CATALYZING THE INTERNET OF THINGS AND SMART CITIES

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ABSTRACT:

Many Smart City and Internet of Things (IoT) solutions are fragmented and the economy suffers. To deal with this issue, the National Institute of Standards and Technology (NIST) initiated the Global City Teams Challenge (GCTC) to catalyze collaboration among different stakeholders. The goal is to style and deploy IoT and smart city solutions that are replicable, scalable, and sustainable, thereby resulting in the identification and adoption of a consensus framework for smart city technologies. The second round of GCTC is currently in the first phase. Future smart city projects would enjoy a cosmopolitan IoT communications fabric which will function an infrastructure for the deployment of truly sharable and replicable smart city solutions.

Keywords: Internet of Things, Smart City, GCTC, IoT Fabric.

I. INTRODUCTION:

The concept of Cyber-Physical Systems (CPS) or Internet of Things (IoT), which has been around for quite a decade [1], is currently creating an excellent deal of buzz within the marketplace and media, with a promise to reinforce the way we live our lives. There are three major arenas for IoT applications—in the buyer , industrial, and public sectors. Recent interest has mainly focused on the buyer side, including consumer appliances, home area networks and other applications Industrial applications are promising to enhance business outcomes for several sectors, including manufacturing, asset management and healthcare.

In the case of public sector applications, the web of Things may be a major enabling concept to accelerate the event and deployment of smart city solutions. Thistext discusses the general architecture of IoT and therefore the problems with current practice of smart city deployments. The article then presents a replacement collaborative approach that uses the concept of a “challenge” for the acceleration of broader and faster adoption.

II. IOT AND SMART CITIES ARCHITECTURES:

To understand the essential characteristics of IoT and smart cities, it's useful to research the composition of a typical IoT solution and show how the architecture are often mapped thereto of smart cities. Figure 1 illustrates the simplified layered structure of IoT. At rock bottom of the structure is that the Hardware layer, where tangible hardware elements like sensors, actuators, chips, and radios are found. the weather during this layer typically interact directly with the environment, with other hardware elements, or sometimes with the users/consumers.

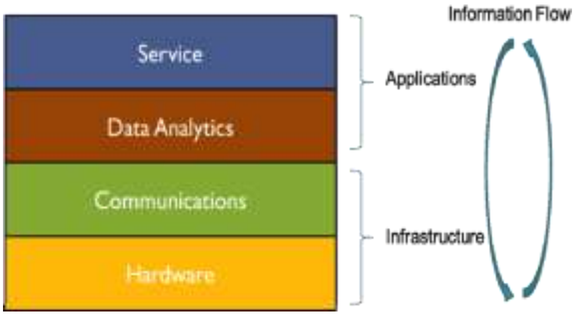

Figure 1: Simplified IoT and Smart Cities Architecture

The next layer is that the Communications layer, which is usually called "connectivity." This layer connects and binds different components within the Hardware layer in order that information can flow between layers or between hardware components. this is often where well-known technologies like Ethernet, Wi- Fi, cellular, and short-range wireless are found. for a few applications, the Communications layer is minimal (e.g., scaled right down to an indoor bus or to simplified connectivity among different hardware components).

The next layer is that the Data Analytics layer. This layer receives data from the Communications layer, then stores, analyzes, and processes them. this is often where "big data" applications could reside, for instance , within the case of applications that need collection and analysis of knowledge from an outsized number of sources. However, it should even be noted that this layer might be relatively thin and straightforward , especially within the case of embedded applications. In other words, the info Analytics layer doesn't necessarily imply the necessity for an enormous database and a particularly fast processor.

Many distributed IoT-based control systems employ a comparatively small-scale Data Analytics layer. An example of a small-scale layer are often found during a smart thermostat that would also function as anarea administrator within the house network.

On the opposite hand, many IoT solutions deployed at a city- wide scale may require an enormous centralized data repository and more powerful processors to handle a bigger amount of knowledge from multiple sectors and applications. An example of such a system might be a city's disaster command center that's designed to supply simultaneous visibility into different departments (e.g., water, energy, transportation, healthcare, etc.).

The main function of the Data Analytics layer is to gather data from the lower layers and extract useful information from the set of knowledge . Note that the set of knowledge itself might not have significant value and should not be very useful to the user. the knowledge extracted from the info , however, might be valuable in taking actions and achieving a desired outcome .

The top layer is that the Service layer. This is the layer where intelligence resides and decisions are made. This layer receives information from the info Analytics layer, then makes decisions on next steps. subsequent steps could include displaying the knowledge on a monitor screen or operating and controlling actuators. The Service layer is vital because it's within the position within the architecture to make the very best value for the users of the system. Many business decisions are made during this layer, including human-in-the-loop actions. The human-machine interface are often a crucial think about this layer.

Once the choice of subsequent step is formed at the Service layer, sometimes (but not always) information starts flowing within the reverse manner (i.e., from Service layer right down to the Hardware layer). this is often very true for systems supported some sort of autonomous control. On the opposite hand, it's sometimes a person's being who makes the choice and executes it. In either case, the top result's some sort of action that closes the loop of the knowledge flow. an identical representation of IoT data flow was proposed in another article [2].

Many developers consider IoT to be the mixture of just the 2 bottom layers (Hardware and Communications). it's important to notice , however, that these two layers are merely a neigh borhood of the entire IoT architecture. In many cases, the highest two layers (Data Analytics and Service) play more important roles in defining and producing the important value from the system. Also in many cases, the planning and implementation of the highest two layers could also be more complex and unclear than rock bottom two layers. In many cases, the highest two layers are heavily including business cases that are important factors in determining sustainability and replicability of the solutions.

In the case of smart city applications, it's often easier to conceptualize the architecture as two groups of layers— Infrastructure and Applications. “Infrastructure” typically refers to rock bottom two layers of the IoT architecture, and “Applications” refers to the highest two layers. In some cases, however, the info Analytics layer could belong to the infrastructure group, counting on the character of its functionality. Many solutions/products that belong to the appliance group have more flexibility in deployments than those belonging to the infrastructure group. this easy IoT architecture can function an initial template to map different smart city solutions to create consensus on their technical interoperability, which is important in addressing the challenges in accelerating the market for IoT and smart cities.

III. CHALLENGES FOR ADVANCING IOT IN CITIES:

Smart cities use smart technologies like IoT and CPS to enhance the standard of lifetime of the residents and citizens. Although progress in deploying IoT solutions has been quite impressive, the IoT market still suffers from the difficulty of “fragmentation, [3]” and therefore the smart city market shares similar concerns. Many smart city solution projects are isolated and heavily believe custom-solution developments. Naturally, many of them are over emphasized on customization and under-considered “one-off” projects for future upgrades and expansion. As a result, these deployments are isolated and don't enjoy economies of scale. Although many cities share an equivalent issues (i.e., parking problems, traffic jams, pollution , etc.), they often don't share best practices and find yourself reinventing the wheel. during this landscape, it's very difficult to make common standards for development and deployment of interoperable solutions.

IV. GLOBAL CITY TEAMS CHALLENGE:

To address this issue, the National Institute of Standards and Technology (NIST) has teamed up with US-Ignite and personal sector partners to make the worldwide City

Teams Challenge (GCTC) program [4][5]. The objective of the GCTC is to replicate, demonstrate and demonstrate measurable and sustainable models for incubating and utilizing operational, standard-based IoT solutions and demonstrating measurable benefits in smart communities / cities. “Replicability” means the solutions should be designed to work in additional than one city or community with minimal customization. “Scalability” means the answer should be functional no matter the dimensions and volume of the deployment. “Sustainability” means the project should be designed to last beyond its initial funding stage. In other words, the solution used is (1) to generate its own revenue to support operating costs or (2) to provide adequate concrete benefits to municipal governments willing to hide the operation cost using their budgets. Many of today’s smart city deployments lack one or more of those characteristics. GCTC places significant emphasis on the power to live tangible benefits for residents and citizens, thus empowering leaders within communities to demonstrate the advantages of adoption.

To achieve the goal of GCTC, the program was designed to make a voluntary environment for multi-stakeholder collaboration. As are often seen in Figure 2, multiple cities and technology innovators are brought into the program and asked to coalesce around shared challenges (e.g., pollution , traffic management, emergency response) to make teams called “Action Clusters.” Each Action Cluster creates a project plan with a timeline to demonstrate their accomplishments during a tangible manner. Because each action cluster includes multiple members, it's likely that the result of the answer are going to be replicable to other cities. within the case that a team has just one municipal partner, the team is inspired to determine additional partnerships with other cities by demonstrating measurable and quantifiable benefits of the answer . it's also important to notice that replicability and interoperability should be supported collaboration that's global instead of just regional.

There are two compelling reasons for cities to participate in the GCTC. For the cities that have already skilled successful deployments, it's a chance to market their solutions and be the origin of replication for other cities that face similar challenges. For the cities that are just beginning to consider the deployment of smart city solutions, it's a chance to find out from other cities’ projects and to showcase their home city ready partner for companies with reflective Smart City technologies.

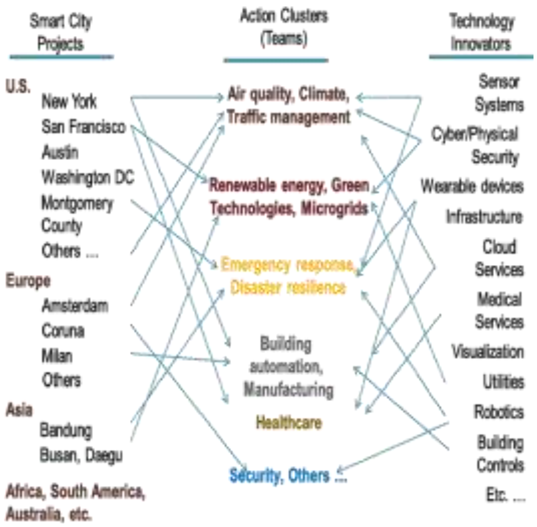

Figure 2: GCTC Approach

For corporations, GCTC is a chance to spot new business partners, demonstrate their proven solutions, and enlarge their market.

Academic institutions participate so as to seek out opportunities for joint R&D with cities/communities and partners which will enable the joint development and deployment of latest technologies. the method also allows researchers to spot key common characteristics and components among different applications and implementations, which can help the market to seek out convergence on best practices and eventually cause broadly adopted standards.

The first round of GCTC ended on June 1, 2015, after a nine-month process of team building, incubation, solution development and deployment, quite 60 teams, composed of over 200 organizations and three dozen cities/communities round the world, gathered at the National Building Museum in Washington, D.C., to present and demonstrate the impact of their smart city solutions. Many high-profile visitors and speakers, including King Willem- Alexander and Queen Maxima of Netherlands and U.S Transportation Secretary Anthony Fox came to celebrate and promote the team's achievements. The event was attended by more than 1300 people and was closed by several media outlets.

Based on the success of GCTC 2015, subsequent round was launched in November 2015. This new GCTC round consists of two phases. the primary phase will continue until June 2016, with the main target on building the teams and defining the project goals, timelines, and Key Performance Indicators (KPI) of the quantifiable impacts to residents and citizens. Participants will demonstrate and pilot the solutions and can build partnerships with as many cities as possible. The second phase will specialise in deploying the solutions, achieving the goals (based on the KPIs devised during Phase 1), and measuring the impacts. Phase 2 will culminate in June 2017.

GCTC 2016-2017 contains key elements of GCTC 2015 and promotes teams with two ambitious goals:

•use solutions that are shared and reflected in multiple cities across multiple continents

•provide tangible measurements of the improvements made by the solutions, like reduction of average commute time, reduction of pollution , reduction of water loss.

V. FURTHER DISCUSSIONS: IOT SMART CITY FABRIC:

One of the missing links in accelerating the deployment of IoT/CPS and smart city solutions is that the lack of a “connectivity fabric”--a commonly shared IoT/CPS network infrastructure among cities and communities [6]. As of today, there's no easy mechanism for an IoT solution to be deployed and become operational during a plug-and-play manner. for instance , an easy flood-level sensor deployed in one city might not share an equivalent backbone infrastructure required to exchange data with sensors in other cities. the present landscape of IoT and smart city is analogous thereto of the communications infrastructure of pre- Internet days.

It is essential that a communications fabric infrastructure be developed which will enable IoT devices and smart city solutions to spot and communicate during a plug-and-play manner, to make synergy between sectors, to scale back overhead, and to catalyze the mass adoption of affordable solutions by the residents in cities and communities. The IoT/Smart City fabric would enable sharing and replication of the solutions beyond the town limit, even as the web broke the physical-distance barrier for communications and commerce. Combined with multi-stakeholder collaboration programs like GCTC, the IoT/Smart City fabric—built to be open and neutral--could allow many cities and communities, large and little , to enjoy the advantages of advanced technologies to enhance the standard of life.

Beginning with its challenging plans [7] [8], NIST has already taken steps to promote consensus around reference structures for the operating system. Informed by GCTC, NIST has taken the primary step to determine a world technical public working party to assist develop an "IoT-Enabled Smart City Framework." [9]

REFERENCES:

[1] Industry Advisory Board, RWTH Aachen University, "Cyber- Physical Systems - History, Presence and Future," February 2013. http://www.ima-zlw-ifu.rwth-aachen.de/fileadmin/user_upload/INSTITUTSCLUSTER/Publikation_Medien/Vortraege/download//CPS_27Feb2013.pdf

[2] E. P. Goodman, Rapporteur, "The Atomic Age of Data: Policies for the Internet of Things," Communications and Society Program, The Aspen Institute, 2015, p.5. http://csreports.aspeninstitute.org/documents/Atomic_Age_of_Data.pdf

[3] M. Smolaks, "Internet Of Things In Danger Of Fragmentation" Tech Week Europe, July2013 http://www.techweekeurope.co.uk/workspace/internet-of-things-in-danger-of-fragmentation-120566

[4] Global City Teams Challengehttp://www.nist.gov/cps/sagc.cfm

[5] Global City Teams Challengehttps://www.us-ignite.org/globalcityteams/

[6] S.Rhee,G.Mulligan,"SmartAmericaChallenge,"2013-2014,p. 6. http://www.nist.gov/el/upload/Smart-America-Challenge-r1-25p.pdf

[7] E. P. Goodman, Rapporteur, "The Atomic Age of Data: Policies for the Internet of Things," Communications and Society Program, The Aspen Institute, 2015, p.48. http://csreports.aspeninstitute.org/documents/Atomic_Age_of_Data.pdf

[8] S. Rhee, "Internet of Things and Global City Teams Challenge," January 2015, p. 33. http://www.nema.org/Policy/Documents/IoT%20Global%20City%20Summary_NEMA_Sokwoo%20Rhee_01.08.2015.pdf

[9] International Technical Working Group on IoT-Enabled Smart City Framework https://pages.nist.gov/smartcitiesarchitecture/