The "Internet of Things" Creates R & D Tax Credit Opportunity

By Charles R. Goulding, Andressa Bonafe and Jacob Goldman

Charles R. Goulding, Andressa Bonafe and Jacob Goldman look at how the R & D tax credit can be used by companies engaged in creating the "Internet of Things," a fully connected virtual world that provides solutions to real-world needs.

Welcome to the Internet of Things ("IoT"), where virtual-world capabilities meet real-world needs.

Most of us are already familiar with a number of smart devices. Powerful, sensor-equipped smart phones, for instance, have brought an unprecedented level of connectivity to our daily lives.

The IoT promises to extend sensor technology to all sorts of objects, even those that are not usually associated with the term "smart." From a pacemaker to a coffee machine, everything will be linked together through the Internet.

The bourgeoning of this fully connected world represents a unique opportunity for innovation. Throughout the nation, businesses of all types and sizes are engaged in making the IoT a reality. This article will present the tax credit opportunity available for companies engaged in IoT related R & D activities.

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The Research & Development Tax Credit

Enacted in 1981, the Federal Research and Development (R & D) Tax Credit allows a credit of up to 13 percent of eligible spending for new and improved products and processes. Qualified research must meet the following four criteria:

- new or improved products, processes or software;
- technological in nature;
- elimination of uncertainty; and
- process of experimentation.

Eligible costs include employee wages, cost of supplies, cost of testing, contract research expenses and costs associated with developing a patent. On January 2, 2013, President Obama signed the bill extending the R & D Tax Credit for the 2012 and 2013 tax years.

The Real World Internet

The IoT can be defined as "the use of sensors, actuators, and data communication technology built into physical objects that enable those objects to be tracked, coordinated, or controlled across a data

network or the Internet."[1] In other words, it constitutes a scenario where the physical world becomes a type of information system.

In the term, "Internet of Things," the word "things" includes literally everything and anything: goods, objects, machines, appliances, buildings, vehicles, animals, people, plants, soil and whatever else we may encounter in our daily lives. All these "things" may integrate the IoT if enabled with a combination of characteristics shown in Chart 1.[2]

Chart 1.

a unique identity + ability to sense the environment + ability to communicate + remote control

Once incorporated to the IoT, smart objects may become part of a multitude of applications, which, despite virtually infinite possible formats, follow the same logic (*see* Chart 2).

Chart 2.

Capturing data from the object • Aggregating that information across a data network • Acting on that information

Put simply, in the IoT objects are enabled with the abilities to sense and communicate and therefore become strategic tools for collecting information and responding to it. Chart 3 presents two broad categories of IoT applications.[3]

Chart 3.

Information and Analysis			Automation and Control		
Tracking Behavior	Enhanced Situational Awareness	Sensor-driven Decision Analytics	Process Optimization	Optimized Resource Consumption	Complex Autonomous Systems

Throughout the globe, there are currently around nine billion devices connected to the Internet. Within the next decade, this number is expected to reach at least forty billion.[4] According to a recent report from McKinsey, the IoT has the potential to create an economic impact between $2.7 and $6.2 trillion annually by 2025.[5]

The IoT Tax Credit Opportunity

The Internet of Things is intrinsically linked to innovation. On the one hand, new products, novel business models, improved processes and innovative interactions are bound to emerge. On the other hand, groundbreaking technological advances will be necessary before the IoT begins to realize its full potential.

Companies engaged in any type of IoT-related innovation may qualify for significant federal R & D tax credits. The following sections discuss the R & D opportunity available both in creating innovative IoT applications and in advancing IoT technology.

Potential IoT Applications

Throughout different economic sectors, all sorts of industries can take advantage of the IoT. Similarly, the private sphere will also be fundamentally influenced, as a growing number of smart objects become able to interact intelligently with the physical world. Potential IoT applications are virtually infinite. They will serve a multitude of purposes, which can somewhat be summarized in the following categories:

I. Connect with things: The IoT will allow us to learn about things. Interactions with objects and people will be completely transformed by privileged and simplified access to information. Consumers will be able to connect with the products they are interested in, obtaining information on their production, composition, *etc.* Consequently, the multiplication of "smart" products will allow for unprecedented access to data on consumers' behavior. Such a level of connectivity is likely to revolutionize the marketing and advertising industry.

Sensor technology will also facilitate maintenance and repair of objects, what can be of critical importance in the cases of jet engines, bridges and oil rigs, for instance. Communicating sensors can report slight performance changes in a jet engine or minor structural alterations in an oil rig, giving advanced notice of coming trouble.

II. Monitor things: Potential applications for the IoT include new ways to observe and monitor things. This is particularly promising for healthcare purposes, as smart devices will allow hospitals to monitor patients 24/7. IoT applications are likely to expand and consolidate the notion of "Quantified Self," establishing communication between personal health data and powerful algorithms that help predict problems and, therefore, advance

precautionary care. With the aging of the baby boom generation, health-related IoT applications are bound to gain major importance. A recent study estimates that the remote monitoring of patients with chronic conditions may reduce the cost of treatments from 10 to 20 percent.[6]

Similarly, smart packages could help monitor and report conditions surrounding products—temperature, light exposure and humidity are a few examples. Sensors in packages of perishable food could detect changes in temperature and odor, warning in advance of spoilage.

In agriculture, sensor-equipped robots can already monitor individual stalks of corn and generate yield maps that allow for a more targeted use of nutrients and pesticides. Connecting such robots to the IoT, however, would significantly expand benefits, which could include the construction of a shared network of corn stalk information that notifies farmers of particularly virulent pests or fungus in a given region.[7]

III. Search for things: Real world "googling." IoT applications may help track smart objects, providing information on their location, status and conditions. This is particularly interesting for supply chain and inventory purposes. In warehouses, for instance, sensor-enabled boxes would be easier to locate, reducing the time spent on this task. In factories, applications may locate inventory flows between different floors or workstations, eliminating the need for work-in-progress inventory and increasing transparency.

IV. Manage things: The IoT will allow for a better management of things. New networks will link data from products, assets and operations, generating strategic information that can bring unprecedented scientific rigor to decision-making. The recent increase of the urban population has intensified challenges surrounding city management. Potential IoT applications include traffic management tools that use sensors to monitor traffic patterns and rely on the resulting data to optimize flows—adjusting traffic lights and altering bus routes are a few possibilities. LED sensor networks are also emerging as a way of integrating streetlights to the IoT. Security, lighting and parking management and environment sensing are a few examples of potential uses for the light infrastructure.[8]

In manufacturing, IoT applications can bring significant efficiency gains. Smart machinery can provide real-time data on equipment status, reducing downtime. The ability to access the exact location of tagged containers and boxes can improve supply chain management, avoiding stock-outs or overproduction. In households, smart systems can help better manage resources—intelligent thermostats, for instance, can adjust room temperature according to the movement of people in a house.

V. Control things: The IoT can contribute to an improved control of resources and infrastructure. Smart grids for electricity, water and transportation networks are a few examples. Sensor technology can allow for the real-time assessment of resource usage and network performance, facilitating the identification of failures in electricity services and the measurement of the water flow through supply pipes. Potential IoT applications can establish communication between domestic appliances and the grid as a means to overcome load-balancing challenges. Based on data regarding peak demand, energy efficiency and the use of renewables, the grid would decide the best moment for the appliances to start operating.

New IoT applications are likely to generate major increases in productivity for existing products and processes and help create new business strategies. Innovative ways to manage our cities and healthcare systems as well as to perform personal routine tasks are bound to emerge as the portfolio of IoT applications expands.

Increasingly, companies are working on novel applications for the IoT. On October 21, 2013, IBM and Libelium, a wireless sensor network hardware provider, released an IoT Starter Kit aimed at facilitating application development. The innovative development platform combines Libelium's Waspmote wireless sensor platform, IBM's Mote Runner software and 6LoWPAN. It supports both simulated and real IPv6 sensor connectivity. In the words of IBM Research computer scientist, Thorsten Kramp, "[b]y making Internet of Things application development easier, the answers to the grand challenges of our age become more feasible."[9]

Companies engaged in developing new IoT applications aimed at connecting, monitoring, searching for, managing or controlling things are strong candidates to receive federal R & D tax credits.

Enabling the IoT

Even though basic uses of the IoT are already underway, this technology remains on its early stages of adoption. Major challenges must be overcome before the IoT reaches widespread use. Facing such challenges represents a unique opportunity for innovation. Companies engaged in achieving the technological advances necessary for enabling the IoT may be entitled to significant federal R & D tax credits.

The IoT will generate tremendous amounts of data. Therefore, the data management industry must develop new and improved tools to enable the processing of IoT Big Data.[10] The ability to process such data must be linked to the one of extracting meaning from it. For this reason, the predictive analytics software industry will play an important role in creating novel tools that can aggregate and analyze data in order to convey useful information for human decision makers and automated systems.[11]

LogMeln, Inc., a leading provider of remote services located in Boston, is engaged in facilitating these tasks. The company has developed Xively, a public cloud specifically built for the Internet of Things. The groundbreaking platform aims at providing the entire infrastructure necessary to accelerate innovation. It gives developers the services and tools necessary to create products and solutions on the IoT.[12]

The price of sensors, actuators and communication devices is also an outstanding challenge. Innovative processes are necessary to increase the cost-effectiveness of production and to respond to the growing need of smaller, more adaptable and complex systems.[13] Moreover, technology providers must develop shared infrastructures and common standards that will allow for the interoperability of sensors, computers and actuators.

Intel, the world's largest and highest valued semiconductor chip-maker, recently acknowledged the major growth opportunity behind the IoT, which is considered the driver of the next wave of computing. The California-based multinational has set a new business unit denominated "internet-of-things solutions group."[14]

Another technological obstacle is battery life. With the multiplication of connected devices, the use of unconventional power sources that allow for prolonged battery life becomes a must. Ongoing research at the Kansas State University has developed an energy-harvesting radio that draws power from a board made of solar cells from low-end calculators.[15]

Privacy and security are also at the heart of IoT development. The unprecedented level of connectivity will come hand in hand with magnified security concerns. The security software industry must develop innovative tools to neutralize threats of terrorism and hacking in the IoT.[16] Recent headlines have included pacemaker and insulin pump hacks, cars' electronics being taken over remotely, smart meter hacks, not to mention the multiplication of computer worms.

Businesses and policy makers must also stand out to develop new data control and privacy paradigms that fit the emerging IoT. Sharing personal data is a two-way street, where benefits (such as 24/7 health monitoring) may encounter significant drawbacks (such as the use of medical information to deny health insurance coverage).

In addition to the previously discussed challenges, the widespread adoption of the IoT also requires innovative efforts from all the organizations willing to take advantage of it. Companies must develop new processes to integrate real-time data flow into operations. The IoT will change the way each and every department functions, generating unprecedented technological and organizational challenges.

The Internet of Everything

It is difficult to conceive all the different ways in which the IoT will affect businesses, economies and the society. The "Internet of Everything" has brought forward major innovation opportunities, both in enabling IoT development and in creating new applications for it. There is no doubt that the IoT will change our lives. This is the time for innovative companies to say how and when this will happen.

Endnotes

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