NEAL R. GROSS & CO., INC.

RPTS SHIPLE

HIF164170

DISRUPTER SERIES: UPDATE ON IOT OPPORTUNITIES AND CHALLENGES

TUESDAY, JUNE 13, 2017

House of Representatives

Subcommittee on Digital Commerce and Consumer Protection

Committee on Energy and Commerce

Washington, D.C.

The subcommittee met, pursuant to call, at 10:30 a.m., in Room 2123 Rayburn House Office Building, Hon. Robert Latta [chairman of the subcommittee] presiding.

Members present: Representatives Latta, Harper, Burgess, Upton, Lance, McKinley, Bilirakis, Bucshon, Mullin, Walters, Costello, Lujan, Dingell, Matsui, Kennedy, and Pallone (ex officio).

This is a preliminary, unedited transcript. The statements within may be inaccurate, incomplete, or misattributed to the speaker. A link to the final, official transcript will be posted on the Committee's website as soon as it is available.

Staff present: Blair Ellis, Digital Coordinator/Press Secretary; Melissa Froelich, Counsel, Digital Commerce and Consumer Protection; Adam Fromm, Director of Outreach and Coalitions; Giulia Giannangeli, Legislative Clerk, Digital Commerce and Consumer Protection/Communications and Technology; A.T. Johnston, Senior Policy Advisor, Energy; Bijan Koohmaraie, Counsel, Digital Commerce and Consumer Protection; Katie McKeough, Press Assistant; Alex Miller, Video Production Aide and Press Assistant; Paul Nagle, Chief Counsel, Digital Commerce and Consumer Protection; Mark Ratner, Policy Coordinator; Madeline Vey, Policy Coordinator, Digital Commerce and Consumer Protection; Evan Viau, Staff Assistant; Michelle Ash, Minority Chief Counsel, Digital Commerce and Consumer Protection; Jeff Carroll, Minority Staff Director; Lisa Goldman, Minority Counsel; and Caroline Paris-Behr, Minority Policy Analyst.

Mr. Latta. Good morning. And I would like to call the Subcommittee on Digital Commerce and Consumer Protection to order. And the Chair now recognizes himself for five minutes for an opening statement.

And good morning again. And today we continue the Disrupter Series with our focus on the Internet of Things. Most of us just came from the Rayburn forum where our panelists and 17 other companies and universities showcased the important work they are doing in this sector. Members and staff saw firsthand the innovative ways companies and universities are using the Internet of Things to better meet consumer demands.

I want to thank all of you who participated in this event. And I also want to thank our hard-working staffs who put this all together, because without their hard work it would not have occurred.

The Internet of Things, or IoT, loosely refers to a network of connected devices, services, and objects that collect and exchange information. And new devices are being connected all the time. Today, for example, C-SPAN is tapping into the Internet of Things by testing a new and innovative 360 degree HD camera right here in our committee hearing room. While this footage will not be publicly available, this is just one more illustration of how connectivity in this day and age is used to collect, share,

and exchange data in real time.

These connected devices offer businesses and consumers significant benefits. For businesses, IoT is improving efficiency and increasing productivity for all, while helping to drive down overhead costs. For consumers, IoT provides quick, responsive services, enhanced experiences, and convenience.

We are seeing IoT revolutionize a variety of industries and optimize everything from manufacturing and home appliances to automobiles and healthcare.

Specifically, in the healthcare industry IoT is being used to both enhance preventive measures as well as streamline treatment for other health issues. Joining us on the panel today from my home state of Ohio is Dr. Marras. And Dr. Marras is Executive Director and Scientific Director of the Spine Research Institute at The Ohio State University, and plays an important role in the IoT and healthcare space.

His team is using IoT in a variety of ways to help diagnose spine disorders, improve effective back treatments, and identify occupational tasks that cause back injury so that businesses adjust those tasks to reduce the on-the-job injuries.

I look forward to hearing more about the work that our panelists are doing in the IoT space and how IoT has improved the important work you are all doing. I also look forward to

exploring how we, as policymakers, can continue to promote IoT and address any regulatory obstacles or barriers you foresee that may stifle innovation or otherwise hinder the industry.

And, again, I want to thank you all for joining us today.

And is there anyone on our side wishing to claim my additional time? I recognize the gentleman, the vice chairman of the subcommittee, for the remaining time.

Mr. Harper. Thank you, Mr. Chairman, for calling this hearing today on the Internet of Things, or IoT. And I would like to extend a warm welcome to Dr. Gary Butler from my hometown of Pearl, Mississippi, on the panel this morning. Dr. Butler is the founder, CEO, and chairman of Camgian Microsystems, headquartered in my district, in Starkville, Mississippi.

Camgian is driving information and innovation in the industrial IoT world and pioneering efforts to use cutting edge solutions to help address our growing infrastructure problems in the United States. Camgian's award-winning IoT product Egburt, released in October of 2014, is an end-to-end software application specifically designed to intelligently manage large volumes of complex sensing and processing operations.

The distributed computing feature of the Egburt design, otherwise known as edge computing or fog computing, utilizes multi-sensor and information processing technologies to deliver

real-time, actual intelligence to users for the network's edge. Egburt was designed to provide commercial and government customers a broad range of services for remote monitoring applications such as smart infrastructure and condition-based maintenance.

As an example, Egburt powers the new intelligent decision support, or IDS, systems for the U.S. Army Corps of Engineers which is currently installed on the Markland Lock and Dam on the Ohio River.

I'm looking forward to hearing from each of the witnesses today to learn more about how IoT is improving our quality of life, safeguarding the flow of commerce, and strengthening our economy.

With that, I yield back.

Mr. Latta. Thank you. The gentleman yields back.

At this time the Chair now recognizes for five minutes the gentlelady from Illinois, the ranking member of the subcommittee.

Ms. Schakowsky. I want to thank Chairman Latta and the committee staff for organizing this morning's Internet of Things Showcase. I was so excited about what was happening. I was a little bit late; I'm sorry. But it was so impressive to see what these young people are doing.

I was especially proud to welcome students from Northwestern University, which is located in my congressional district. The

Garage at Northwestern is a hub for entrepreneurship and innovation that brings together students and faculty across disciplines. In a given quarter, The Garage is home to some 60 student-founded start-ups and it prepares students to take those start-ups to the next level.

Each year, The Garage holds the venture cap competition where students pitch their start-ups. The Northwestern students at our Showcase this morning were semi-finalists in the 2017 competition. They are not there in the audience yet. I hope they come.

The PedalCell start-up, founded by Northwestern freshmen Vishaal Mali and Christopher Aigner, lets you charge your telephone, your cell phone as you pedal your bike; an energy-efficient way to stay connected as you move through the day.

LifeMotion, founded by mechanical engineering Ph.D. Michael Young, is helping oral cancer survivors restore mouth function. It's a wearable rehabilitation device that logs information for the patient and physician to improve health outcomes.

These are just two great examples of how innovation can benefit our country. Research universities like Northwestern are critical to the future of innovation in the country. And I am working with my congressional colleagues to provide the

education and research funding necessary to help this innovation to continue.

Here they are, our students, our innovators for both the PedalCell and LifeMotion.

Our panel today is made up wholly of participants in our IoT Showcase. I talked with some of you earlier, and I look forward to hearing more about your work. You saw the showcase at the Showcase, the enormous potential for the Internet of Things. I am interested to hear about the challenges our witnesses have faced as we are familiar with in the subcommittee the make-up of connected devices have to think about our -- have to think about user experience, privacy, and security, as well as all the issues of other entrepreneur deal -- that other entrepreneurs deal with.

We value your perspective as we determine how the Federal Government can help consumers realize the full benefit of your technologies. I want to thank you for joining us today.

And now I yield to Congressman Cardenas the remainder of my time.

Mr. Cardenas. Thank you, Ranking Member Schakowsky. And also thank you, Mr. Chairman, for holding this committee. And I would like to thank all of the witnesses for coming here today. It is exciting to hear from so many great American companies that are providing technology and jobs of today and tomorrow.

I am especially proud of Cameron Javdani from Louroe Electronics. Came all the way from the San Fernando Valley, my district, which has been my home my entire life. And thank you for representing us here in this hearing.

Southern California remains to this day one of the great American hubs of innovation in manufacturing. And Louroe Electronics from my district not only embodies this legacy but also takes its products beyond Los Angeles and actually to the rest of the country and to the world. Louroe's state-of-the-art audio monitoring products are used in almost 60 countries worldwide, and which is especially impressive for a company that is actually a small company. And they are constantly evolving to incorporate technologies like the integrated network connectivity behind the Internet of Things, all to help security professionals keep our communities safe.

In fact, in 2015, Louroe Electronics received the President's E Award for exports, the highest honor given to a United States exporter corporation. I used to own my own little small business at one time, so I know what it is like to be in your shoes.

I visited Louroe Electronics more than once. I have seen firsthand their commitment to their employees and to our community. Louroe's CEO, Mr. Richard Brent, as a matter of fact

I ran into him at the airport yesterday, and I said, "You going to D.C.?" He says, "No. I am going to Dallas." He is a leader not only in our community but a perfect example of what it is to be a contributor to knowledge and information and innovation, not just for a local community but for the country and the world.

Again, I am also proud to say that Louroe Electronics is here as part of the presentation today.

And with the interests of time, once again, Mr. Chairman Latta, thank you so much, and Ranking Member Schakowsky, for holding this hearing. I yield back.

Ms. Schakowsky. I yield my time.

Mr. Latta. Thank you very much. The gentlelady yields back the balance of her time.

The chairman of the full committee is not here at this time. And we will recognize the gentleman from New Jersey, the ranking member of the full committee, for five minutes.

Mr. Pallone. Thank you. Today this committee held, is holding its second showcase of new and emerging technological products connected to the Internet. The Internet of Things encompasses everything from an Internet-connected fitness tracking device that counts and records the steps of an exercise-conscious person, to a fully autonomous automobile. And today we had the opportunity to see a range of products that

may help consumers in a variety of ways.

I am particularly interested in some of the products that reduce our use of fossil fuels. Some IoT devices are helping homeowners ensure their homes are more energy efficient, building owners are improving the operational efficiencies of escalators and elevators.

As we learned at the Smart Committee hearing, cities are using smart technologies to save precious water resources and reduce energy usage.

In my district, the city of Asbury Park is installing sensors that can remotely control the boardwalk's lighting, which the city expects will help save money on its electricity bills. Using less energy means using less fossil fuel.

And as we have discussed throughout the Disrupter Series, technological advances are making financial transactions more convenient and efficient, healthcare more accessible, and our roads more safe. The Internet of Things has penetrated all sectors of the economy. And because technological changes have come to all aspects of our lives, we are all faced with the challenges of integrating technology. And particularly, I must mention the challenge of cybersecurity.

At last week's hearing on healthcare cyberthreats, I highlighted that our critical healthcare systems are at risk for

attack. Our health records are part of the Internet of Things, as are many of our medical devices. Right now another one of our subcommittees is having an informational hearing on cybersecurity risk to wireless technologies. And I hope that we, as a committee, will move beyond the informational review and start considering real legislative solutions such as the Democratic bills that have been introduced to address these problems.

After all, it sounds great to have your food delivered by a robot or drone, but we do not want that robot or drone hacked. And while sometimes these cybersecurity threats sound like they come from a science fiction movie, incidents like the Russian hacking and the interference in our elections demonstrates that the threat is real. Creators and manufacturers of Internet-connected technology must take responsibility for mitigating this threat.

So I implore everyone working in this space, including our distinguished witnesses today, to ensure that cybersecurity and data security are built into your products from day one. That way, consumers will have the confidence to buy and use these products knowing protections are in place.

And also be mindful of consumer privacy. In the age of big data, it's tempting to collect more than you need. The more you collect, the more you must secure. And consumers have already

repeatedly told us that they want control of who has access to their data.

I yield the balance of my time to Mr. Welch.

Mr. Welch. Thank you, Mr. Pallone. I want to just welcome Bill Kuhns from North Ferrisburgh, Vermont, U.S. world headquarters of the Vermont Energy Control Systems. But that is a great company. And you have got your display downstairs and presented it to me.

But Mr. Kuhns has 20 years of experience in aerospace. He started a small company in North Ferrisburgh, Vermont. It's a small company in a small town with a large footprint. This morning I saw on display clients using your products from the East Coast to the West Coast. And you may have made a new sale, because it looks like my wife and I could, you know, take advantage of being able to control our thermostat from afar. We don't like to get home to chilly houses in Vermont.

But it's an amazing thing to me to see how, what your technology allows to be done. You know, it was amazing. First of all, you can control your home. But, also, beer makers were able to get precise measurements about the malt making process. So there's no end to the benefit of the precision that can come with the use of the Internet.

And this, Mr. Chairman, you and I started our bipartisan

committee. It has got 21 members on it. This is an area of enormous potential. And the folks here, we want to hear from you about what you did, Bill, with your partner, with Mr. Shepard who's down there, fielding, fielding inquiries, is really tremendous. And we're proud of you in Vermont and look forward to your testimony today.

I yield back. Thank you, Mr. Chairman. Thank you, Mr. Pallone.

Ms. Schakowsky. If I could just have the remaining couple of seconds, I wanted to add Adam Hokin and Andrew Brown, who I hadn't mentioned before as part of PedalCell, for the permanent record. Thank you.

Mr. Latta. Thank you very much. The gentleman's time has expired. And at this time that will conclude our members' opening statements.

The Chair would like to remind members that pursuant to committee rules all members' opening statements will be made part of the record.

[The information follows:]

**********COMMITTEE INSERT 1**********

Mr. Latta. Again I want to thank all of the witnesses for being with us today. We greatly appreciate your time to testify before us at the subcommittee. And today's witnesses will have the opportunity to give opening statements, followed by a round of questions from the members of the subcommittee.

Our witness panel for today's hearing will include Dr. William Marras, Executive Director and Scientific Director are the Spine Research Institute at The Ohio State University. When they wrote my notes up they didn't put the "The" in there that I put in. Because in Ohio we do know it is The Ohio State University.

Dr. Gary Butler, Founder, Chairman, and CEO at Camgian Microsystems Corporation.

Mr. Bill Kuhns, President at Vermont Energy Control Systems LLC.

Mr. Cameron Javdani, Director of Sales and Marketing at Louroe Electronics.

Dr. Mark Bachman, CTO and Co-Founder, Integra Devices.

And Peter Kosak, Executive Director of Urban Active Solutions at General Motors North America.

We appreciate, again, you all being here today. And we will start our panel discussion this morning with Dr. Marras. And you are now recognized for five minutes. Thank you very much.

STATEMENTS OF WILLIAM S. MARRAS, PH.D., EXECUTIVE DIRECTOR AND SCIENCE DIRECTOR, SPINE RESEARCH INSTITUTE, THE OHIO STATE UNIVERSITY; GARY D. BUTLER, PH.D., FOUNDER, CHAIRMAN, AND CEO, CAMGIAN MICROSYSTEMS CORPORATION; WILLIAM S. KUHNS, PRESIDENT, VERMONT ENERGY CONTROL SYSTEMS LLC; CAMERON JAVDANI, DIRECTOR OF SALES AND MARKETING, LOUROE ELECTRONICS; MARK BACHMAN, PH.D., CTO AND CO-FOUNDER, INTEGRA DEVICES; AND PETER B. KOSAK, EXECUTIVE DIRECTOR, URBAN ACTIVE SOLUTIONS, GENERAL MOTORS NORTH AMERICA

STATEMENT OF MR. MARRAS

Mr. Marras. Thank you, Chairman Latta, Ranking Member Schakowsky, and members of the subcommittee. Thank you for this opportunity to speak about transformational innovations, leveraging the Internet of Things occurring at The Ohio State University's Spine Research Institute.

My testimony today will highlight the way in which Ohio State University's Spine Research Institute, or SRI, is coordinating the communication of advanced sensors, imaging and modeling through the Internet to help prevent and better treat spine disorders.

Spine disorders, worldwide, are the most disabling condition known to mankind, are responsible for over 100 million lost

workdays per year in the United States alone. The condition affects 80 percent of the population some time in their lives, and is the second leading cause for physician visits. And we spend over $100 billion a year treating people for low back pain in the U.S. Despite increasing treatment costs, the source of the disorder is often difficult to pinpoint, resulting in spine surgeries which are frequently unnecessary.

At the SRI our mission is to quantitatively understand the causal pathways for spine disorders and use this information to prevent and treat spine disorders. The SRI is unique in that it is a true collaboration between engineering and medicine. This collaboration has resulted in important breakthroughs, which have contributed to the prevention of countless workplace injuries and improved the lives of patients.

The use of innovative technology to collect and exchange data through the IoT has made all of this possible. I would like to highlight three specific examples of how we are using technology associated with the IoT to make a positive impact in this important research area.

First, we have developed smart, wearable sensored devices that are capable of quantifying the extent of low back impairment. The sensors track the patient's spine motion patterns and wirelessly transfer it to our laboratory servers via the IoT where

it is compared to our spine motion databases. This information is then sent to the physician to assist in diagnosis and clinical decision-making. The test can be repeated after treatment to objectively track the effectiveness of the treatment.

This system is currently used to evaluate spine patients at the OSU Wexner Medical Center and is being tested at the Ohio Bureau of Workers' Compensation.

And the second example, we use advanced sensors and biomechanical modeling to prevent spine injuries in the workplace. We can simulate work and objectively evaluate occupational risk in our laboratory. Workers perform their job while a variety of smart sensors measure how they move, how they activate their muscles, and monitors the forces they exert.

This information communicates with our sophisticated personalized biomechanical models via the IoT. These models allow us to understand the forces imposed on the spine tissues during work, and help us understand how much exposure to specific work tasks is too much exposure. Using this approach, we are able to redesign work tasks and objectively evaluate the effectiveness of the interventions.

We have used this approach to help numerous companies, including Honda, Ford, Toyota, BMW, Boeing, and many others reduce low back disorders. In fact, Honda has been recognized by

industry experts and Forbes magazine for reducing injuries in North America by 70 percent in just over five years. A current project with the Ohio Bureau of Worker's Compensation has developed occupational pushing and pulling guidelines that will soon be distributed throughout the state via the IoT.

A final example of our use of technology relates to the IoT, involves predicting the outcome of spine surgeries before the surgery takes place. By combining IoT data from wireless motion, force, and muscle activity sensors with a patient's own biomedical imaging data from CT and MRI, we are able to build precise personalized computational models of a patient's spine. These models can be used to better understand the root cause of patient's injuries and help the surgeon choose the best treatment options. The personalized modeling has the potential to improve the current success rate for spinal surgeries.

In addition, this virtual modeling can be made tangible by simply sending the data to a 3D printer. We are able to print exact models of the patient's spine and help the surgeon better understand the patient's specific anatomy and explore the use of this technology for custom spinal implants.

Many of these advances have been made possible through the compilation of massive amounts of data regarding the unique aspects of the patient's tissue architecture. However, one of

the biggest challenges in this work involves getting access to patient information because of the patient protection laws. While patient identity protections are certainly necessary, they also create significant hurdles in attempting to assemble large database of patient outcomes and hamper the effectiveness of machine learning efforts.

Another significant roadblock is sustainable federal funding for long-term research efforts such as these. Given the lack of certainty in federal research funding in recent years, these and future efforts could be in serious jeopardy.

I would like to thank the committee again for their time. I would like to -- I look forward to the committee's questions. Thank you.

[The prepared statement of Mr. Marras follows:]

**********INSERT 1**********

Mr. Latta. Well, thank you very much for your testimony.

And, Dr. Butler, you are recognized for five minutes. Thank you.

STATEMENT OF GARY D. BUTLER

Mr. Butler. Good morning, Chairman Latta, Ranking Member Schakowsky, and members of the subcommittee. Thank you for the opportunity to testify today.

My name is Gary Butler and I am the founder and CEO of Camgian Microsystems Corporation, a developer of advanced sensing and analytical processing technologies. Camgian, a Starkville, Mississippi based high tech company, has been recognized by leading technology analysts such as Gartner for our product innovation in the Internet of Things sector. While much of the attention in IoT has been focused around consumer applications, our efforts are addressing the commercial market. Sometimes described as the Industrial Internet of Things, this segment of the IoT space represents a new form of intelligent systems that are optimizing the dynamic of humans, data, and machines to drive revolutionary gains in productivity and efficiency.

From maximizing asset utilization to improving safety, industrial IoT technologies stand to transform business and drive a new wave of global economic expansion.

To address this opportunity, we developed Egburt, an award-winning IoT software platform built in an edge computing model. Egburt performs advanced multi-sensor data processing at

the network's edge to enable efficient and scalable IoT operations with economical utilization of communications resources.

In partnership with our clients, we are developing industrial IoT applications built on Egburt in areas related to condition-based monitoring and maintenance of remote, high value assets and equipment. Based on our experiences in developing and deploying such systems, I would like to offer the subcommittee my perspective on the state of industrial IoT and its future.

At Camgian, we see IoT as a critical technology trend that doesn't merely connect the physical world, but powers it using advanced computing. That is to say, IoT extends the reach of today's software and data processing technologies far beyond traditional Internet boundaries and into the physical world around us. This is enabled through a system architectural model where industrial assets are imbued with sensing, processing, software, and communications technologies. The result is the generation of critical insights into the operation and maintenance of industrial systems that were previously unavailable.

Today, such insights are driving better and faster decisions and delivering enormous economic business and economic advantages to companies and organizations worldwide.

A case study includes our work in condition-based monitoring

where we are partnered with clients responsible for managing the reliable operations of remote industrial assets. Examples include large civil infrastructure systems such as locks and dams, and power systems for marine operations such as diesel engines and generators. In these cases, downtime due to unscheduled maintenance can represent millions of dollars of economic loss.

To address this problem, we are leveraging Egburt in the development of new applications that will provide operations and maintenance personnel the ability to remotely and efficiently monitor the condition of large numbers of industrial assets across their enterprise. Specifically, this includes the remote collection and analytical processing of large volumes of asset sensor data to identify failures before they happen, and drive radical improvements in operational reliability and safety.

The potential value of eliminating unscheduled downtime across the industrial sector is enormous, but represents only one example of the economic power of this technology trend. Similar IoT enabled gains in productivity, cost reductions, and worker safety are emerging in other markets and are now driving the technology's widespread adoption throughout our society in areas such as transportation, manufacturing, oil and gas, healthcare, power distribution, and agriculture, to name a few. Management consultant Accenture estimates that industrial IoT technologies

could add $14.2 trillion to the global economy by 2030, including $7.1 trillion to the United States.

Looking ahead, fueling this growth will be new innovations in advanced sensor and analytical processing technologies. With billions of industrial sensors deployed today and growing, exploiting the untapped value of the massive data sets generated from these devices will be the next big leap in IoT's technology evolution.

With Egburt, we are tackling this big data challenge through a confluence of innovations in real-time signal processing, data analytics, and machine learning with the aim of transforming today's human-centric IoT models into semi-and fully-autonomous intelligent systems. This will include automating the data to decision continuum, a tipping point in IoT's evolution that will spark a wave of automation, reinventing industrial processes and transforming the future workforce.

Thank you. And I will look forward to your questions.

[The prepared statement of Mr. Butler follows:]

**********INSERT 2**********

Mr. Latta. Well, thank you for your testimony.

Mr. Kuhns, you are now recognized for five minutes. Thank you.

STATEMENT OF WILLIAM S. KUHNS

Mr. Kuhns. Thank you, Chairman Latta, and Ranking Member Schakowsky, and the rest of the committee for inviting us to share our perspective.

I am Bill Kuhns, President and Co-Founder of Vermont Energy Control Systems in Vermont. We are a small company and started based on an observation that may seem fairly mundane: most things don't work the way they are supposed to. In fact, every building we have been in we found out that the systems in that building may have been designed well, but they don't work well. And there is an enormous amount of energy, an enormous amount of value that is lost from systems just not working the way they are supposed to.

So part of our mission is to provide an open-source, non-proprietary solution that allows people to instrument and understand what is happening in the buildings and the systems that they own.

In pursuit of that, I would like to start by echoing the comments of Daniel Castro from the 2015 IoT event: Congress must avoid heavy-handed regulations that can stifle innovation. This is an area where innovation is really happening at a breakneck pace. Just as with the early Internet, there is a lot of chaos.

The potential benefits are enormous, but it is not clear exactly what is going to happen. It is important that we allow the evolution of this technology to proceed with as few barriers and impediments as possible.

As a small business owner, I am very much aware of the challenges that small businesses face. According to the Bureau of Labor Statistics, the percentage of people employed by small businesses in the country has been in decline for decades, and the rate of small business start-ups has been in decline for more than ten years. This is a problem in the IoT space because small businesses are much more able to move quickly and be agile and take advantage of opportunities.

Every regulation, however well-intentioned, adds to the costs and risks of starting a business. Even more critically, it distracts the entrepreneur from focusing on the purpose of the business. You can't be innovating when you are filling out regulatory paperwork. This might be an expense for a big company, but it can be lethal for a small business.

I would like to give you just a simple example from my own experience. This is more on the economic side than on the IoT technology side. But this month we wanted to hire a part-time college intern this summer from the University of Vermont. We discovered that in Vermont, even though this would be our first

actual payroll employee we have to have workers' compensation insurance. For a big company in our industry, that might add 1 or 2 percent to payroll. For us, it added more than 10 percent to our payroll costs. And even more importantly, it took a day-and-a-half of my time to figure out how to comply with that regulation.

As we launch our IoT products, we have plenty of technology challenges and security challenges, other things we need to focus on. It is important that regulatory compliance does not add another layer of costs, delays, and uncertainty.

A second issue that I want to touch on briefly is radio frequency spectrum. We are particularly interested in low frequencies that penetrate building structure. And these frequencies don't support high data rates. They are not useful for cell phones and that sort of thing, but they work very well through structures, through walls, and trees. In the U.S. there is only a small band available, and those frequencies are different from what is in use in the rest of the world. That means that if you buy a sensor that is built in Europe it won't work in the United States. And it means that ours won't work there.

It would be helpful to free up additional low-frequency spectrum for low-power devices. It would be crippling to sell rights to specific frequency bands at auction, as has been done

in other auctions of the frequency spectrum. Bandwidth is a finite public resource. Selling it to the highest bidder effectively shuts out small businesses.

Finally, I would like to touch on security. There has been some very good points made on security. And it is particularly near and dear to our hearts.

There was a significant breach accomplished recently through a compromised building management system installed by one of our competitors. As a manufacturer in that space, that got our attention. We are very sensitive to that issue. And every connected device is a risk; if you can connect to it, so can an intruder.

Physically, I live in a very safe area. I live on a dead-end road in Vermont and it is wonderful. On the internet I live in a high-crime district. We see literally hundreds of probes and connection attempts every day. It is exactly like having masked men coming around my house and trying to open the doors and windows. We are doing all we can to make sure the doors and windows are locked, but it is obvious to me there is no way we can continue to have new and innovative products without also introducing new vulnerabilities. We need to figure out a more effective strategy for protective measures, deterrents, and law enforcement in this area.

631 And with that, I am done. Thank you very much.

632

633 [The prepared statement of Mr. Kuhns follows:]

634 **********INSERT 3**********

Mr. Latta. Well, thank you very much for your testimony today.

And, Mr. Javdani, you are recognized for five minutes. Thank you very much for being with us today.

STATEMENT OF CAMERON JAVDANI

Mr. Javdani. Thank you, Mr. Chairman, Ranking Member Schakowsky.

I am delighted to appear before the committee today to discuss the successes and challenges that Louroe Electronics has experienced with IoT technologies in the security and surveillance industry. We are proud to be an American manufacturer of audio technologies for security systems, and have products used in almost 60 countries today. Since our founding 1979, our technology has evolved from standalone analog devices to a current portfolio of integrated network-connected devices and sensors.

The benefits of IoT technologies in security applications are numerous. Primarily, networked devices allow security officers to monitor larger geographic areas and take advantage of economies of scale to reduce the operating costs of a security system. This design allows for faster identification of a security incident, faster response times to a security incident, and the ability to send relevant information and evidence to the appropriate authorities in near real time.

Technology growth within the security and surveillance industry is largely focused on the analytic capability of a

system. Very few surveillance devices are monitored in real time, which means that IoT devices are data sensors, and not surveillance equipment as they are more conventionally thought of.

The analysis of this data, which is an automated process, will alert security officers and staff in the event of an incident. Louroe technologies, including vocal aggression detection and gunshot detection, look for certain acoustic patterns that represent security threats. Used alongside other networked security technologies, this type of system provides for optimization of security resources, as it no longer becomes necessary for staff to monitor all areas at all times.

As IoT technologies continue their adoption in the security industry, there are certain risks that present themselves. Unauthorized access to data, either stored on recorders or being sent over a network, present challenges to be sure that Americans' privacy expectations are met. Certain basic security practices, especially in the consumer market, can be taken to make sure that unauthorized access is restricted or does entirely not take place. Most notably, it is recommended that users of IoT devices, security or otherwise, add a password to their devices or change the default username and password that comes pre-loaded on an IoT device.

Without taking appropriate precautions, consumers put themselves at risk of their privacy being violated. Online websites and communities exist where non-password protected cameras, or cameras that still use factory default login credentials, are streamed live over the Internet for anyone to see. Certain malware and viruses scan networks for IoT devices that accept these default credentials, and then compromise these devices for use in large scale denial of service attacks.

Despite these risks, the adoption of IoT devices in the security industry continues to accelerate. For Louroe Electronics there are two key areas of success I wish to point out for the committee.

First, since late 2011 we have worked closely with the U.S. Commercial Service within the Department of Commerce to export our technology. Thanks to the work of trade administration officials in American embassies, and especially the work of the West Los Angeles Export Assistance Center, we have more than doubled the number of countries we have exported to. In 2015, we were honored to receive the President's E Award for Export Achievement, the highest recognition a U.S. entity may receive for export activity. This is an achievement that could not have become reality without our partnership from the Commercial Service.

Second, we have made advantageous use of free trade agreements for international market access. For a small business in America, the removal of trade barriers creates new opportunities to reach new customers with more affordable products. As the current administration has stated their intention to review our trade policies, I urge the Congress to ensure that any change to trade agreements preserves that market access, and that supply chains for American small businesses be maintained. Any change that restricts either will reduce exports and increase product prices to the detriment of American manufacturers. However, an opportunity exists to update agreements to address IoT industries and technologies, many of which did not exist when the agreements were enacted.

Mr. Chairman, thank you for the invitation to appear today before the committee. I look forward to answering your questions and the committee's questions on IoT opportunities and challenges. Thank you.

[The prepared statement of Mr. Javdani follows:]

**********INSERT 4**********

Mr. Latta. And, again, thank you for your testimony.

And, Dr. Bachman, you are now recognized for five minutes for your statement.

STATEMENT OF MARK BACHMAN

Mr. Bachman. Chairman Latta, Ranking Member Schakowsky, and committee members, thank you for inviting me today to share some thoughts and insights on the opportunities and challenges in the Internet of Things. I would especially like to thank Representative Mimi Walters, who represents the University of California Irvine in California's 45th Congressional District, for support of UC Irvine.

For this testimony, I am representing two organizations, the University of California Irvine and Integrate Devices. UC Irvine is a world class premier research university, the Orange County campus of the University of California system. UC Irvine promotes IoT through research, education, outreach, and tech transfer. Integra Devices is a spinout company from UC Irvine that develops smart sensing modules for IoT, utilizing unique intellectual property for advanced manufacturing, machine learning, and energy harvesting.

My testimony describes my experiences and perspectives regarding some challenges and solutions for IoT. I can only briefly discuss these topics now, but I provide more information in my written testimony that covers overview of IoT, the role of the public university in leadership and stimulation of the local

IoT economy, and the spinning out of my IoT start-up.

This testimony comes from my direct experience in these topics. As a professor and IoT Evangelist, I spent many years studying IoT, working with researchers and companies to implement technology for IoT applications. As an entrepreneur, I have brought technology out of the university to convert it into commercially viable goods and services.

The Internet of Things promises to bring dramatic changes to the way we do things in our world, bringing large quantities of new data and insights about industrial processes and operations, enabling us to do business with greater productivity, efficiency, and safety than ever before. There are expected to be 50 billion connected monitoring devices deployed by 2025. And using sophisticated analysis of data from thousands of monitoring units in the industrial and civil infrastructure, we can better understand the complexities of our operations and identify ways to improve the way we do things.

Most of these improvements will have significant economic benefit. The resulting combined economic impact of IoT is predicted to be between $4 to 11 trillion by 2025. Industry and manufacturing, transportation, and civil infrastructure represent the largest markets. Home automation and consumer products, while significant, represent the smallest of the IoT

markets.

Universities such as UC Irvine have the potential to be a powerful catalyst in leading the effort towards next generation IoT. Research and development in areas such as basic sciences, information sciences, social sciences, and business lead directly to insights, technologies, and methodologies that can drive IoT applications, services, and products. In Orange County, California, UC Irvine provides leadership for our IoT ecosystem through research, training, public outreach, and the stimulation of enterprise.

UC Irvine provides a common ground for companies, government, and the public to work together on IoT topics. Several organizations on the UC Irvine campus are active in promoting and stimulating the IoT economy in Orange County. These include the California Institute for Telecommunications and Information Technology, Calit2, and the UCI Applied Innovation Institute. Calit2 works with industry and campus researchers across disciplines to convert basic research results into technology that is practical and of value to industry. UCI Applied Innovation brings campus-based inventions and entrepreneurship together with Orange County's vibrant business community to support job creation and economic growth.

My own company, Integra Devices, is producing IoT products

based on technology that was developed at UC Irvine over the last 15 years. We produce highly-integrated, wireless smart sensing modules that can be used to monitor industrial and infrastructure operations. Our sensing devices are fully self-contained, requiring no additional hardware, can be placed on machinery and infrastructure, and can analyze their activity in real time, extracting the key features of the signal to send to the cloud. Our devices can learn the patterns of machinery, and within a few hours can identify the natural state of machinery and report when it deviates from normal behavior, providing key information for predictive maintenance and operations.

Many of our devices can run under zero power conditions, meaning that they do not need to be cabled and they do not need to have batteries replaced. This is highly-advanced technology that requires new manufacturing methods to build our devices. The key manufacturing for our devices is done in the United States.

Most of the research leading to these products was done at UC Irvine. Some of our current development is funded by the National Science Foundation. Integra Devices has benefitted greatly from research performed at the University and continues to partner with UC Irvine and other public institutions to develop new IoT technologies and applications, and train the next generation of IoT leaders.

Having worked in both public academia and the private sector, I am convinced that a strong public-private partnership will stimulate the next generation of technologies, business practices, applications and services, and small companies for IoT, ensuring that the United States retains leadership in IoT over the coming years. I have worked with and presented to colleagues, business leaders, government agencies, and entrepreneurs in the technology industry in Europe, Asia, and the Americas. The significant degree of cooperation between our public institutions and universities is the envy of the world and widely regarded as one of our key advantages for bringing innovative technologies, practices, and enterprises to the market.

The Internet of Things is probably the most significant tech market of the 21st Century, and is one that the United States can lead, if we are committed to doing so.

Thank you.

[The prepared statement of Mr. Bachman follows:]

**********INSERT 5**********

Mr. Latta. Thank you very much for your testimony.

Mr. Kosak, you are recognized for five minutes. Thank you for being with us.

STATEMENT OF PETER B. KOSAK

Mr. Kosak. Thank you. Good morning, everyone. My name is Peter Kosak.

Mr. Latta. Is his mike on, please? Thank you. Mr. Kosak. Thank you. Still technology issues. The most simple.

Good morning. My name is Peter Kosak. And I am Executive Director of Urban Active Solutions and Maven at General Motors.

I thank you, Chairman Latta, Ranking Member Schakowsky, and distinguished members of the subcommittee for the opportunity to speak to you today about the new initiatives that General Motors has to address changing mobility needs of consumers.

At GM, disruptive technology developments are unlocking access and efficiencies in transportation, resulting in new and improved services. I highlight three today. The first is embedded connectivity in vehicles. The second is app-based access, and control for consumers. And third, and lastly, data science is enabling efficiency in operating systems and services.

Twenty years ago, recognizing the value and potential of embedded connectivity, General Motors pioneered automotive telematics with the creation of OnStar.

When I first learned about OnSTar back in 1995, I couldn't imagine the potential of embedded connectivity, although I

certainly could understand the benefits of safety notifications and a call center that could download directions and destinations to my in-car navigation system. It has been fascinating to watch subsequent connectivity developments, especially in safety, such as GM working with doctors and first responders to understand how crash telemetry data can prepare first responders for crash events.

Leveraging the foundation of OnStar and other key technologies, General Motors is extending its core business into transportation as a service, where embedded connectivity, app-based access, and data science are transformative. We have created a new brand called Maven, an innovation leveraging GM's leadership in automotive connectivity. Now in 17 cities, Maven is a platform for on-demand mobility, offering multiple vehicle-sharing products for consumers and businesses, such as Maven City, Maven Home, and Maven Gig.

The Maven City and Maven Home car-sharing platforms, which launched in February 2016, offer a wide range of vehicles that are distributed where people live and work for shared-use. In 15 cities, members can rent vehicles by the hour, by the day, week, or month. Insurance, fuel, and maintenance are included in rental. The entire service, in the entire service your phone is your key fob. It's an entirely keyless experience.

Maven removes the need to own and keep a car for those who cannot own a car or choose not to own a car. And we have also seen that the service serves as a mobility alternative or option for current vehicle owners.

Seventy-five percent of Maven members are Millennials, a hard-to-reach target segment for auto makers. Members have driven over 350,000 hours nationally, 50,000 in D.C., and 50,000 in Chicago, 28,000 hours in LA, launched last October.

Building on Maven Home and City, we launched an on-demand leasing program for rideshare drivers in March 2016, which evolved into what we now call Maven Gig. Maven Gig is an enabler for the sharing economy. We provide Gig drivers with access to vehicles on a weekly rental basis for as long as they want to work for an app-based ridesharing or delivery company like Lyft, Instacart, and Grubhub.

With Maven Gig, a driver can carry commuters in the morning and the evening, make deliveries during mid-morning and afternoon, and deliver lunches and dinners at mealtime, while having access to a car or crossover for their personal use. Since it's launch, Gig drivers have logged over 140 million miles, providing rides for over 17 million customers. In mid-February, we began deploying the Chevrolet Bolt Electric Vehicle into San Francisco ridesharing applications, starting with 25. We are now

up to 80 in San Francisco and San Diego.

The efficient, flexible Chevy Bolt is uniquely capable for ridesharing, offering 238 miles of all-electric range and DC fast-charge capability. In less than four months, we have logged over 550,000 miles, enabled by over 5,000 DC fast-charge events, and carrying over 50,000 riders. Bolt EV drivers are averaging about 130 miles a day, which is about four times that of private vehicle owners. Ten percent of total days driven among all drivers are over 240 miles, making it clear that charging and range limits are not issues.

Bolt EVs are yielding unprecedented carbon-free miles per vehicle while increasing public exposure to EVs, demonstrating that on-demand ridesharing drivers will use EVs, and while building a compelling business case for public charging.

At the same time, Maven is building new partnerships with charging providers and electric utilities. Maven's Bolt EV deployment provides operational learning and a sound foundation for the next step: the creation of autonomous vehicle systems based on EVs for ridesharing.

In fact, General Motors announced this morning the production of our next generation of Bolt EV/AV test vehicles at our Orion assembly plant in Michigan. While Maven City Home -- while Maven Home, City, and Gig are new, in-market ways for

consumers to access automobiles for personal use or as a means to generate income, autonomous or self-driving technology promises opportunities to make urban, chaotic urban environments safely manageable. Maven can seamlessly integrate with mass transit as a coordinated first/last mile solution, and fill gaps between taxis and mass transit systems via dynamic shuttles.

In summary, business model and technology innovations promise to transform mobility, affording greater access and improved quality of life for cities. Embedded connectivity, app-based access, and data science will yield safer and more robust transportation systems, with more modality and options. GM is making investments in connectivity, IT, electrification, and autonomous technologies to maintain its leadership position as we all, collectively, drive towards this exciting future.

Thank you for the opportunity to speak to you today. I will be happy to answer questions during testimony.

[The prepared statement of Mr. Kosak follows:]

**********INSERT 6**********

Mr. Latta. Well, thank you very much for your testimony this morning. And that will conclude our statements, opening statements from our witnesses this morning.

And we will begin with the questions now from the members. And I will recognize myself for five minutes.

Dr. Marras, if I could start with my first question to you. In your testimony you mentioned that you work with Honda and have been recognized by industry experts and Forbes magazine for reducing injuries by 70 percent over a 5-year period. Will you speak to how IoT enabled you to address this issue and see how, and also to see the results so quickly?

Mr. Marras. Yes. The IoT allows us to really leverage massive amounts of information. And so we are able to really streamline. We could do the testing of the various tasks that were causing the problems; we could communicate with our computers back at the lab; we could transmit that information back to the people at Honda and they could correct these situations very efficiently. So the IoT has just enabled us to greatly accelerate and leverage the analysis procedures that we typically do.

Thank you for your question.

Mr. Latta. If I just may follow up. When we were over at the IoT event, you had different disks on your display showing how monitors were set up to actually see how an individual -- could

you maybe walk through that, especially with how workers' compensation, how you were able to help them to look at those workplace injuries that a worker might have?

Mr. Marras. Yes. So one of the, I think you are probably talking about our push/pull models --

Mr. Latta. Right.

Mr. Marras. -- that we have been developing. And we have known for a long time that lifting is a risk. And we have been able to convince industry to control the exposure to lifting so they are not injuring workers.

But what is happening is now people are piling thousands of pounds of load on carts and having to push them around and don't understand much about those risks. So we have developed a system where we could look at how the body responds as potentially workers are pushing and pulling under different conditions. And we are trying to look inside the body to understand exactly how the disks are responding and figuring out exactly when the worker is exposed to too much stress, given that task.

And then we note that, the forces that are in hand, which is something you can measure in industry, and that becomes the limit. So we are using the Internet of Things to distribute this information through apps and through the website all around the state, and really all around the country, so people can control

their workplaces given this information.

Mr. Latta. Thank you very much.

Mr. Marras. Thank you.

Mr. Latta. Ms. Kosak, if I could turn to you.

As our vehicles become more connected there is a greater opportunity for the bad actors out there to potentially attack a vehicle. Would you discuss what GM and the industry are doing to ensure the vehicles are safe from cyber threats and other attacks?

Mr. Kosak. Sure. You know, I think that really our work in this area dates back to the inception of OnStar that I mentioned in my opening statement. OnStar has been embedded connectivity and the ability to get information out of the vehicle and control the vehicle. It became an app-based service as well in 2010 when we introduced RemoteLink.

So, we have a long history with working with embedded connectivity. And I, I think that there are three things that have evolved since we started. The first is that the team responsible for that area has continued to grow, both in size and in capability. And our area in Maven we now have three individuals from our chief product security officer embedded with our team, working with the IT and product teams to ensure that, secondly, and maybe most importantly, cybersecurity is designed

into these systems.

So it is not worked into systems afterward. It really is designed in from the outset, with very clear objectives and requirements.

And then another important area, I think, is sharing information. So, with the Auto ISAC where our chief products security officer is a chairperson on that auto body which shares best practices and learnings in this area. I think this is one area everyone agrees is so important that you need to share information. There are not competitive advantages to be had that we need to share information when attacks occur and they are thwarted, letting other auto makers know what kind of attack there was and how it was thwarted.

So, I think the team growth, I think that designing in cybersecurity protection and sharing information carefully, not just within the auto industry but with the defense industry and the aerospace industry where also, you know, there has been a lot of great work done as well. I think these are the three, three areas that make me confident that we are addressing what is a fast-changing landscape.

Mr. Latta. Well, thank you very much. And my time has expired.

And the Chair will recognize the gentlelady from Illinois,

the ranking member of the subcommittee, for five minutes.

Ms. Schakowsky. Thank you.

Dr. Marras, I was very interested in your testimony. I have spinal stenosis, and so at some point I may be a consumer of what you have been studying and producing. But it sounded to me like you were saying that the need for security of private information is somehow a barrier to aggregating that information. Did you, did you say that?

Is your mike on?

Mr. Marras. The models that we have in our data to pinpoint where the issues are, are predicated on the fact that we can identify what abnormal tissue stressors are within the spine. And so, in order to understand abnormal, you have to understand normal. And everybody is different.

And so, one of the things that is unique to our work is we are able to build massive databases of what, how the spine responds.

Ms. Schakowsky. Right. But can't you just remove the individual information?

Mr. Marras. Yes, we can. But and that is what we are trying to do. But that is becoming quite a barrier.

For example, some of the studies we have done, it has taken us three years to get by the IRB, just because of the tight

restrictions in the IRB regulations. So it is a lot more difficult than it sounds, but it is not easy to compile this type of information. And you would think it would be very easy to just strip away the name and keep everything else, but it is not. There are still a lot of barriers to doing that.

Ms. Schakowsky. Thank you.

So, Mr. Kosak, I introduced a bill last week called the HOT CARS Act. And you talked about how life can be made easier and better with IoT and how GM is doing that. It was one of the most disturbing events I have ever had, because it was parents, loving parents, responsible parents who, as human beings, made a tragic mistake and forgot their children sleeping in the backs of their cars. Eight hundred children since 1990 have died from heat stroke in the back of cars.

And it seems to me with all the bells and whistles that are on our automobiles right now that there has to be a way -- and I think GM is an innovator here -- in making sure that that doesn't happen, that these are preventable, and that we have the technologies, or at least they are available, for us to develop to make sure that this never, ever happens.

Can you comment on that?

Mr. Kosak. Well, I think the emotion in your voice is justified. I mean, I can think of nothing more, you know, grave

or senseless than the issue that you are describing.

I think sensing issues, any issue and being creative, I think that is what innovation is all about; it is about sensing a problem and finding solutions. For that particular case, General Motors has developed a technology that is on many models now that will continue to roll out which senses at the beginning of a trip when either of the rear doors is opened for any reason, and then at the completion of that trip simply reminds the driver to check the rear seat area to make sure that there is nothing back there, most importantly a child.

So these kinds of reminders can be very important. And I think these kinds of things are increasingly important because people are leading such chaotic lifestyles and they are so distracted. And I think that is the, that is the most heart-wrenching part in the stories that, you know, you are describing where people were just harried doing things, probably, you know, running around doing things for their children, and that is when things can happen.

Ms. Schakowsky. So, my legislation would require in all new cars that there be this kind of technology. And, you know, my car reminds me if I have left my keys in the car. And it seems to me that something as important as a child in the car and saving a life would be so incredibly important.

And I would just like to say to my chairman that I am hoping that we can explore, explore that. You know, there are not that many pieces of legislation that are a matter of life and death and give us the opportunity to save lives, and so I would hope that our committee can look at that so that this would be standard in automobiles going forward.

And I yield back my time.

Mr. Latta. Thank you very much. The gentlelady yields back the balance of her time.

The Chair now recognizes the gentleman from Mississippi, the vice chairman of the subcommittee, for five minutes.

Mr. Harper. Thank you, Mr. Chairman. And what an incredible group of witnesses and excitement that we sense and see where we are going on this.

And so, Dr. Butler, welcome. We are glad to have you here. And what year did you start Camgian?

Mr. Butler. Two thousand six.

Mr. Harper. Okay, 2006. And we are now 2017. Did you envision the progress that you would have made to this point when you talk about where we are today with the IoT?

Mr. Butler. I didn't. I think we are making great strides in the United States in advancing this technology. I think the opportunity for the United States is significant, both

domestically in terms of operational savings and productivity, but also as a business that we can propagate to the rest of the world.

Mr. Harper. Let's talk a minute about what is an important issue and ongoing almost crisis, and that is our aging infrastructure that we have in this country. I know the President was in, I believe, Ohio recently. And your company, Camgian, along with Egburt, your technology that you have, tell us a little bit more about how that is impacting, particularly the Markland Lock and Dam on Ohio River and what you see as this technology to help us with that aging infrastructure.

Mr. Butler. Sure. Our software has been built to provide enterprise with monitoring applications. So, for example, it is very flexible in terms of integrating advanced industrial sensors and then also integrating the sensor processing and analytics associated with that data. So, we can build very scalable products that can extend out to this type of infrastructure.

Now, when considering the aging infrastructure problem, one of the problems that we have in the United States today, a lot of these large, critical systems were built more than 50 years ago with a 50-year lifespan. So what we are seeing now is that the unscheduled maintenance of these systems is rapidly increasing.

So, in addition to new innovations in terms of repairs and refurbishment, concrete and steel, it is our thesis that data can bring a lot to that market by making these systems intelligent, by imbuing these systems with sensors and communications and analytics technologies, can provide both engineers and operations personnel real time, valuable insights into the structure health and operational conditions of these systems over time. And so they can use that information to make better decisions about how to address these problems before they become failures.

A system like the Markland Lock and Dam, for example, if that system goes down it is millions of dollars of economic impact to the local economy per day. So it is very important that these systems maintain significant up time in their operations.

Mr. Harper. And then this, and these sensors and this information that is gathered realtime, it allows you to know when there is perhaps a crisis, perhaps a problem that needs immediate concern and helps them stay on a better maintenance schedule, I assume?

Mr. Butler. That is correct. That is correct.

Mr. Harper. You know, you also stated that the industrial Internet of Things applications certainly are driving some amazing revolutionary gains in businesses. So what you are doing there is through the Army Corps, U.S. Army Corps of Engineers there

at Markland. But talk about what you think we are going to see or what we should look for as how this really benefits businesses on what you're doing.

Mr. Butler. Sure. I think that same model, when it comes to improving down time and reducing failures in mechanical systems, it applies an extrapolates across a number of industrial markets today. That includes areas like manufacturing. It also includes areas like agriculture. It includes areas like transportation, healthcare, energy for example. Any of these industries that rely on equipment to drive their business model, these types of efficiency gains are enormous in terms of significantly reducing any down time in those systems; and also, the aspect of security and safety with the failure of these types of systems.

So the type of work that we are doing with the Corps of Engineers today I think also applies across the industrial industry or industrial market and sector in general, and not only applies, obviously, to domestic problems that we are addressing here in the United States, but also around the globe.

Mr. Harper. So, when we are looking at this, particularly how we make sure the Congress doesn't get in the way, what, do you have any, any thoughts as to what we can do to help as we develop the industrial IoT?

Mr. Butler. Yes. Good, good question. I --

Mr. Harper. This is your chance to give us advice.

Mr. Butler. Sure. I think, you know, Dr. Bachman said a moment ago that this is the most significant technology trend of the 21st Century. And I agree with him on that, on that matter.

This could be an enormous job creator for the United States in the sense that the value that can be extracted from industrial IoT technologies is enormous across industries, as we, as we have heard. So, as it relates to what the Federal Government can do, I think really three things:

Number one is to lay out a national strategy for IoT that is focused on becoming the leader in the world; number two, serving as a catalyst to start this market. That has been done previously with the Internet, with DoD and the ARPANET. I think we need to do the same thing in the industrial IoT. And I think smart infrastructure is a great place to start. Because if we can build and deploy systems in that market, that will extrapolate to other markets and help us grow, again, both domestically and internationally.

And if you think about job creation, if I were to, as a high-tech company executive, if I think about scaling my business to jobs that that would create -- our product engineering jobs, jobs for electrical engineers, jobs for mechanical engineers,

jobs for industrial engineers, computer sciences, service jobs -- so there are lots of jobs that can be created here. And we can service the world with these types of technologies if we decide to take the lead in the market.

Mr. Harper. Dr. Butler, I hate to cut you off but I am way over on my time.

Mr. Butler. Oh, sorry.

Mr. Harper. But thank you so much. Very informative. And with that, I yield back.

Mr. Butler. Thank you.

Mr. Latta. Thank you very much. The gentleman's time has expired.

And the Chair now recognizes the gentlelady from Michigan for five minutes.

Mrs. Dingell. Thank you, Mr. Chairman.

This is an important hearing, a subject that is near and dear to me. The Internet of Things is revolutionizing the way we live our everyday lives by offering both companies and consumers a wide array of benefits. We are especially, and as you have seen in the discussion today, the benefits have increased connectivity. We are seeing it in the transportation sector in all the ways that we have been discussing this morning.

In my home state of Michigan we are watching the auto industry

turn into the mobility industry. And this transformation is being driven by the development of connected and automated vehicles. So I am very pleased that the committee is continuing to focus on this.

Before I ask my questions, which I won't have enough time to do it, I want to support what my colleague from Illinois, Jan Schakowsky, was talking about in the technology for the HOT CAR bills. I am going to be co-sponsoring it with her. And would say to all of you we even need to be looking at technology further. That is one way. But wouldn't it even be better if we talked to child seat makers about putting technology in the child seat?

So, I want to commit to work with you, and already started on that. So that is how, what we are talking about today, how can innovation make a difference.

But let me quickly go to General Motors, Mr. Peter Kosak. Your testimony talks about GM's investment in Maven, a ridesharing service. It is my understanding that Maven Gig is doing great work with ridesharing applications. How transformative will Maven be? And where will we see the greatest benefits ultimately down the road?

Mr. Kosak. Yes, that is a great question. I think this, the -- I guess my answer would touch on a number of issue and opportunity areas.

Maven is a platform, and as a sharing platform the objective is to have a set of assets that are better utilized, more efficiently utilized overall. And, you know, we are thinking a lot about under served communities and serving persons with disabilities, and a variety of different situations where there isn't sufficient service today.

And you could even imagine, though, a rural environment where you have harried parents, you know, frantic to get their kids to after school activities, and the need to get elderly to, you know, mid-morning doctors' appointments or out to do errands, or serving persons with disabilities. And through the Internet of Things and by providing ridesharing services, by linking these things together you can get complementary sources of demand, satisfied by a shared-use platform that then in the end is economically viable, that can serve a number of different cases that it would be difficult to justify a service for alone but that now can be integrated.

And you could even imagine entrepreneurs who have a small fleet of autonomous vehicles in their community serving all these different use cases. So, I think that the ridesharing platform that we have in the form of Maven is foundational to provide for autonomous insertion and for the better utilization of automotive assets against a whole variety of use cases, not individually but

in combination.

Mrs. Dingell. In your testimony you also discuss Maven Gig's deployment of full electric Chevrolet Bolt vehicles in San Francisco and San Diego for ridesharing applications. I am concerned that we have not seen AV -- if many people buy EVs as we would like to see. And I think that everybody would like to see it.

The Chevrolet Bolt EV is the first commercially available mass market affordable electric car. How will your deployment of the Bolt in ridesharing applications like Maven Gig help lay the groundwork for both the deployment of self-driving, but perhaps also increase down the road people's confidence in EVs?

Mr. Kosak. Yes, I mean I think the answer is very directly. In this application in California, as I mentioned earlier, the number of miles covered in these vehicles on average is four times what personally-owned EVs are covering. And so it is really pushing the limit.

Really there is a chicken and egg problem right now with electric vehicles and with charging infrastructure. No one wants to put charging infrastructure place until people by EVs, and people don't want to buy EVs until there is electrical charging infrastructure in place. And with this deployment we are pushing the boundary. We are going to charging station installers and

electric utilities. We are demonstrating the level of demand that you can generate with a ridesharing service. That is an incentive for them to put in place charging infrastructure. And then I think privately-owned vehicles will, will sort of draft in behind that.

I also think it is a highly-visible application of EVs. You know, the drivers can't believe how much they are able to drive. And they are able to get 160 miles of charge in just an hour with a charger. So we have a lot of cases where people are getting into the back of these cars during ridesharing and they are saying, "What is this?" And it gets this dialog going around just how capable and cool EVs can be.

So, I think by from both a visibility perspective and then also from driving and infrastructure installation perspective it is having a direct impact.

Mrs. Dingell. Thank you.

Thank you, Mr. Chairman.

Mr. Latta. Thank you very much. The lady's time has expired.

The Chair now recognizes the gentleman from Texas, the former chair of the subcommittee, for five minutes.

Mr. Burgess. Thank you, Mr. Chairman, and thank you for having this hearing today.

Before I get started with my questions I just want to acknowledge the participation of constituents from the district, the good folks at Network Thermostat, who participated in our Internet of Things Showcase downstairs.

And, Mr. Chairman, I also have to say I had occasion to be up very early this morning and you have had staff who were on the job getting things ready at a very early hour. So, congratulations to you on motivating your highly-efficient staff to be so attentive.

Dr. Marras, I wasn't going to ask you this but now I have been provoked by one of Ms. Schakowsky's questions on the issue of data collection and data sharing. And this was a big part of another bill that this, not this subcommittee but this committee did, called Cures for the 21st Century. And this is a way we deal with data and the interoperability of data. And you have touched on that in your testimony. In fact, I really like the fact that you laid out enumerating how can Congress help with what you have identified as a problem.

So you spoke to it a little bit when you answered Ms. Schakowsky's questions of difficulties you run up against with the institutional review boards and data collection, but could you just expound upon that a little bit?

Mr. Marras. Yes. Thank you for the question.

It is very, it is very difficult to get through the burden of the layers and layers and layers and layers of protection that are involved with patient data. Now, I fully agree we need patient data. And I always thought it was a whole lot easier than what it is to get through this to build these databases that we really need to understand spine disorders.

But, like I said, it has taken us a matter of years to get access to the data we need because of the way the laws are set up.

Mr. Burgess. So, you are building a database of biometrics and biomechanics that could be enormously useful for people who are studying in this field, and a database that probably hasn't existed before you put pen to paper to try to create it. And I am sure there are other applications in other areas of medicine. But it, it is difficult.

And I think we, you know, again when we worked on the Cures bill we identified some of those difficulties. But it is so massively important that the people who are able to accumulate and categorize and the encyclopedia that you build off of biomechanics is going to inform future physicians and scientists in a way that is almost unimaginable now.

Mr. Marras. Exactly. And, you know, I agree totally with the spirit of the law. But the way it is, the way it works and

to gain access to the data you need to build our databases is just extremely burdensome. And as we all know, funding for these types of studies is extremely tight. And one has to jump through many, many, many, many hurdles in order to get access to the data that we really need. It is not impossible, but it's just --

Mr. Burgess. Right.

Mr. Marras. -- extremely difficult.

Mr. Burgess. I am glad that there are bright people such as yourself that are working on this because the future generations will thank you.

Mr. Kuhns, I just wanted to, first off, acknowledge in your testimony, your written testimony, acknowledge the amount of chaos that is in this environment. So that can be a positive thing. And some of us live with more or less amounts of chaos in their lives. And chaos can be a driving factor in creativity.

One of the things I really liked about your testimony is you referenced the 2015 hearing that we had on this, on this same subject. And I just wanted to take a moment and quote the last concluding thought from my opening statement that morning. "In our examination of privacy and security issues, it is important that we balance these concerns with the creativity and innovation driving this market forward. Too much potential for economic progress and consumer welfare is at stake to act without a full

appreciation for what this market can offer."

Those words were true two years ago; they are true still today. So I thank you for reminding me how, the important work that we are doing.

And then, finally, Mr. Kosak, on the issue of the child in the hot car. I do want to encourage you. When I first learned about OnStar many, many years ago that was one of the first things that crossed my mind: here is a technology that if it could detect a life form in the car, whether it be a child or a pet or an elderly person who was left in the car that now is achieving a temperature that is incompatible with future existence, that something ought to happen, and somebody ought to be notified, and either the horn honk, or the windows come down or the lights flash. So I have always felt that that is something that is technologically within our grasp.

So, I am grateful that your scientists are working on it. I think it is important. And I just don't recall a problem occurring in the 1950s and '60s. Maybe it did and we just weren't aware of it because it wasn't reported. Or maybe there is something different about the technology we have in our vehicles now that make our children more susceptible to this type of accident.

But I am grateful that you are working on it. I think it

is an important concept, and one that really just begs for a solution. And now to listen to your thoughts on that.

Mr. Kosak. Well, thank you very much for the comment. I agree. I mean I think that is a good example where you can demonstrate the power of connectivity and then communicating important things.

We have been using, you know, passenger-side occupant sensors for some time for not only sensing an airbag, sensing an occupant to make sure that seatbelts are worn or to relate to the airbag system itself to judge the size of the occupant and all of that. So, I think that identifying these issues and then using the power of technology to solve problems is something that we are thinking about every day.

Mr. Burgess. Thank you, Mr. Chairman. I yield back.

Mr. Latta. Thank you very much. The gentleman's time has expired.

The Chair now recognizes the gentleman from California for five minutes.

Mr. Cardenas. Thank you very much, Chairman and Ranking Member, for having this hearing.

Mr. Javdani, as you mentioned in your testimony, Louroe Electronics has partnered with the U.S. Commercial Service. Louroe has been recognized by the U.S. Department of Commerce,

and you have also worked with American embassies to bring American products to other countries. How has government investment affected Louroe Electronics' ability to grow?

Mr. Javdani. Thank you, Congressman. There are a number of programs that we take advantage of with government investment. As you mentioned the work with the U.S. Commercial Service, we have participated in a handful of trade missions to international markets, noticeably to Latin America. And the work that the Commercial Service provides to us in those markets is introducing us to potentially interested customers.

These types of customers are at a very high level. I like to say that I could cold call for ten years and not get these kinds of appointments. And through the influence our embassies have internationally, we get an audience right away.

Secondly, we work with a group CMTC, California Manufacturing Technology Consulting, to help us optimize our production process, our planning process, our innovation process. CMTC is an organization with funding from NIST and also MEP, the Manufacturing Extension Partnership. Through our work with them we have found ways to reduce the operating costs of manufacturing, improve our forecasting methodology so that we have fewer dollars tied up in both raw materials and finished goods. And we use those dollars then to invest in R&D, in pursuing new IoT-related

technologies.

So, as Dr. Butler mentioned moments ago, when we look at the new types of jobs being created, what Louroe Electronics is finding is that our investments into R&D increases our need for computer scientists or coders or the types of jobs that are specific to IoT fields, as opposed to more traditional analog electronics or other types of manufacturing.

Mr. Cardenas. Thank you.

Gentlemen, when it comes to much of what is driving private industry in the Internet of Things, does much of it have to do with increasing productivity for the end user, and also increased safety for the end user? Are those two driving factors? Because when I was out there looking at many of the products around the corner here with the displays that are going on, that seemed to be two main themes, whether it is vehicles or something with intelligence in it.

Mr. Javdani. I can briefly speak to that. What we find is that most of the work that goes into an analysis or process can be automated. So productivity can increase because the time that would have been needed to conduct review of certain data is now automated. So that frees up worker time for other, other items.

Mr. Kosak. If I just -- oh, sorry.

Mr. Cardenas. Go ahead. Yes.

Mr. Kosak. If I could just add to that, I think maybe the ultimate example of that is autonomous vehicles where, you know, they see better and they see more than human drivers. And by networking them together you can create vastly safer systems for personal mobility overall.

Mr. Cardenas. So, efficiency, increased productivity again a common theme; right?

Mr. Kosak. Yes. Efficiency in group management and safety, and just better sensing and response.

Mr. Cardenas. And, again, safety as well, some two major themes.

And I have a tongue-in-cheek question. Is the Internet of Things, does it tend to be a male-dominated environment, gentlemen? What does the diversity look like?

Half the population of this country are women, and yet, at the same time when it comes to technology and certain environments, or what have you, we find that it seems to be mostly men hanging out in that environment. What is the industry doing that you are aware of, or what are you involved in directly that is trying to make sure you are cognizant of that?

And matter of fact, I saw something recently where a very famous man, Warren Buffett, said, I have tremendous confidence in the U.S. economy. And he was commenting about how his sisters

are just as smart as him, his sisters are just as capable as him, but he was the guy in the family so he was the one that got to rise to being this famous, incredible entrepreneur. And yet, he was saying, you know, my sisters are just as capable as me, but the environment nurtured me to be the guy instead of my sisters. And then the main point that he made, he said, I have tremendous confidence in the United States economy, because look at what we have done with only truly taking advantage of half of our workforce, half of our resources.

In other words, he is pointing out the fact that if we include women and we are cognizant of that, maybe we will be even more successful, maybe we will be more innovative, maybe we will advance quicker, faster, better.

Any comments?

Mr. Marras. I think it is beginning to change. I think it goes back to our educational system. You know, I am, my primary appointment is in an engineering college. And, you know, some of the --

Mr. Cardenas. I am an engineer, too. And I remember in those classes women, very smart on campus, just weren't in class with me.

Mr. Marras. And there, especially those in biomedical engineering, care more about people. You're starting to see more

and more of them. It is just a slow change.

Mr. Cardenas. Well, my time is up. But if you can share sometime today about maybe some activities that are going on to increase that awareness and make that difference.

Thank you, Mr. Chairman.

Mr. Latta. Thank you very much. The gentleman yields back.

The Chair now recognizes the gentleman from New Jersey for five minutes.

Mr. Lance. Thank you, Mr. Chairman. And good morning to the panel. Thank you for your testimony.

Later this afternoon I am meeting with the Christopher and Dana Reeve Foundation, located in Short Hills, New Jersey, in the district I serve. So I am particularly interested in Dr. Marras' testimony regarding your fine work at the Spine Research Institute.

Dr. Butler, can you please explain how connected devices and Internet connectivity capability have affected your business?

Mr. Butler. It certainly has put us now in a position to scale our business. I think it is a tremendous opportunity, again, across multiple markets. So it allows us to scale in a variety of different industries beyond some core industries that, that we are focused on today.

I think if you look at the make-up of the workforce that we

have in our company today, again as I mentioned to Congressman Harper earlier, we have product developers, electrical engineers, mechanical engineers, industrial engineers, but we also have software developers. We also have service people that support the service side of our business and sales, marketing and, of course, finance.

And I think that over time, as we scale our business we will scale in all facets of that business. And so I think in terms of creating more job opportunities in the United States, if we are the leader in this industry and we are the provider of these technologies and services to the global economy, we will see job creation across that entire spectrum of our workforce.

Mr. Lance. And have you seen increases in employment in recent times?

Mr. Butler. Yes. And we are, we are hiring now. We plan to hire a number of new engineers as it relates to percentage of our total employee base by the end of this year. So we are, we are growing on the back of the IoT industry at this point.

Mr. Lance. And regarding employment of engineers, is there a flow from our graduate schools regarding engineers in this country?

Mr. Butler. Yes. I think for us it is a combination of both: we hire new college graduates and we also hire more

experienced engineers as well. A lot of times we look to hire experienced engineers to take on new project management roles and leadership roles in the organization. And then we bring in new college graduates to work with those more experienced engineers as part of our product development program. So I think it is really a combination of both.

Mr. Lance. Thank you.

Dr. Bachman, can you explain, please, how the collection of data from installed devices can be used to optimize business practices and operations?

Mr. Bachman. Yes, sir. Most of the operations we do, we really don't know what is going on. We are assuming that there is a certain -- that our machines are working the way they are supposed to work, and so forth. If we can monitor them, then we know when things aren't working the way they should.

And, so, at the very beginning of IoT the value was seen as in predictive maintenance and making sure that things are working the way they should. But it goes beyond that, because when you have that data and you can correlate against other things, things that you may not even think are relevant, like the weather, for example, or where the trucks are on the highway, you discover all kinds of patterns that we would normally not understand. And you can leverage that information to improve your operations, whether

you are turning your lights off ten minutes sooner, or maybe you are changing which warehouses you are going to be using.

It is the aggregation of many different types of data from many different sources that really brings the true value of IoT. So, when I talk to people, the easiest thing we understand is, yeah, I can see where my pipes are leaking. That is valuable; right? That is a very obvious example.

But the way I describe it, it is like a chess game, you have many, many different things going on. And if you have data on all of that then you can optimize your chess game and you can do ever greater value that way.

Mr. Lance. Thank you.

And, Dr. Bachman, different people in different situations often define privacy differently. Do you think that the market is capable of addressing concerns related to privacy in the Internet of Things market over time?

Mr. Bachman. This is an issue that is continually evolving, so there is no silver bullet that you can point to today. So, I think we have to recognize that, and recognize that this is going to be continuously a challenge that we are continuously solving.

I will have to say that it is not just Internet of Things. So we get the benefit from the solutions of other industries, such as mobile connectivity or apps and so forth that are also

addressed. And the biggest markets are in industry where privacy is not so much of an issue but security is an issue. And there is going to be a number of developments, of course, that we are all looking at, end-to-end encryption and, you know, better authentication and these types of things to prevent malicious break-ins.

But, also, the business models are going to -- at least at the beginning people are taking steps where security is less of a concern in the sense that they are analyzing data but they are not controlling machinery, for example, at this point.

Mr. Lance. Thank you. My time has expired. Thank you, Mr. Chairman.

Mr. Latta. Thank you very much.

The Chair now recognizes the gentleman from West Virginia for five minutes.

Mr. McKinley. And, thank you, Mr. Chairman. I might suggest, Mr. Chairman, that along this topic there was a great book published last year, in April of 2016, Stephen Chase wrote called "The Third Wave." And it might be something we might try to encourage all the members of our committee to take a look at that to see, because he addressed this issue at least over two years ago and finally got his book published last year. But it is an excellent article -- book about the possibilities that we

have in this, "The Third Wave," if you all happen to have read that.

Mr. Kuhns, I have got a question of you, for you. Do you know whether or not the IoT provisions are being included within certification for LEED buildings? Do you know whether or not they have creeped into there to be one of those key factors?

Mr. Kuhns. I don't know specifically with respect to LEED buildings. One of the problems is that IoT is kind of a general phrase that can be applied to almost any Internet-connected device. So what we are particularly more interested in is standards or best practices that relate to energy efficiency, to systems actually working, regardless of the technology and regardless of whether you label that as IoT.

Mr. McKinley. Okay. I just, I just would like to see us move into that.

Mr. Kuhns. Yes.

Mr. McKinley. I think it is an opportunity for people to get more LEED certification and to use our technology, the Internet of Things, to be able to do more higher efficiency buildings.

Let me, just an overall concept of what I have heard all five, six of you in your presentation. This proliferation of Internet of Things, both in Chase's book and your own technology and what

you have seen and how it has grown over the years, it seems like it opens the door for a virtual smorgasbord of bad actors and malware being developed. Because if, as the article said in USA Today this morning, if we can't even protect our electric grid, how do we think with all these smaller firms, how are we going to prevent someone from gaining access to our personal lives, whether it is the telephone or our cars or whatever that might be? What role can we do, should we be playing to try to correct that?

Mr. Kuhns. So, let me just take it if I could. That is one of the points that I tried to make in my initial testimony.

From where I sit, we can do as good a job as possible at making sure that our devices are secure and that default passwords are changed. In fact, we don't even use default passwords at all for that exact reason. But what is missing is if I am in my house and somebody is going around rattling the door, I can call the police and say, "Hey, there is a bad guy trying to get in."

In the Internet people are rattling my doorknob hundreds of times per day and there is not really anyone I can call. I feel like we need a national or maybe international more effective law enforcement response. We need to have somebody looking at bad guys and tracking them down.

I can give you a list of IP addresses in Ukraine that tried

to get into our system today, but there is nobody to give it to. So, I see that as a, yeah, we need both sides. We need to have better door locks, but we need to have somebody tracking down the bad guys and doing something about it.

Mr. McKinley. Okay, thank you. And I hope the rest of you get back to us. I would like to hear from your perspective because if our utilities can't prevent it, I wonder about individual firms that don't have that.

Mr. Kosak, back to you. Because I, I really thought Ms. Schakowsky hit a homerun with her question. A second, follow-up question I think would be just as fundamentally is if we believe, if we think there is a predicate for using seatbelts, why are we able to operate our vehicles without wearing a seatbelt?

Mr. Kosak. Do you mean why isn't it --

Mr. McKinley. Why are cars, why are manufacturers not putting a triggering mechanism in so that if it is so important why don't we go so fundamentally as the car can't start unless someone has a seatbelt on?

Mr. Kosak. Well I, you know, I can't answer the broader societal question. I can say that we do a lot to strongly encourage in my --

Mr. McKinley. A little bell comes on every -- I know when my wife doesn't put her seatbelt in the car a little beep goes

on. But if something is fundamental, if we say that is going to be something we can save lives and save energy and for healthcare if we would wear seatbelts, I am just curious why we have not done that.

Mr. Kosak. Yes, I am not, I am not sure. But, again, the reminders are pretty relentless. And to some, you know, pretty irritating. But I think they have become more pervasive, you know, with we have identified more direct ways to communicate that are harder to ignore.

Mr. McKinley. Thank you. My time has expired.

Mr. Latta. Thank you. The gentleman's time has expired.

And the Chair now recognizes the gentleman from Florida for five minutes.

Mr. Bilirakis. Thank you. I appreciate it, Mr. Chairman.

Dr. Marras, can you please explain how the use of innovative technology in IoT has contributed to the work being done at the Spinal Research Institute? And I would like to, if you could tell me a little bit on how you have helped maybe possibly veterans, you know, that have spinal chord injuries as well with this technology.

Mr. Marras. Yes. So the IoT basically allows us to marry information from wearable sensors that talk about how you move, with information from data we could get, for example, of

veterans', like, prostheses and things like that and how they hit the floor, with information about how they recruit their muscles. And the IoT marries that information with our models. And our models are distributed amongst many different sources, so we could download anatomy from databases, we could download architecture and reverse engineer a person's spine.

And it basically allows us to communicate in a very, very efficient way which if you were doing this by hand would take you, you know, months compared to what takes now seconds. As a matter of fact, our models used to take months to build, and now we can build a model of a person in seconds. And it helps us understand what is unique about that person, how much tissue loading is too much tissue loading, and what needs to be done to help fix that.

And I should also say we don't focus on spinal chords, we focus on spines.

Mr. Bilirakis. Okay, very good. Thank you.

Dr. Bachman, can you please speak to how privacy concerns are being addressed by industry, especially as we see the number of IoT applications increasing rapidly?

Mr. Bachman. So, I think privacy, especially for consumer-facing products is a big concern for everyone. And I think what, what I am seeing is that there is no single standard way to address that. And, in fact, most of the devices that I

am familiar with follow pretty much the mobile phone model. They basically consider themselves a mobile phone without a front face on it.

So there is no, there is no single solution other than what is already being done for mobile devices. However, there is a lot of good ideas that are being discussed, for example, things like end-to-end encryption, things like better authentication. I think we would benefit greatly from standards that sort of lay out what is considered a safe device and what is not considered a safe device.

Also, we would benefit greatly if we could have independent watch dogs, for example, that indicate these products are considered safe and these aren't; sort of an Energy Star type of certification. I think that would really help, actually, everyone, not only the consumers but also the industry because when we have the trust of the consumer then we can sell our products to them. But if people feel like we are stealing their information, then they are not going to buy our products. So, some sort of independent certification or eye on this would actually help us a lot.

The other thing is I think one last thing I want to mention because this is something that we don't have any requirement to do, but if we were to build an IoT device, we have no requirement

to disclose what data we are collecting. And I think it would be very helpful if there was such a requirement. Because when you buy a product, even if it is completely secure and no one can hack in, you don't know how much data it is collecting, when it is collecting, and what it is sending to the owner that, to the company that is selling you that. They may be selling your information to other people.

At least in the apps we are used to having to sign an end user license agreement, and in devices we don't have to do that. So I think it would be useful to have some sort of requirement of disclosure, even if it's a voluntary with a star, you know, with a certificate or something like that associated with it.

Mr. Bilirakis. Okay, thank you very much.

Dr. Butler, is there anything we can do as policy makers to promote the growth of industrial IoT? Dr. Butler.

Mr. Butler. Yes, I think there are a few things. I think, number one, continue to work with organizations like the IIC and the OIC, the consortium, that are today looking at, looking at how to grow the industrial IoT space. I think, as I mentioned earlier today, I think adoption would be great. I think the opportunity for adoption within the federal space today is significant. And I think if we look back historically on how the internet came to pass and its growth, the Federal Government was

instrumental in that in terms of developing the ARPANET and the NSF funding that went along with that to serve as a catalyst. So, I think adoption in certain areas.

And then I also think funding research and developments in the key areas to provide competitive advantage. And I think a light regulatory touch to promote innovation.

Mr. Bilirakis. Very good. Thank you.

Anyone else, I have got, well, got -- No, I am over. I am over, Mr. Chairman. I yield back. Thank you.

Mr. Latta. Okay. The gentleman yields back.

The Chair now recognizes the gentleman from Oklahoma for five minutes.

Mr. Mullin. Thank you, Mr. Chairman. And thank you to the whole panel for being here today.

Although I don't consider myself a tech-savvy individual, I do realize that technology is in a lot of cases making our lives easier and saving lives at the same time. We are talking about the new technology of detecting when we leave a child in a car seat.

I can tell you, my wife and I, we have five kids, and they age from right now 13 to 6. But when we had just had our twins, we jumped out at church and walked into the church and immediately realized we left our 4-year-old daughter in the car seat. I mean,

it was less than probably two minutes and, fortunately, it wasn't hot that day, it was this beautiful fall day, but it can happen. It can happen just like that. And any parent that has been a -- that has had young kids know that that can happen quickly. And that is where technology comes in.

And so we appreciate all you all being here.

Dr. Marras, is that how you say it?

Mr. Marras. Marras.

Mr. Mullin. Marras. Dr. Marras, thank you for being here. I understand the technology to which you are looking into right now is to protect backs, spinal injuries. A question that I have, I come from, you know, a very athletic background and fought professionally for a few years. And, ironically, I am limping today. I have no idea what I did to my back. But it can happen tomorrow.

My wife who her and I are going to be celebrating our 20th anniversary tomorrow -- I got to throw that in there by the way, Chairman, I have to throw that -- you know, 20 years is a big task --

Mr. Latta. Oh, our anniversary is tomorrow. It is 31.

Mr. Mullin. Oh, 31, is it? I am not going to say my wife can make 31 years with me. I couldn't have made two.

But she is very athletic. And she was working out the other

day and literally just bent over to grab a weight and hurt her back for the first time ever. The technology that you are having I know can help, you know, diagnose to some degree of what is causing that and the movements that cause it.

Specifically what I wanted to talk about, though, is moving into the realm of professional sports, but moving into the realm of even the smaller kids, is it possible that this band that you are having, I guess that wears on your wrist, is that where you are moving to; is that right?

Mr. Marras. Not exactly. It is on the, on the spine.

Mr. Mullin. On the spine.

Mr. Marras. Yes.

Mr. Mullin. Is it, is it possible for you to build it to detect it in athletes and programs and knowing the pressure, the pressure points? Because maybe we can change some of the techniques that we are showing that can prevent a lot of this.

Mr. Marras. As a former college athlete I am very sensitive to your question. And I have experienced all kinds of problems myself. The thing that is unique about the spine is you don't know when damage is occurring. Typically in the spine, when you have serious problems it occurs in the disk. And the disk is very atypical because there are not very many what is called nerve endings in the disk. You really can't feel what is going on until

it is too late.

And so with our technology, by bringing people into our laboratory and putting smart sensors on them and building models of what they are -- how they are responding to this, we could pinpoint how much is too much exposure to whatever, including sports. As a matter of fact, we have had some experience doing this with golfers. And when you think about golfing, you are holding a club that weighs just a few ounces, yet the loads on the spine can be tremendous. We have to get to that level of detail and look inside the body before we understand how much is too much. And that is what we try and offer.

Mr. Mullin. So is this, is this more looking towards the period of rest that, say, hey, after you do this so long maybe you should rest a certain time?

Mr. Marras. Yes, it could be that. But we prefer to look at it as maybe you shouldn't be using that technique that is damaging the spine. And there might be better ways to go about doing you work or doing your sports.

Mr. Mullin. With the technology that you are having, is someone capable of wearing it while they play the sport? And I am not saying necessarily golf because that is a sport I don't even begin to try. There is limits to what I am able to do.

Mr. Marras. Yes, so, you know, we are talking about really

a variety of technologies here. And some of them, yes, can be worn on the field. Other ones you would have to simulate the game in our laboratory. But at the end of the day we need to compare it against what are normal loads in the spine and what are abnormal loads in the spine. And that is how we understand when you are doing damage.

Mr. Mullin. Well, thank you for the technology you are looking into. I think it is going to pay huge dividends and on a lot of professional athletes moving down the road. So, thank you so much.

Mr. Chairman, I yield back.

Mr. Latta. The gentleman yields back.

The Chair now recognizes the gentleman from Pennsylvania for five minutes.

Mr. Costello. Thank you.

I just, Dr. Marras, wanted to follow up on some of the dialog you had with Mr. Bilirakis about how the predictability tool would impact healthcare costs. And I understand that is your thing, spines. Perhaps you could share how that application might be applied in the healthcare realm with other types of surgery.

And do you ultimately think that it will mean reduced healthcare costs or avoided healthcare costs? I would be curious for you to just speak on that to the extent that you would like.

Mr. Marras. Well, thank you for that question. It is a great question.

If you look at healthcare costs associated in the spines, we spend more money treating people for spine disorders than we spend treating people for cancer. So, we are talking about enormous numbers. And if you look at medicine applied to the spine, it is more of an art as opposed to a quantitative science.

And what we are trying to bring to the table is a way to quantify what physicians are facing. We are not trying to do medicine; we are trying to give them the tools to make it more quantitative and more precise. Because the way it works now when you have a spine disorder is, you know, your back hurts. You go see your doctor. They are not really sure what is going on. You go see, get an MRI. And the MRI might cost you 1,500 bucks, and it has got about a 10 to 15 percent chance of telling you what is wrong.

And so then they will send you to physical therapy. And if that doesn't work, then they will send you to, you know, get injections. And at the end of the trail are surgeries. But it is trial and error. And that gets very, very expensive.

What we are bringing to the table is the ability to quantify what precisely is wrong with that person. And only change what you need to change. And in that way we think it is going to be

very, very cost effective and allow people to get the kind of, go directly to the kind of treatment that they want as opposed to this long slog of try this, try that, as it is exacerbating over time.

Mr. Costello. Right. And I found your testimony very compelling.

Do you have any sense of how you, from an analytical perspective, how much you may be able to reduce the number of types of procedures or testing that will be avoided as a result of the application that you could provide? And what about other types of surgeries or ailments that there might be something more preventative or more preemptive that could be done as a consequence of the type of application that you have and the type of technology that is available?

Mr. Marras. Well, our technology allows us to actually do virtual surgeries on people. We could build a model of a particular patient's spine, along with all their nooks and crannies, and all the individual components of their problem, and figure out exactly what surgery that person needs. Because right now surgeries are, you know, throughout the country probably about effective less than 50 percent of the time. And that gets very expensive.

Mr. Costello. How are insurance companies responding to

this?

Mr. Marras. Well, we are --

Mr. Costello. Or not responding to this.

Mr. Marras. Yeah. We are -- they are tightening up on what they are allowing because there has been a lot of abuse of surgery over the years. A lot of times people go right to the surgery as opposed to seeing exactly what is wrong with the person. And they tend to, for a lot of surgeons, they do more surgery than what is necessary.

Mr. Costello. Dr. Bachman. Thank you. Dr. Bachman, zero power technology, National Science Foundation funding. The question that I have is you speak to your involvement with NSF and its support, and its role in supporting IoT -- couple acronyms there -- and are you aware of the need or any opportunity to update or expand federal grant funding language as a consequence of the emerging role of IoT?

Mr. Bachman. Yes, sir. We are funded by the NSF to develop zero power sensing. That means you can create a sensor, put it somewhere, and not have to create the batteries or not have to hook up to a cable, which is extremely valuable for a lot of remote sensing applications. That kind of technology is not something you buy off the shelf. It is a very advanced technology, so it requires sort of fundamental work. And that is where

organizations like the National Science Foundation are very helpful.

I do think it is helpful that they do frame what they are funding in the sense of a market such as IoT because it helps guide the research to be a little bit more focused on the application. And that has been helpful for me, because otherwise we may just develop something that can't be turned into an actual product. And we actually want to turn these into products to make things better.

So I do, I do like the fact that we frame the -- and certainly NSF has helped me do that, frame what they are funding in terms of market applications. Although I would hate to lose the spirit of, you know, free thought and, you know, truly basic research that they support as well.

Mr. Costello. Thank you. And as my questions, if you have any follow-up, anything else comes into mind or any other gentlemen on the panel that want to offer any comments on those questions, I would certainly encourage you to do so in writing.

Thank you. I yield back.

Mr. Latta. Thank you very much. The gentleman yields back.

And the Chair recognizes the gentlelady from Illinois.

Ms. Schakowsky. Thank you, Mr. Chairman. I just wanted to enter unanimous consent to enter into the record a statement from

the Electronic Privacy Information Center.

Mr. Latta. Without objection.

[The information follows:]

**********COMMITTEE INSERT 2**********

Mr. Latta. And seeing no other members here to ask questions, I want to thank all of our witnesses today for participating. You know, when you all were across the hall at the Internet of Things Showcase, there is great interest and there is excitement there, and I think people really see the future right now today. And when we look at the estimate there could be 50 billion devices interconnected out there by 2025, we know where we are heading.

And so I really appreciate your testimony today.

And pursuant to committee rules, I remind members that they have ten business days to submit additional questions for the record. And I ask that the witnesses submit their responses within ten business days upon receipt of the questions.

And before I adjourn the subcommittee, I just want to again thank the committee staffs for all the hard work that they did in preparing for the Internet of Things Showcase because, again, it was a great success, and I appreciate it.

And without objection, the subcommittee is adjourned. Thank you very much.

[Whereupon, at 12:38 p.m., the subcommittee was adjourned.]