



PROPOSAL FOR

SMART STREETLIGHTS
RFI #: 2017-0001

PREPARED FOR

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1. About Us

Allegiant, Inc. provides comprehensive services and tailored solutions for the construction industry. We specialize in helping commercial, industrial, municipal, and utility clients complete their projects on time and on budget.

Our services include:

- Telecommunications
- Integrated infrastructure
- Management consulting
- Smart planning and solutions
- Automation programs
- Data management and analytics
- Customer engagement
- Cybersecurity
- Risk management
- Renewables

Allegiant provides unparalleled engineering, procurement and construction services across the Energy, Water, Transportation, and Telecommunication domains. We are experts in multiple, concurrent distributed infrastructure programs and possess first-hand knowledge of the intricate planning, permitting, site design and construction related to Smart engagements. A community's journey to Smart status should begin and end with Allegiant.

Allegiant focuses on the foundation of all Smart functions—the convergence of physical infrastructure, communications and analytics—to infuse intelligence into communities. Communities that operate from an integrated framework boost their sustainability, resiliency and citizen satisfaction, and expand their opportunity for economic development.

Our integrated approach to Smart Projects include:

- Engineering – energy, water, transportation, telecommunication, cybersecurity
- Program Management – project management, schedules, costs, distributed architecture, standards, documentation, and vendor management
- Implementation – permitting, environmental services, construction management, safety, utility interconnection
- Commissioning and Integration – verification, bandwidth, and service level agreements



2. Project Overview

Allegiant is proposing a Smart Streetlight Solution for the City of Pittsburgh. Our Smart Streetlight Solution will provide the necessary components that are essential to building and operating a Smart City. The Smart Streetlight Solution will allow the City of Pittsburgh to plan strategically and execute practically its Smart City Vision and further define the city as a symbol of 21st century economic and civic transformation.

Our Smart Streetlight Solution will create significant benefits for the City of Pittsburgh by helping the City of Pittsburgh: create local jobs; advance the City's sustainability goals; reduce the City's energy consumption and operations costs; improve public safety; enhance public goods and services; improve transportation, mobile energy and connectivity options; and support future economic growth in the City of Pittsburgh.

Our Smart Streetlight Solution will replace existing streetlights with LED-based lamps which will reduce energy and operations costs for the City of Pittsburgh by fifty percent or more. In addition, our Smart Streetlight Solution will provide additional community. Our Smart Streetlight Solution will network the City's LED-based lamps which will deliver an even faster return on investment. This will reduce the payback period down to six years from ten years, as a result of features such as remote management, advanced metering infrastructure, demand response, distribution automation, and smart services.

Our Smart Streetlight Solution uses recent advances in intelligent design; communications; digital technologies; data security, sharing and analysis which will make the City of Pittsburgh a more livable, resilient, economically sound, and sustainable city. Our Smart Streetlight Solution uses smart sensors and embedded devices that work together with an open, secure, and connected infrastructure to create a distributed layer of intelligence that can save energy, streamline the City's operations, improve quality of life and provide revenue streams from smart services.

Civic value is at the core of our Smart Streetlight Solution. Our Smart Streetlight Solution design is nascent but the technologies underpinning our solution which make the solution scalable, practical, and operationally efficient are not.

Based on our experience we realize that creating a Smart Solution comprised of smart devices such as smart streetlights starts with addressing the City's specific vision. There is no one-size-fits-all approach for building an intelligent environment. Smart cities will develop in many different forms and over time. Each city faces its own challenges, all dependent upon geographic location, population and existing and future concerns. We understand this and this is why our Smart Streetlight Solution will help shape and drive the City of Pittsburgh's vision and allow it to come to life.

We have helped the City of Boston solution its Smart Utility Vision by providing the design and rollout plan. In the U.S., San Diego is addressing infrastructure challenges through the GE Intelligent Cities platform. The first-in-the-nation pilot adds sensor technology to LED street lights, with a focus on parking solutions in the city's urban core. In 2014, San Diego



became the first U.S. city to widely use GE's LED fixtures with LightGrid™ outdoor wireless controls. The technology, deployed on more than 3,000 street lights, saves San Diego more than \$350,000 in energy and maintenance costs a year thanks to smart metering of individual light poles.

Our Smart Streetlight Solution

Our Smart Streetlight Solution addresses:

- Energy Efficiency
- Movement and Noise Management
- Air Quality Management
- Intelligent Secure Lighting Network
- Traffic and Parking Optimization
- Data Management and Analytics

Energy Efficiency

Our Smart Streetlight Solution is an innovative, modern and multifunctional lighting solution powered by renewable energy sources. Made from high quality components, our Smart Streetlight Solution will illuminate streets, parks, parking lots, City buildings and it will create appealing and modern visual environments that will not just promote renewable energy sources, but also lower installation, energy and maintenance bills.

Our Smart Streetlight Solution uses LEDs and a control system to deliver significant ecological value. The extensive energy savings lead to a similar reduction of greenhouse gas (such as CO₂) emissions. Dimming options, when implemented with LEDs, unlike conventional light sources, allow major energy efficiency. They enable a precise matching of light level to practical current needs which will reduce the City's carbon footprint and long-term operation costs.

Our Smart Streetlight Solution will help the City of Pittsburgh save electricity through automated streetlights by fitting the streetlights with wireless photocells that communicate back to the City of Pittsburgh's web-based system. Also, by installing power-generating systems for pavements to convert the energy from every single person walking on the pavement into a meaningful amount of power.

Through the automation and power-generating systems we estimate the measures could save more than 450,000 kilowatt-hours of electricity annually and reduce carbon dioxide emissions by almost 330 tons. The automation increases operational efficiency and saves time and energy. For instance, the City of Pittsburgh will be able to detect automatically when streetlights are malfunctioning rather than patrolling the City.

Our Smart Streetlight Solution will realize about 75 percent electricity savings with significantly better light quality and has the added advantage of eliminating mercury waste disposal. The power consumption of HPS units is approximately 3.4 kW, which remained constant from dusk to dawn. Our Smart Streetlight Solution power consumption is measured

at 1.24 kW at its full intensity and reduced to about 0.71 kW at 50 percent intensity when there is no traffic. When traffic is detected, lights come back on to full intensity.

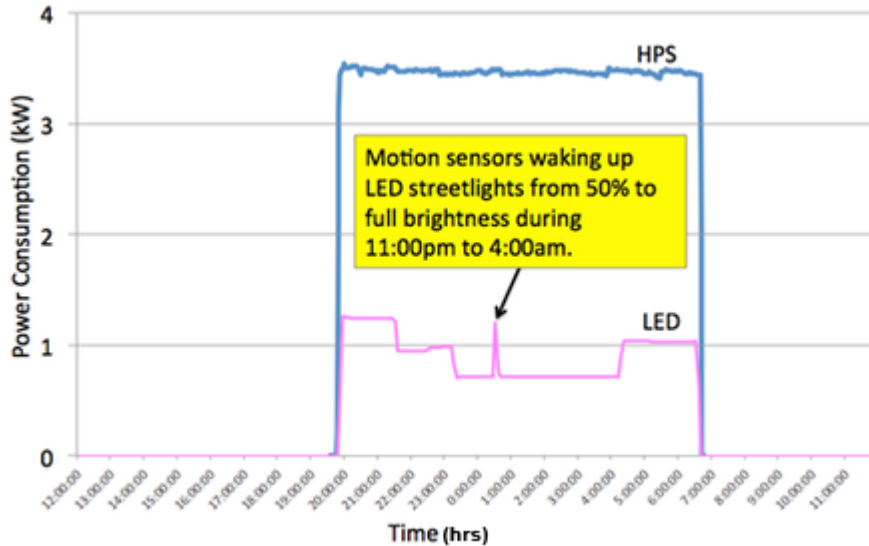


Figure 1: Comparison of electricity consumption of two street lighting systems (HPS vs LED) over the course of a day.

LEDs cost more than HPSs. The initial purchase costs of LEDs are recovered in six years based on electricity savings and annual recurring operations and maintenance costs. The saving-to-investment ratio—the ratio of the total savings over the project's useful life to the cost of the project—is estimated at 1.92. Replacing existing street lighting systems with intelligent LED systems can significantly reduce electricity consumption throughout the City of Pittsburgh.

Movement and Noise Detection

Through smart sensors and devices our Smart Streetlight Solution will allow the City of Pittsburgh to monitor and respond to disturbances and events in real time. The ShotSpotter gunshot detection system will be fully deployed and integrated into our Smart Streetlight Solution. Additionally, our Smart Streetlight Solution will use sensing nodes on light poles to estimate crowd sizes, check vehicle speeds and other tasks.

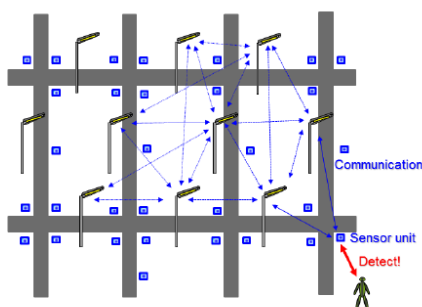


Figure 2: Communication flow to allow movement and noise management.

Air Quality Management

Our Smart Streetlight Solution will monitor air pollution to provide the City of Pittsburgh with city up to date and accurate data to help with planning and pollution reduction initiatives. Such initiatives can include:

- Emergency weather response (flashing to alert drivers to flooded streets)
- Aiding water conservation efforts by observing humidity, temperature, moisture

The sensors used in our Smart Streetlight Solution provide real time measurements of carbon dioxide, nitric oxide, particulate matter, temperate, pressure and humidity. The sensors send data over a low power secure wireless sensor.

Intelligent Secure Lighting Network

Our Smart Street Light Solution uses an Adaptive Control System. The Adaptive Control System is an advanced metering device that captures real time interval data from and full control of all smart sensors and devices implemented on the secure wireless sensor network. The intelligent secure wireless network lighting control system automatically incorporate new network sensors. Moreover, additional smart automation systems such as temperature and pollution sensors, traffic signals, security, fire detection, visibility conditions and traffic sensors may be integrated and supported easily.

The technology is designed to enable a gateway to cover entire cities or hundreds of square kilometers. Communication between end devices and gateways is spread out on different frequency channels and data rates. Because it uses a chirp spread spectrum approach, communications with different data rates do not interfere with each other and create a set of “virtual” channels increasing the capacity of the gateway. Data rates range from 0.3 to 90 kilobits per second.

The intelligent streetlight network allows for provision of secure Wi-Fi service for use by the City’s operations, guests to the City, partners, vendors, and the City’s citizens. And allows for provision of a bi-directional secure wireless sensor network that is used by the spatially distributed autonomous sensors to monitor physical or environmental conditions.

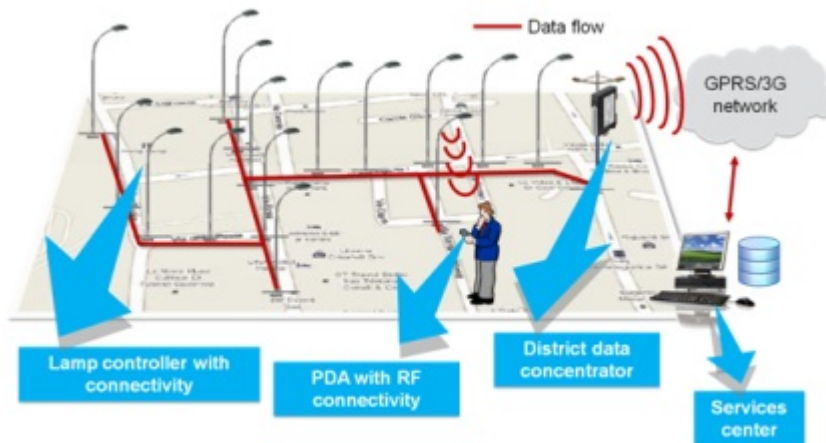


Figure 3: Communication flow of the intelligent lighting network.

Traffic and Parking Optimization

Our Smart Streetlight Solution uses sensors to allow the monitoring footfall and traffic flow creating data to aid in city planning and parking optimization. Drivers will be directed to available spaces also reducing emissions from idling cars. For instance, drivers will be able to find parking easily and in real time using a smart phone, and the environmental and transportation data will help the City of Pittsburgh meet its traffic management and climate goals.

Other features of the sensors include:

- Automatic accident detection and notification
- Rerouting traffic based on current road conditions (reduces emissions)
- Help first responders during emergencies
- Track carbon emissions and identify intersections that can be improved for pedestrians and cyclists

Data Management and Analytics

Our Smart Streetlight Solution will allow the City of Pittsburgh to manage and provide data to entrepreneurs and students to develop applications helping City to create jobs.

Our Smart Streetlight Solution will focus on the following:

- Systems to manage large volumes of events data, both real-time and batch.
- Logical and statistical techniques that will help identify the right events and correlate with various conditions, both event- and operations related, and, finally, predict the outcomes.
- Data filtering: This refers to the analysis of events and intelligent filtration of redundant data based on predefined conditions from the event data stream. This technique uses Boolean logic

- Point-of-detection algorithms: These algorithms can help develop patterns of their occurrence, which can help in taking proactive actions. For instance, time-wise and day-wise patterns for events can be developed. Further, filtration criteria can be applied to remove all patterns caused by electric, communication or network issues, and then the remaining patterns can be used to explain occurrences of certain operation outcomes, such as outages, power quality or device tampering.
- Data clustering: This is an unsupervised model that uses data similarity to group the data points. Similar categories of events can be clustered together, with analysis performed to extract business value from the clusters of events. For example, we can identify clusters among all event types and then develop relationships between outcomes and clusters of events. Device status, meter tamper and power quality events can be a cluster to determine issues such as open neutrals or flickering lights.
- Correlation: This measures the association between two variables, while assuming there is no causal relationship between the two. We can develop a correlation among various events and other outcomes to determine future behavior. For example, correlation between event type and consumption fluctuation can help with revenue assurance.
- Factor analysis: This allows variables to be grouped into common sub-groups in order to reduce the number of factors to be initially analyzed. For example, by performing factor analysis, we can identify dominating factors that contribute to events or a set of events or an outcome.
- Regression: This refers to the statistical relationship between two random variables to predict the outcome. Commonly used for forecasting purposes, regression examines the causal relationship between two variables. An example is using regression to analyze the relationship between equipment conditions in the field, such as a prediction of transformer failure, based on the demand from meters associated with it.

3. Deployment Plan

We anticipate the implementation period for our Smart Streetlight Solution to be approximately 2 to 3 years, followed by a 10 to 15 year operations and maintenance period. We will pilot the Smart Streetlight Solution with an installation of 4000 smart streetlights.

4. Technical Specification

Smart Streetlight Solution

The basic components include:

1. Advanced power stages (lamp ballast or driver) aimed to drive the lamps with the highest efficiency
2. Communication interfaces to allow the assembly of a digitally monitored, secure, and reliable network
3. An additional smart sensors to monitor weather conditions, lamppost inclination, and air pollution



The intelligent lamppost begins with its ballast or driver. Innovative solutions for powering LED street lights, engineers require a large portfolio of solutions that address both electrically isolated and non-isolated applications, driving single or multiple LED strings for different levels of output power (from 60W to 130W), specifically designed for outdoor applications.

Most lamp driving solutions are based on a digital approach, and this is where the true intelligence comes in. An 8-bit or a 32-bit microcontroller handles all the functions needed to drive the lamp and, at the same time, manages all the data for implementing a smart street lighting network.

Operational Consideration

We will perform the maintenance of our Smart Streetlight Solution.

5. Business Model

The City of Pittsburgh should use a design, build, finance, operate and maintain (DBFOM) model where availability payments are made based on ability to meet negotiated performance criteria.

Our Smart Streetlight solution will include:

- A take-back plan for recycling the bulbs and housings at the end of their useful life.
- Ongoing maintenance of the Smart Streetlight Solution
- City of Pittsburgh will generate revenue by delivering secure Wi-Fi through advertising and sponsorship-based models
- City of Pittsburgh will generate revenue by providing electric power to the grid

6. Evaluation

The proposal should be evaluated on the following:

- Create local jobs;
- advance the City's sustainability goals;
- reduce the City's energy consumption and operations costs;
- improve public safety;
- enhance public goods and services;
- improve transportation, mobile energy and connectivity options;
- and support future economic growth in the City of Pittsburgh.