The City of San Diego, Current by GE and AT&T recently announced the world’s largest city-based Internet of Things (IoT) deployment. By placing 3,200 Current’s CityIQ™ intelligent nodes on streetlights throughout the city, San Diego is putting powerful real-time sensor data into the hands of the community and benefiting from a new app economy.

EXECUTIVE SUMMARY:
The streets of San Diego are like the nervous system in your body. At any moment, millions of actions are taking place – cars driving by, people crossing the street, lights changing – there is constant activity. Capturing vast amounts of real-time data from thousands of Current’s CityIQ™ intelligent nodes mounted on streetlights throughout the city and making them actionable via APIs will unleash previously untapped smart cities innovation from within the developer community. Think of the App Store. Apple puts all iPhone sensor-data APIs on an open platform that’s accessible to the app-development community. The availability of apps since 2008 has grossed nearly $40 billion for developers. A similar app and sharing economy opportunity exists now for the City of San Diego thanks to data coming from its new digital smart city infrastructure.

Implementation:
In February 2017, the City of San Diego announced the world’s largest city-based IoT platform deployment. Deployment began in September and is expected to be completed in early 2018. As part of the initiative, the Performance & Analytics Department of San Diego launched its Open Data Portal where people can find data about city operations, including public safety, street repairs, public facilities, code enforcement and business licensing. The platform features open APIs for accessing and using the data.

The City is building a new business and cross-departmental collaboration model to leverage the multi-application, horizontal digital infrastructure enabled by CityIQ and its ever-expanding ecosystem partners to solve specific city challenges from parking/traffic optimization, urban planning, pedestrian safety to gunshot detection.
On June 22 and 23, Cleantech San Diego, CyberTECH, City of San Diego, Current by GE, AT&T and Intel hosted a Smart Cities San Diego Hackathon as part of San Diego Startup Week to explore how applications using real-time data from the 3,200 smart sensors that will be deployed on streetlights throughout the City of San Diego will help solve problems with traffic, parking, public safety, urban planning and environmental challenges. More than 60 engineers, programmers, designers, entrepreneurs and students making up 15 teams participated in the 17-hour, overnight hackathon and competed for $3,500 in prize money. The winning teams were: 1st) DreamBiz: developed an app to help business owners find the ideal location for their store front; 2nd) See Things: developed an app to help report possible drunk drivers; and 3rd) ParkA: developed a parking optimization app. In month of October, local universities and entrepruners unleashed more innovative apps using CityIQ data in SDHacks and AT&T Hack-o-ween. The winning teams from SDHacks were: 1st) Colored Bars and Toy Cars: showcased the data visualization, network communication via texting framework techonogy; 2nd) Where is Everyone?: developed an iOS app for monitoring and predicting pedestrian traffic. The winning teams from AT&T Hack-o-ween were: 1st) M.O.I.S.T: developed an app to control the lawn watering system with intelligence; 2nd) Parkey: developed an app to show nearest parking with reminders for tickets and parking spot memory; 3rd) CityIQ Companion App: developed an in-car parking service app. More smart city hackathons in San Diego are planned for 2018 with a goal of 100+ apps in total being developed from the local community to boost up the sharing economy while solving city challenges. Current’s Innovative Apps Center showcases some of the innovation from the developer community in the past year, which demonstrates the potential growth of app economy.

As a precursor to these projects and others in the San Diego region, in 2011 Cleantech San Diego, the City of San Diego, UC San Diego, San Diego Gas & Electric, GE and others launched the Smart Cities San Diego collaborative to facilitate the development and implementation of technologies and initiatives that drive existing smart cities programs forward, identify new opportunities, embrace additional collaborators and make the San Diego region a leader in the smart cities movement. Over the years, the San Diego region has become a leader in the smart cities movement thanks to the projects
facilitated by Cleantech San Diego between key public, private and academic partners that are driving the industry forward.

Methodology:
- Differentiating services by repurposing existing streetlight infrastructure to a multi-applications horizontal digital infrastructure
- Upgrade 25% of outdoor lighting with latest LED technology; 14,000 new LED light fixtures expected to save $2.8 million in annual energy costs
- Deploy 3,200 intelligent sensor nodes to establish the multi-application horizontal digital infrastructure
- Leverage energy savings, public private partnerships and financing to fund the project
- Launch public-private-people partnerships including the City of San Diego, San Diego Gas & Electric, UC San Diego, Cleantech San Diego and GE
- Leverage digital infrastructure and cross-department operational budgets to eliminate costly redundancies and single point solutions, accelerate new service offerings and generate direct and indirect city revenue
- Unlock potential of software development community by providing access to real-time sensor data to help optimize traffic and parking, plus enhance public safety, environmental awareness and overall livability for San Diego residents
- Empower each department with real-time and historical sensor data to solve its specific challenges without a separate single-purpose technology deployment
- Empower residents with an open data platform for improved services and open APIs for accessing the data
- Empower the developer community with real-time sensor data collected and aggregated from the digital infrastructure.
- Conduct numerous smart city hackathons to unleash the innovation from the developer community to improve urban lives
- Establish a San Diego App Marketplace to flourish the app and sharing economy
- Scale apps built in San Diego to be used in cities around the world.
- Scale City of San Diego services as the population continues to grow
- Flourish from the exponential growth of its App economy
- Formalize Standards and Data Policies to formally address data management and operations in anticipation of the deployment

Conclusions:
The City of San Diego demonstrated a new business model that consists of repurposing existing infrastructure, incorporating public-private-people partnerships, minimizing departmental capital expansion and leveraging energy savings and cross-departmental operational budgets and transforms the City with a multi-application citywide digital infrastructure. Thanks to the City’s Open Data initiative and the real-time sensor data, Current’s CityIQ™ platform, San Diego is empowering its citizens with transparency and efficiency and unleashing innovation from the developer community. The City itself will
be the first beneficiary of the exponential growth of the app and sharing economy as its neighborhoods become safer and smarter.

**Added Value:**
- Cost avoidance through multi-applications and future-proof IoT platform
- Optimized transportation networks
- Public safety event avoidance and mitigation
- Improved public services
- Faster emergency response
- Development of IoT curriculum for schools
- Economic growth through new business and job creation
- Civic pride and enthusiasm
- Ability to tackle problems with unprecedented speed and scale
- Uncover and own actionable real-time data
- Ignite the exponential growth of app economy
- Improved real-estate planning and optimize small businesses locations with traffic, parking, pedestrian and micro-level environmental data from the digital infrastructure
- Streamlined city revenues from parking fees, parking enforcement, improved locations for small businesses/retail stores, safer communities and less traffic congestion

**STRATEGIC OBJECTIVES**
Empowering communities, fostering innovation and improving infrastructure are critical to enhancing livability and workability in the City of San Diego. With its limited resources, the City aims to give developers the opportunity to make their neighborhoods safer and smarter and to grow the app and sharing economy.

**SCOPE OF IMPLEMENTATION**
The initial 3,200 CityIQ intelligent nodes are in the process of being deployed across the City of San Diego. Real-time sensor data will be open to app developers with a goal of creating 100+ apps by 2018 that solve specific challenges from City departments such as transportation, police, economic development, public works and more. The City anticipates both short- and long-term economic impacts will come from its new digital smart city infrastructure. By early 2018, sizable revenue will be generated from parking fees and streamlined parking enforcement. In the long term, the compounding app economy, cost avoidance for single-purpose technology deployment, real-estate development planning models and small businesses and retail store location optimization tools have the potential to bring increased revenue and jobs to the region.
Downtown Deployment Locations

Smart parking enforcement planned coverage areas (Gaslamp, Little Italy, East Village, Cortez Hill)

Proposed Core San Diego Node Deployment Locations
CURRENT STATE OF IMPLEMENTATION

Deployment of 3,400 CityIQ intelligent nodes started in October 2017, and is expected to be completed by early 2018. The CityIQ intelligent cities APIs with real-time simulated data are being made accessible to local universities and hackathon participants. The first Smart Cities San Diego Hackathon using the CityIQ APIs was hosted by Cleantech San Diego, CyberTECH, GE, AT&T, Intel and City of San Diego on June 22 and 23. A total of 12 apps were developed from the hackathon, where 100+ entrepreneurs and startups participated in the challenge. The winning app, DreamBiz, which was developed by a City of San Diego employee, helps entrepreneurs, small business and developers make smarter decisions about their future business ventures by aggregating disparate CityIQ data into a consolidated platform. Two more hackathons were conducted in October with more than 20 apps developed by the local community.

At Innovation Day in September, each City department was introduced to app providers who demonstrated solving specific department challenges using the digital infrastructure enabled by CityIQ. The current state of implementation has kick-started a comprehensive plan to train, recruit and retain local talent with a goal to exponentially grow San Diego’s app economy in the coming years.

INNOVATIVE CHARACTERISTICS OF THE PROJECT

The City of San Diego’s new digital smart city infrastructure is a highly innovative approach that provides a multi-application, horizontal platform for solving challenges in public safety, emergencies, gunshot detection, crime investigation, pedestrian safety, traffic, parking, real-estate planning and more. It dramatically improves cross-departmental collaboration within City administration, reduces cost redundancy and eliminates capital expenditures on single-purpose technology.

Climate Action Plan:
The City of San Diego’s Climate Action Plan is one of the most ambitious in the country and the City sees a need to incorporate smart city solutions if it is to reach its goals. The City is getting feedback from app developers who say they are excited by the opportunity to work on efforts that also allow them to be civically engaged. These developers find it appealing to work on apps that could make them money and also help tackle urban challenges like climate change.

App Economy:
Just like Apple’s app store was developed by third party developers, the City of San Diego will now have a platform where third party developers can help build the smart city apps of the future. For example, local startup M911 built an app providing public safety officials with the identity, indoor and outdoor location, photos, audio and live video streams of 911 callers using CityIQ data.

**City-owned Real-time Data:**
The City of San Diego is committed to the principles of open, accessible, efficient and transparent government and the use of technology to help put those principles into practice. The Performance & Analytics Department is devoting its efforts to creating a process for making its data publicly available online via its Open Data Portal. The City recognizes that making data available online in this manner will promote civic engagement, improve service delivery, allow for more effective communication with the public and increase opportunities for economic development. There are currently nearly 70 static/historical data sets in the portal. The real-time CityIQ sensor data, made available through RESTful APIs, are owned by the City, are interoperable with any cloud platform and will enrich the City's existing data sets to spark innovation from the developer community and enable real-time civic engagement and improved citizen services.

**Cross-departmental Horizontal Platform for Multiple Applications:**
Each City department has its own challenges. As each department is working to solve its challenges, the cost of redundancy and inefficiency can be eliminated with the digital infrastructure and all departments can take advantage of the real-time and historical data from CityIQ IoT platform with existing or newly innovated applications.

For example, smart city apps could positively impact:

**Parking:** The average conversion rate of parking citations in San Diego is 7%. it is estimated that over 30% of city traffic congestion is driven by people looking for parking. Traffic costs the San Diego economy significant amounts of money every year, through its detrimental effect on productivity, fuel emissions and traffic accidents. According to the 2015 Urban Mobility Scorecard, travel delays due to traffic congestion caused drivers to waste more than 3 billion gallons of fuel and kept travelers stuck in their cars for nearly 7 billion extra hours. Traffic also has a significant correlation to real estate prices in neighborhoods.

**Pedestrian Safety:** On average, a pedestrian was killed every two hours and injured every eight minutes in traffic crashes in 2013.

**Crime-Related Costs:** According to the Center for American Progress, violent crime costs Americans more than $42 billion in 2010.

**Gun Violence:** According to ShotSpotter, 75% of shootings go unreported.

**IMPACT OF THE PROJECT**

**Energy Savings:**
3,400 Current by GE CityIQ sensor nodes will be installed on streetlight poles throughout the City of San Diego as they concurrently upgrade 14,000 light fixtures to GE Current, LED luminaires. All retrofits include Adaptive Control by GE Light Grid Technology and Current’s Evolve™ LED luminaires, which are expected to save the City $2.8 million in annual energy costs.

Cost Avoidance:
It is essential to note that this deployment has the added benefit of future-proofing the City, which means that it takes into consideration the City’s future needs. By installing all of the applications at once with the CityIQ IoT platform, the City of San Diego can avoid future costs of installing one-off point solutions. The total cost-avoidance in this scenario totals $30.8 million.

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Parking:
The City of San Diego’s smart city digital infrastructure will allow for parking optimization, higher utilization of parking spots and easier enforcement of parking laws. Based on experiences with prior deployments of similar technology solutions, a 40% reduction in time spent looking for parking is expected. Based on a prior pilot of the same applications, parking enforcement revenue is expected to increase by 15% with an additional annual revenue of $4.5 million. Optimized parking enforcement will also lower repetitive motion disability claims by city workers who manually chalk tires.

Traffic:
Studies conducted by application providers indicate that smart city solutions could improve traffic by 10-20% by optimizing city management of traffic and providing en-route guidance improvements. Less traffic also means lower greenhouse gas emissions. The societal impact of this is significant and reduced traffic could improve air quality and associated health and productivity benefits. Bicycle data will help planners ensure they are building bike lanes where needed to enhance mobility throughout the city. In addition, traffic has a significant correlation to real estate prices and improved traffic should lead to higher real estate values in a number of San Diego neighborhoods. San Diego’s CityIQ sensors will also provide valuable data for enhanced mobility planning in support of the City’s ambitious Climate Action Plan.

Public Safety:
In the long run, San Diego’s smart city sensors are expected to act as a deterrent to crime, thereby increasing public safety. The City of San Diego recently had a scenario
where a gun was shot downtown and no CCTV security cameras or bodycam were available to provide threat evidence. The prevalence of optical and audio sensors has often been shown to directly impact crime. Video data from digital smart city infrastructure will make it easier to identify, and, therefore, arrest criminals. Auditory sensors will be useful for locating gun violence. This same technology has been applied in many other cities, with the median reduction in gunshots recorded as 20% across cities that saw reductions. The scaled deployment of CityIQ sensors will likely be applied to maximize coverage of high gunshot areas throughout San Diego, and the overall percentage reduction from this deployment is conservatively estimated at 15%.

**Existing Applications Adoption:**
A number of smart city applications have direct and indirect impacts that can be measured by their impact on GDP, city budget and number of jobs. Existing application providers such as CivicSmart, ShotSpotter, ParkitSD, Genetec, Catergraph and others can leverage San Diego’s CityIQ live data and enhance coverage and accuracy with minimal cost.

**Data Asset Value:**
While economic uses of this type of data are difficult to ascertain, some clear use cases that generate significant value are made possible by the data. For example, improved crime data will allow insurance companies to improve their risk modeling and accurate foot traffic data will improve retail real estate pricing and outdoor advertising optimization.

It is expected that the value of these entirely new types of data sets will be large in volume and wide in scope. Putting a value on this economic potential is inherently ambiguous for a number of reasons. First, the data sets being created are entirely new in type, and therefore do not have prior impact examples for comparison. Second, the exact business model of the data distribution is yet to be determined. Options include providing free and open access on the City of San Diego’s open data portal, charging a subscription fee in a for-profit enterprise, or charging fees to cover costs in a nonprofit endeavor. Finally, the size, file format and compatibility with other data types would significantly affect potential value generated by data subscribers.

**Social Impact:**
The City of San Diego’s smart city digital infrastructure will also offer societal value in various forms:
- The quality of life benefits that come from reducing gun crime, improving mobility, streamlining processes, etc.
- The specific benefits that come from partnering with GE, a company committed to ensuring the technology is deployed to maximize societal benefits, social equity and the long-term growth of San Diegans.
- The community development benefits that come from potential Community Development Block Grant funding opportunities in “areas of concern” where CityIQ sensors are placed.
FEASIBILITY OF THE PROJECT

With assistance from Cleantech San Diego, the City installed 3,600 LED streetlights with the GE LightGrid adaptive control system downtown – one of the first deployments of this technology in the country. The system was the first outdoor streetlight meter approved by SDG&E and is now a City-wide standard. The City is partnering with GE to upgrade streetlights to reduce energy costs by 60% as well as transform them into a connected digital network. A pilot was completed in August 2016, which showed a glimpse of the technology’s potential, and we have since been proud to announce San Diego’s commitment to deploy the largest digital installation of this kind anywhere in the world. The current city applications including Cartegraph, CivicConnect, CivicSmart, Genetec, ShotSpotter, PTV are already demonstrating enhanced capability with the real-time sensor data. In only 17 hours, a total of 12 apps were developed from the Smart City San Diego Hackathon during San Diego Startup Week in June 2017. The apps ranged from urban planning, economic development, traffic management, parking, to tourist guidance. The results of the Smart Cities San Diego Hackathon prove the ease of use and robustness of CityIQ API data, and demonstrates how the possibilities for creating innovative and valuable smart cities applications are endless.

“Repurposing San Diego’s lighting infrastructure in a way that allows the community to put their hands on the heartbeat and nervous system of the city is our way of building a smart city app store,” said David Graham, San Diego Chief Deputy Officer.

PARTNERS INVOLVED

- Jason Anderson, President and CEO, Cleantech San Diego
- Austin Ashe, GM, Intelligent Cities, GE
- Scott Crider, VP, Customer Service, SDG&E
- Ramesh Rao, Director, UCSD, Calit2
- Sameer Sharma, Global GM, Smart Cities IOT Solutions, Intel
- Mike Zeto, GM, Executive Director, Smart Cities, AT&T

REFERENCE WEBSITE

https://www.sandiego.gov/environmental-services/energy/programsprojects/digital-infrastructure