placement in areas of yellow and even more so in areas of red because you don't want to be wasting seeds. These are $300 a bushel seeds so even saving 10% on seed costs pays for this system in one season.

You can also tell it to not plant an area. We had a field trip up to a farm in North Baltimore and they had a grass drainage area down to the middle of their field so they didn't want to plant crops there. So the planter automatically row by row would stop planting as we crossed that no plant area and then pick up again on the other side -- all automatically, all done with no inputs from the driver.

Then they went out and proved it to us. They went and dug them up. So that was pretty cool. All right. And this can apply to other types of jobs in the field as well. Okay, next slide.

So to field preparation, every inch matters. So think about being in a combine -- a big huge machine, 30 feet to either side of you. So you probably overlap about three feet on either side trying to drive this thing in a straight line and make sure you overlap and catch everything. But if we can control that down to an inch, we just saved you again 10% across the board in terms of time,

fuel, and labor to do that job leaving control of your machine to that level of accuracy to do all of your jobs. Next, please.

So another thing that comes to mind about precision ag is use of resources. So we have a system called field connect, which is basically water sensors and then a wireless connection back to a hub back to the internet. First thing that farmers find out once they start monitoring actual moisture set - I'm sorry, moisture levels below the surface -- in other words, below what you can see going out there yourself.

They find out they typically were overwatering because they didn't realize how much moisture there was below the surface. But these sensors get driven into the ground and have sensors at multiple depths. So once you know, you know what to do correctly. That's just one example.

Another one that shows that this also crosses across industries. In California, all of the snow and rain is in the north; all of the agriculture is in the south. So they have to pump water from north to south with electric pumps, with you know, electricity. So if you can use a lot less water on the ag side in the south, you saved a big bundle on your electric bill. And I'm told that moving that water is about 40% of north - I'm sorry, of California's electric bill. So that's probably a few bucks. All right. Next slide.

So this slide here I believe is taken from sugarcane production in Brazil. And these are huge farms. So 50,000 acres would be a typical field, a typical farm size in Iowa that would be a small corner of these fields. They're measured in hectares. And in the spring and fall when there's planting and harvesting, they run 24 hours a day. So this guy is out there in the middle of the night doing his thing.

Also, closer to home on the eastern shore of Maryland, a fair amount of agriculture. It's pretty flat. Bay is on one side. That's pretty flat. Atlantic Ocean is on the other side. That's pretty flat. A lot of wind during the day when the sun is shining. Can't use the sprayers because of the wind. But in the evening when the sun goes down, the wind goes down and with GPS you can drive at night and do your spraying in the evening. So, a Maryland farmer's life. Next please.

Okay. So we talked about or Don mentioned all of our machines now have modems in them in addition to that GPS receiver. So this is a next wave of IT I guess being applied to the ag world. So again, nothing there is to scale but we went last year in 2017 to 4G modems in all of our machines as they roll off the assembly line. So the machine itself is now trying to make a data only call back through a cell tower, back through the internet to a series of servers called myjohndeere.com. The farmer can then log in and retrieve information.

So a real basic example of this is one of the first things farmers learn is that their machines sit there in idle and not doing anything. They're on but not doing anything. So that's wasting fuel. That's polluting the atmosphere for no corresponding benefit and depreciating the machine. They all have one counter on them and these large machines depreciate at about 30 to 50 bucks an hour. So if you're sitting there idling as much as 20-30% of the time, that's wasting a lot of money for absolutely no reason.

So unless you have that feedback, you don't know to manage for it and be able to eliminate it or even get rid of it altogether. So next slide, please.

So again this is a whole area of telematics. Another example would be on our construction side we had big dump trucks -- not dump trucks, these things. Can't think of what it is - big machines. Customers were concerned about that

we needed a larger gas tank. And the telematics guys got ahold of that and said well, what's the real issue? What are they really concerned about?

And it turns out that what they really wanted was to be able to fill up all of the fleet in the morning and not touch it during the rest of the day. So we had enough information. We've got 200,000 machines out there in the field. And so every year we get 200,000 years' worth of data.

So we could tell that just by bolting on an auxiliary tank would solve most of our customers' problems and not having to redesign the platform for a number -- I'm going to make it up -- for $1 million, you know, to redesign the entire machine. So, you know a 20-gallon bolt on tank was the answer rather than, you know, upgrading to the next larger size of gas. All right. Next slide.

All right. So I'm not going to go through this in great detail. You'll have to read quickly if you want this information. Or I guess the slides will be available. This gives you somewhat of an idea as to what the service is, the wireless services that we can provide our customers.

Wireless data access is what we're kind of - I'm sorry. Remote data access is kind of what we're doing now -- sharing computer screens. So the dealer can see the screen in the tractor. When you're trying to get your software update and it's not working right, he can work with you wirelessly rather than sending somebody out there. Wireless data transfer allows transfer of large files that can be too big to be emailed. And other services are coming along.

So we need basically LTE type speeds. But coverage is a problem for us. We don't have cell coverage out in America's croplands. Next, please.

So what are we doing about the problem? That's kind of our problem, so what are we doing about it? Next, please.

Two of the most relevant federal programs do provide monies for rural America are one under the FCC, The Universal Service Fund. I'm assuming everybody on the call pays their phone bills. So you're paying into that every month. Then the FCC doles out those funds under several programs. Two most relevant for us are The Connect America Fund and The Mobility Fund.

Also over at USDA is the Rural Utility Service, which loans money -- it gets paid back to the government -- for rural infrastructure, including broadband. Next slide, please.

All right. We also founded the Agricultural Broadband Coalition. It's chaired by AEM, Association of Equipment Manufacturers, and the Farm Bureau. But we've got National Corn Growers, American Soybean Association, National Association of State Directors of Agriculture, Trimble, CoBank, Lindsay Corporation -- which makes center pivots -- and a few other folks. Next, please.

So this is the mission statement of that group. So we're supporting broadband infrastructure -- mobile broadband particularly over ranch lands and croplands and making sure that agriculture is part of the conversation in the national telecom policy level. Next please.

So these are some of the things that we've been advocating for. I keep mentioning cropland. That's been our key metric to try the get the FCC to think about how you can help agriculture with these public dollars, where it would need to go, think about major areas of cropland as measured and put out by USDA. It's only three blocks away from the FCC here in town. Half

the FCC walks by USDA on the way out of metro on the way to work. So maybe they could stop in once in a while.

So these other things are policy ideas for public dollars going into rural broadband. Next, please.

These are two groups that I'm a member of that have taken on some responsibility for rural broadband. One's with the FCC and one's with NTIA. And I'm probably running out of time so next, please.

There's been some activity on the state side. Nebraska signed - sorry. Iowa signed in Connect Every Acre. That's Terry Branstad, now Ambassador to China but when he was Governor of Iowa it was signed into bill. And Connect Every Acre was kind of the moniker. Next, please.

This is what happened to the bill a couple years ago. Had some tax breaks and created a fund which hasn't been funded yet for more broadband, but also did some streamlining of the site regulations which helped the carriers quite a bit. Next.

Other states are getting into the game. Nebraska also created a taskforce to take a look at broadband over cropland and the rest of the state. Next, please.

And lastly, we have at a federal level the Precision Agriculture Connectivity Act or PACA. So this creates the other task group, which is the FCC with USDA and other stakeholders to take a serious look at what is the status of our mobile broadband coverage over our nation's cropland and ranchlands and then recommending a plan to fix that gap. Next.

All right. So Precision Agriculture needs two things -- one is interference-free reception of GPS, and this connectivity piece that we're talking about which is just basically cell towers over cropland.

I believe that's it for me.

Don Williams: Thank you, Mark. Appreciate that. Remember if you have questions, use the question box on the right-hand side of your screen to submit questions and we'll get to those after the presentations.

Our next speaker is Aaron Ault. Aaron received his BS and MS degrees in Electrical and Computer Engineering from Purdue University. He's an avid software and hardware developer, spearheading the development of several open source ag related initiatives, including the Open Ag Data Alliance, the Trellis Framework, and the Open Ag Tech and System Center at Purdue.

Aaron is also Vice-President of Ault Farms, managing daily operations and as he has said getting his hands dirty. Ault Farms is a Midwestern family farming operation with 3,200 acres of corn, soybeans, and wheat and 3,000 head of beef cattle. Please welcome Aaron Ault. Aaron, it's all yours.

Aaron Ault: Thanks. So thanks everybody for attending today. I'm coming to you from the Open Ag Technology and Systems Center here at Purdue University. We've been created to try to bring some of the innovative power of open source that the tech world has figured out to bear in agriculture to try to really improve and increase the potential for data to improve farming. The next slide, please.

And so as he mentioned, I'm a farmer myself, so I farm during the week. I'm also a computer engineer and help found this OAT Center here at Purdue. So

there's my farming credentials. They are my street cred. That's my actual farm. That's where my cows and my corn are all at. So next slide, please.

And so the OATS Center here we got started - we actually officially launched in the Center this January. The acronym stands for Open Ag Technology and System. Primarily to enable new things to happen in agriculture through the use of open source culture, provide a lot of things to help bring that to bear in agriculture and at our core really build a lot of great open source projects and try to participate in building the world wide community in open source and ag, which is really exploding right now.

It's been very heartening to those of us in the trenches to really see the amount of interest out there in the tech community on trying to help the agriculture space.

And so we were launched in January with a key grant from the Foundation for Food and Ag Research. And next slide, please. As well as an industry center, these are some of the partners that we have engaged in sort of helping get to the board levels, find the direction of the center, and try to remain engaged in the problems that are really relevant to agriculture. So next slide, please.

And one of the examples of that we like to use to explain kind of what open source brought to the tech world that ag could really help with, learn from, is the speed of innovation. One of the things that as a farmer who tries to use data on my own farm, it's been kind of frustrating I think at the farm level. The data's been the future for about 25 to 30 years. And it just seems like it's perpetually the future. It used to be small data. Now it's big data but it's still off in the future somewhere. And we think it will help us all to produce better food, but the details of that are still yet to be determined.

So an example - one of the reasons we claim that that's the case in ag is that it's way too hard to try new ideas. It's way too difficult to try something and figure out whether it's going to fail or whether it's a good idea. And when you have open source, it really reduces the barrier to innovation. It speeds those things up.

So here's an example. This is an application I actually built on my farm. I use it every day to log antibiotic treatment for cows. And the creation of this app alone saves me three man hours a day during an outbreak of a particular disease. And in the first two years that I've been using it since I made it, I've cut the death loss on my farm in half -- primarily from being able to run these sort of in the moment sensitivity trials for various antibiotics with the cows on my farm.

But I think the most interesting part about this app is I wrote 1,400 lines of code to do it and it took me about 20 man hours from the point of conception until it was actually done and in production. And if you look behind the scenes, I used 296,000 lines of other people's code from 764 different open source libraries. And that would take more than a year for me to put together on my own. The idea that I can take those things from the open source community and build new value is one of the key enablers I think to making data really work on farms. Next slide, please.

One of the exciting things going on here at Purdue, we've recently gotten a grant from -- we didn't but the Wabash Heartland Innovation Network, this ten county region in Indiana is really focused on trying to improve and experiment in IoT and rural broadband and these kinds of things in that area that you see there. Next slide, please.

And so there were three pillars of this overall initiative. One was to improve the region's next gen manufacturing. A really key pillar was digital agriculture and IoT in addition to a regional cultivation fund to try to help bring a lot more innovative power to this area.

But what you should hopefully be seeing come out of this in the near future is some education, research, various adoption of new technologies, and most critically a lot of new test beds in these areas as well. So hopefully those will be coming by very soon as we get started on that. Next slide, please.

So I think to get down to it one of the key things we recognized early on with the center was if you look at what want from data, I think it can be summarized by this one slide. Data should flow from whatever source the farmer has into whatever tool that farmer wants without manual intervention. That's really what they want from data, right? They want to be able to farm and have data give them the answers they need in their tools without having to think about it or go to websites and export files and email them around. Next slide, please.

And if you think about it, if you're a researcher at a university working in ag too, that's also what you want from data. You want data to move from the field where it's being collected into whatever tools you want. So not a lot of scrips can generate the charts that you need without a lot of manual angling of all that stuff. Its format should just work. The data should flow. Next slide, please.

That's also what statisticians want from data. And next slide, please. And you see when you think about it, there isn't anyone that doesn't want that. That's what everyone wants from data. They all want it to do what it's supposed to do without them having to manually touch all those bikes and export them and

email them around and things like that. It doesn't matter who you are -- that's the key to what data needs to do to provide real value to people. Next slide, please.

So if you want to sum that up in one word, it's automation. Now I think at agriculture especially at the farm level it's critical to understand that the core business of farming is not agronomy; it's logistics. The way most farmers all have the same access to genetics, you know, at least within the US here we have access to the same seed genetics, the same chemicals, the same fertilizers. We all have the same people we buy stuff from.

But the way we differentiate is logistics -- that we get our equipment to the field in time to get the crop planted before the rain comes even though three people called in sick today and there's duct tape wrapped around the hydraulic hose and we're pouring hydraulic oil in the top as fast as it's running out the end to try to beat the rain.

And so the data, if you're going to make data useful in the farm in any real context, it has to be automated in real time. And that's where I think a lot of the broadband question comes into play, is that you can't get real time data if you don't have decent connectivity out there.

So I'm going to show you an example now -- next slide, please -- of what a real value network or what the ag data value proposition is really all about and how this automation comes into play. And so you'll see a progressive farmer today may have a cloud based system. You see in the picture this there that they signed up with an OEM to have their data flow from the combine let's say to the cloud and then the cloud mixed in their field boundaries or something down to their combine.

And then if it's a really advanced system, it can stream all that live to their mobile app and they don't even need to be in their combine to see what the combine monitor sees and it's probably going to a laptop somewhere that's archiving that information and so on. Next slide, please.

And then all of a sudden a new company pops up, Machinehealth.com and they say hey, if you can give me access to the machine data that was streaming to your cloud, then I can actually give you additional insights into like when a bearing is about to go out or whether we think you ought to change your transmission filter right now or we'll analyze your as planted maps, so we're tracking how well your planter was performing in different areas and compare it to what it was supposed to be doing in those areas, thing like that.

And so from the farmer's perspective, he's not going to go to a website ever ten minutes and download a file and email it over to machinehealth.com. There has to be this orange what we're going to call an API connection that automates the movement of that data, that as it flows from the combine the farmer has ahead of time created this sort of permission type for that data that as it comes into his OEMcloud, it needs to automatically end up in this new third-party service that's going to be providing value to him. Next slide, please.

And then as you're starting to deal with this data, you've got a couple different services now. He starts to get feel the need for something like a Google Drive or a Dropbox for himself where he just kind of like his field and final yield data and everything just fit so that he's got a place to put it. So that's what I'm going to call his cloud of choice. That's also an API connection. It could be providing or receiving data from any of these places. Next slide, please.

And once you have that sort of a thing, the farmer's used to data, he's used to it driving his decisions and coming in in real time, there's now an open market for all of these additional services and sensors and things to start making a real dent in his daily decision making processes. So maybe he buys some field sensors like slow moisture sensors from one company. That feeds into his cloud of choice and then that's maybe going into a benchmarking service like Farmer's Business Network that would tell him how well he's doing in various areas of his field compared to other people that have areas of field that are like those.

Those things may be pulling data from various university trials behind the scenes and even producing things in a recommendation service that would all get sinked back to this farmer's cloud of choice -- so like nitrogen recommendations or planting prescriptions and things like that.

And then of course the big master thing that would help all farmers in their daily management is some sort of logistics management service, right? That helps them track this planting process through to completion. Next slide, please.

And then there's the people outside the farmer like the co-op that would be his local fertilizer dealer that is actually going to go spread the fertilizer and create maps of where the fertilizer went and so on and come back to the farm. And they have soil testers and all these things and all this data flows around sort of in real time to actually make this happen. Next slide.

And then now I think one of the more interesting things in this area is people are looking and watching to sort of validate and legally create these records and traceable things that move through the industry. So, next slide please.

So if you want to take away from that picture, the basic way that these kinds of systems are created are from these core low level distractions that I'm going to call an API connection -- which is an automated way for data to get from place to place that requires a sort of broadband connection -- a microservice if it's internal to your company or just a service if it's external -- something that reacts to data coming in -- a storage or catching layer -- something that has a copy of some set of information and has to keep it in sync with another place, and of course open source libraries. None of that works if you don't have open source libraries sort of solving interoperability problem behind the scenes. Next slide.

So if you guys are interested, I won't go into a lot of detail but if you go to Trellisframework.org you can see a pilot that we put out with the produce industry for exchanging food safety data automatically at http trellisframework.org. We just released that last November and we're currently working on a global pilot to put these things all in place to get this automated movement for food safety data and for fresh produce as well and the global fresh produce industry. So next slide.

And that is it for me. So if you guys are interested, please check us out at the Open Ag Technology and Systems Center here at Purdue. Thanks.

Don Williams: Well, thank you Aaron. Thank you for the presentation. Appreciate it. Again, use the question box on the right-hand side of your screen to submit questions and/or comments at any time. And we'll answer those after the presentations.

Our next speaker is John Selep. John is the Founder and President of Ag Tech Innovation Alliance, Co-founder and Board Member of the Buying Institute -- which is a nonprofit collaboration of incubators and innovation spaces in

California and the western region focused on supporting early stage ag and food technology companies, advancing the productivity, efficiency, and sustainability of our food systems.

John is a former communications engineer and a technology executive at AT&T Bell Labs and over a dozen years with Hewlett Packard managing R&D for both wired and wireless for the networking business unit. John's got a master's in engineering from Stanford and a Harvard MBA with 30 years of experience with technology commercialization.

Please welcome John Selep. John, it's all yours.

John Selep: Thank you, Don. As part of the introduction I probably should have mentioned my father grew up on a farm and spent most of his young career in ag. After World War Two, he went into engineering and I and most of my siblings followed that path into the technology side.

But coming back to agriculture has always been an interest of mine. I grew up in Wisconsin. I live in California now. And I spent the last five years focusing on the ag and food technology environment here in the California region. Next slide.

Looking at our global food system, it's a complex value chain that spans multi-trillion dollar industries both in crop production as well as protein production, and there's a range of complementary ancillary products, services, and technologies that support that. Next slide.

Underpinning all of that of course is information technology. Information technology helps the seed developers and the crop input side. It's critically important in the fields for crop production. Information technology and

connectivity are also important for easing the efficiency of post-harvest processing and distribution. So it really underlies that entire value chain from farm to fork.

America is an agricultural leader and we have great technologies that have helped us remain efficient in terms of delivering that food and ag value. Next slide.

But America's leadership as an agricultural leader is under threat. There are critical issues that threaten our productivity today and in the years ahead -- issues revolving around labor -- so the availability and cost of labor -- issues particularly in the west to keep our crops and fields productive. Rising land costs, energy, and economics also threaten our global competitiveness as we fight to produce and export our crops around the world. And also service our local demand, domestic demand in the face of import pressures.

Increasing costs from regulatory compliance and the availability or the potential for information technology and big data to solve some of the compliance and reporting requirements and ease the burden on the small and mid-size farmer are tremendously important.

And also changing consumer preferences. Over the last five or ten years, many consumer packaged goods companies have gone to great lengths to simplify their ingredient stream, removing chemical-based preservatives and other ingredients in favor of plant-based, in some cases organic or natural antioxidants in food preservative.

All of these issues are dramatically changing what's going on - on the farm and I want to share with you a couple of key examples. Next slide.

One of those issues is labor. Increasing labor is shifting the selection of crops and what farmers grow and it's spurring innovation in a number of different areas of technology. Next slide.

That's just one example. Here in California, strawberries are one of the top ten crops. The entire US consumption of fresh market strawberries has tripled over the last 25 years. California has led much of that growth in terms of production to satisfy the demand. And our growth here in California has nearly tripled in that same period.

But over that same period, imports from Mexico and elsewhere have grown over ten times. So it's critically important that we keep California strawberry production cost effective. Next slide.

Based on labor laws already on the books in California, California strawberry growers are anticipating a rise in their labor cost alone for strawberry production of 69% as minimum wages and a 40-hour work week before overtime kick in gradually over the next four years. Labor costs being half the cost of production for fresh market strawberries, overall strawberry production costs are projected to rise 30 to 40%. To keep America's strawberry production costs competitive, we're going to have to rely on robotics and automation to boost harvest productivity in the fields.

As another example on the next slide California used to be a major producer of stone fruit -- that's apricots, nectarines, peaches, and plums. Our production of stone fruit has continued to increase but stone fruit acreage, which was stable up until about 2001 has fallen over 45% in the last 15 years. This represents growers taking out established stone fruit orchards and replacing them with nut trees, vineyards, or other crops.

The reason they've been doing that is because of the uncertain harvest labor availability. Stone fruit are typically a very delicate crop that needs to be hand-picked and hand-picked at that point in the ripening cycle for their crops where it's ripe enough to have flavor and sweetness but not so ripe that it'll turn to mush before it gets to the grocery shelf.

The availability of labor and the uncertainly about whether you can have that harvest labor to pick your crop has made it very risky for growers to continue to produce stone fruit over other crops. They risk their entire year's harvest if they can't get harvest labor into the fields at the appropriate time in the ripening cycle for that fruit. And that's uncertain given the, you know, the variability of weather. A warmer summer can accelerate the ripening and suddenly your scheduled harvest labor is coming too late to pick your crop.

In the next slide, although we were once a top 20 crop in California, peaches and other stone fruit could diminish further or even disappear unless a harvest labor solution is found. Again, robotics and automation -- robotics for picking and harvesting fruit are needed to produce harvest productivity.

As yet another example of the challenges we face in agriculture, on the next slide is water. Water in California, we have rainfall three months of the year -- December through February -- and for nine months of the year effectively no moisture, no precipitation in the bulk of the central valley region. We rely on snow melt and ground water for the bulk of our harvesting.

And because of ground water regulation and increasing drought and uncertainty over the last five or six years, farmers are making increasing decisions to optimize their production for the water they can rely on. And actually fallowing land that was once America's most productive farm land is now in same cases going fallow because of the lack of water.

It's just one example of that. California -- on the next slide, Elaine -- California is a global producer of almonds. We satisfy 80% of global almond demand. I was chatting with a group of visitors from the Netherlands about California agriculture and I was talking about almonds and suddenly their eyes grew round as saucers. They said marzipan. Think of all the Danish pastries and, you know, French pastries with almond paste and almond extract. And they suddenly realized where all of that was coming from. It was coming from California.

We have almost a million acres of almond production, mechanization. By the way, almonds are a fully mechanized crop. There's no hand labor involved in either the pruning, fertilizing irrigation, or harvest. It's all mechanized. So we've enabled the almond industry to really flourish without being constrained by labor.

But on the next slide, water availability may further constrain growth. The bulk of the counties responsible for almond production in California are in the south San Joaquin Valley, which relies almost exclusively on ground water and surface water flowing through large aqueducts from northern California region based on snow melt coming out of the Sierras.

Based on ground water regulations that will take place over the next four to five years, farmers are making real decisions as to whether they should remove their almond orchards, fallow land, or make other provisions to be able to feed their crop.

So precision agriculture -- Mark Lewellen earlier in this webinar was talking about moisture sensors in the field connected to irrigation controls that can be controlled wirelessly where growers can make day by day decisions on do

they hit the button and turn on the irrigation pump, spend the money to pump the ground water to be able to irrigate their crop, or can they stretch that a day and you know, there's enough moisture in the soil for their crop to continue to flourish? They're literally trying to get every last bit of production they can out of every drop of water.

So innovation is clearly needed. And connectivity to drive those Internet of Things sensors and irrigation controls is clearly needed.

On the next slide, to address these needs for innovation in California, University of California in conjunction with Ag Start -- an organization that I head -- and a number of other incubators and accelerators across California have banded together to create a collaborative network statewide of invocation resources making it easier for innovators and entrepreneurs to access the resources they need -- not just mentorship and co-working space, but also maker spaces, physical equipment, wet labs for bioscience and looking at different crop treatments, greenhouses as well as growing fields to do real field trial validation of different approaches from deficit irrigation to different crop treatments to different microbial solutions to enrich the productivity of the soil.

California is a very active innovation ecosystem with lots of startups, incubators, and accelerators. Many of them had have all done their own. What we've found -- on the next slide -- is that by connecting those resources together into a collaborative statewide network, each of these incubators and accelerators realized they can offer their cohort of startups greater value greater services by connecting them to other resources across the state. And those other resources across the state find that they offer more value if they can connect to those entrepreneurs and innovators in other regions of the state.

And so we've got over 15 to 20 different incubators and accelerators that band in together to be able to share resources, connections, and connectivity across our startup community into a true collaborative network statewide.

Happy to answer any questions. That's on the next slide is the close. But I appreciate your interest and we'd love to share more about what we're doing in the western region to support innovation and entrepreneurship in the food and ag space. Thank you, Don.

Don Williams: Thank you, John. Appreciate the presentation. We have a very brief presentation coming up which is on the Global Cities Team Challenge and one of the groupings within that organization. I was going to ask Mark to speak about this as we were fortunate to have him on the leadership team of the Ag and Rural SuperCluster, but Mark has done enough on today's webinar.

So this first slide is just laying out very briefly who the Global Cities Team Challenge organizers are. And those involved in the NTIA, NIST, Department of Homeland Security, International Trade Administration, and the National Science Foundation. Next slide, please.

As today we heard that smart agriculture continues to develop with measurable results, measuring results is very important. We've heard it helps manage cattle ranches, fields that have sensors that can tell the farmer that we have to use water, fertilizer, pesticides, how they can save labor and resource costs.

I also want us to think about in terms of really the importance of telehealth in rural America. So you don't have to drive three hours to get to a doctor. We may be using virtual reality so that rural students can learn about solar power and take virtual field trips.

We also heard today about entrepreneurial and small business incubators and maker spaces in rural America. And this supercluster is designed to encourage action clusters and to learn from those action clusters. Next slide, please.

So we're already seeing a number of clusters that have bloomed. A couple of examples -- University of California is setting up agricultural innovation centers in several of their campuses. Purdue University is going to develop a ten-county test bed for smart ag and rural connectivity with lots of measurement. The State of Pennsylvania Ag department is working on western Pennsylvania's supply chain project to support farm to table food sheds. And I just spoke with the organizer of that a couple of days ago and they've got over ten counties already involved. And finally, New York State Health Department is working on action clusters in the telehealth field.

My point is just I want you all today, you know, we encourage you to anticipate in this or to help publicize existing projects or develop new ones. Thank you.

And now we want to move to questions. We've got quite a few questions from the audience. And let's start with one from someone in the state of Washington. Mark, I think this is primarily for you. They're going to be doing a survey of types in their community to ask about what technologies local farmers are using. And they want to know if the term telematics is a John Deere term or is that something generically used in the community that everybody will be able to understand.

Mark Lewellen: Okay. Good question. No, that's not a John Deere term. That's a fairly broadly used and accepted term although a lot of people probably have not heard of it or don't know exactly what it means. I know from a Deere

perspective we actually put it on our construction machines first. We actually have a construction forestry division in addition to the large ag side of the business.

The construction guys are kind of way ahead of the ag -- well, not way ahead but several years ahead of the ag folk in terms of applying this technology. Construction guys, their big thing is no unplanned down time. So they know they need to maintain their machines. So they want to be able to do it on schedule and when it's planned, not have it break down on them in the middle of the day.

So any color equipment should know what you're talking about in terms of telematics operations because everything I talked about is not unique to Deere. All the other manufacturers are trying to do something very similar.

Don Williams: Thank you. Appreciate that.

Aaron Ault: Don? Hey, this is Aaron. I just want to add really quick if somebody wanted to test some things out, we have a reasonably famous open source project called ISOBlue that is an open source telematics unit you can put together yourself and forward things to the cloud and hook it up to any kind of equipment you want.

Don Williams: That sounds promising. Thank you. Got another question from someone in Sonoma County, California. And they're asking a general question which is, you know, the county's topography is very hilly, diverse, a lot of hard to reach areas, pretty limited broadband access. And they're wondering what ag tech for software and hardware could be used in Sonoma County to reach agricultural areas that are experiencing not a lot of broadband service.

John Selep: This is John Selep. I can speak specifically to some of the activities that we've got going in California. We're actively looking to leverage some of the existing infrastructure that are in place in a number of counties. In California we have irrigation districts that use surface water canals, which are essentially privately owned right of ways or publicly private partnerships. These water districts are a semipublic agency.

They have basically unlimited right of way where you can bury fiber broadband backbones without having to trench. And we're actively looking to do some feasibility studies of deploying that in various places. We're not waiting for the traditional cell phone companies to put up towers because they've clearly demonstrated over several decades their unwillingness to do that in rural, sparsely populated regions. But we're leveraging some of the infrastructure that does exist in those rural areas to provide effectively backbone access for wireless and internet service providers.

What we're envisioning is public-private partnerships where the water or irrigation districts, they own the backbone because they have canals and we'll rely on partnerships with private wireless internet service providers to provide the connectivity down to the individual farms or.

So there's promise. We don't have a solution in Sonoma County yet but stay tuned.

Don Williams: Well, you know, it's great to leverage local assets and to try to form public-private partnerships where you need to expand broadband. Thank you.

Got another question here which is basically asking to what extent satellite service is relied upon for smart agriculture and farming and the ranching industry. And I guess this question really is, you know, to what extent, what

percentage would you say roughly where people are using satellite services rather than land based services.

Mark Lewellen: So I can answer that. Probably less than 1% of our customers are using an iridium modem-based satellite for a limited suite of our telematics solutions. You have to be a pretty big customer and be pretty remote for this to make sense for you. Satellites in general are expensive and limited in bandwidth. The ones coming along, the SpaceX and WebEx and all might be wonderful if they actually come to fruition but it's much too early to make that decision on a technical or business model basis.

We'll see how it goes. But for the moment, those wonderful, beautiful cell towers are the LTE's delivery system of choice for farming.

Don Williams: Thank you. We've got one final question I think we can try to squeeze in here. And this concerns someone from an economic developing board. And they would like to know Vine could work with them to help establish an incubator in one of the counties.

John Selep: This is John Selep, representing the…

Don Williams: Yes.

John Selep: Vine. I'd be happy to chat offline with whoever wants to reach out. My slide have the contact information for me. And we can talk about the specific county, specific resources. We're actively looking to expand the network. We found that counties have unique assets and resources themselves. Some of the - every county has a state fairground which is also an emergency shelter and as an emergency shelter, it needs critical infrastructure like connectivity.

And finding in some counties in California they're using what used to be kind of the underutilized state fairgrounds as startup incubators. Very innovative.

Mark Lewellen: Yes I've heard about that. That's an awesome idea.

John Selep: Again, leverage what's already out there and press the assets we have and get higher utilization frankly of those same assets. Wonderful creative idea. But I'd be willing to talk…

((Crosstalk))

Man: I think that's great.

John Selep: Reach out.

Don Williams: Yes, leveraging local assets that are already there and making partnerships is a great way to proceed.

We only got about a minute or so left. I wanted to just ask maybe generally what do you think are the bandwidth requirements for infield rural broadband connectivity. I mean, what would you all like to see as bandwidth available?

Mark Lewellen: Well I guess I'll jump in first. I mean, LTE type speeds are fine for us. I'd actually trade coverage for speed if I could.

Don Williams: Okay.

John Selep: I would echo what Mark says. Most of the Internet of Thing sensors that we see for such things as water, moisture sensing, and irrigation controls, they're

frankly extremely low bandwidth requirements. They're just popping up a couple of packets of data on an infrequent interval -- maybe once a minute or two in terms of soil moisture. And so it doesn't need high bandwidth.

What we would really love is ubiquitous coverage. When you get to the farm, you know, the farm office or the farm house where you've got children who are trying to do school assignments, you've got the farmer who's trying to file his compliance reports and everything else. That's where the bandwidth requirements might become higher. But, you know, we're not streaming Netflix into the middle of a farm field.

Don Williams: Well said. Well listen, we're out of time. I want to thank everybody who asked the questions. And as we conclude today, I want to remind you all that Broadband USA's Practical Conversations webinars, scheduled for the third Thursday each month at 2:00pm Eastern Time. And next Wednesday July 18th next month we're having a webinar on statewide strategies for rural digital inclusion.

I want to thank all of our speakers today. We really appreciated your insights and your expertise. Thanks, everybody. Have a great afternoon.

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