LOUISIANA TECH
UNIVERSITY

COLLEGE OF ENGINEERING AND SCIENCE

City of Ruston
Andrew Halbrook
Engineering Technology Manager
701 E. Tennessee Avenue
P.O. Box 2069
Ruston, LA 71273-2069

Dear Mr. Halbrook:

I am writing to express my support and intent for ***Innovation***-related activities as part of the Department of Transportation (DOT) Better Utilizing Investments to Leverage Development (BUILD) Transportation grant program proposal. Let me assure you that my departments, college, and university are fully behind the mission, vision, and research themes of this proposal.

In addition to the capabilities for improving the transit experience for drivers, bicyclists, and pedestrians, we intend to introduce Smart Lighting capabilities to improve safety in critical areas during dark times of day. However, I assert that much more technology must be put into place in order to improve energy efficiency, mitigate environmental impact, detect and prevent collisions, and ensure the safety and security of information. For all these purposes, we propose to build a Smart Cities Innovation Testbed to be comprised of a network of connected sensor motes. Each mote will be an energy-efficient IoT device that will consist of (1) a low-power microprocessor, (2) a sensor board, and (3) wired or wireless telecommunications capabilities, and will be embedded into the newly constructed street, sidewalk, and drainage infrastructure.

The communications protocols will vary based on need and availability. When streaming data is required (e.g. for time-sensitive information and video feed) and where access to the downtown fiber-optic network is available, the sensor motes will transfer data using this wired connection. When wired connections are not feasible, motes will use a wireless card. The City of Ruston's Smart Grid Advanced Metering Infrastructure (AMI) already presently uses the 900 MHz RF bandwidth, which can be explored for additional purposes. When access to this band is impractical, the testbed will incorporate other wireless cards to operate with alternate protocols, such as 802.15.4, Zigbee, Digimesh, SigFox, LoRaWAN, and 4G LTE. 4G communications can be put in place for sensors located in remote, rural areas, far from any other existing wireless network.

The sensors placed on these motes will serve a number of purposes, including but not limited to (1) pipes and drainage, (2) environmental monitoring, and (3) driver safety and security. Water sensors will be placed adjacent to pipes and drainage ditches to collect such measurable quantities as vertical liquid level, flow rate, and presence of liquid contaminants. Other above-ground

sensors will capture data to monitor environmental conditions such as temperature, pressure, humidity, and particle concentrations of harmful gases (e.g. CO_2, NO_2). Weather stations connected via these motes will detect wind speeds and rainfall to develop a finer-grained approach to storm and tornado tracking, and can be used in control algorithms to automatically adjust Smart Lighting. Sensors on these smart lights and traffic signals will incorporate cameras and Radar sensors to measure distance and velocity to facilitate Smart Traffic control. For the facilitation of autonomous and semi-autonomous vehicle systems, locations will be identified for the placement of 5G microcells, once this technology becomes commercially available.

For the advancement of Cyber Security in these low-power IoT devices, special attention will be given to the microprocessor operating systems, wireless protocols encryption and authentication algorithms, and the classification of sensor data as public or private when uploading to the Cloud. Once on the Cloud, artificial intelligence and deep learning algorithms will be developed to perform data fusion and make only the most relevant statistics available to interested parties. Private data will be made available and visualized for City of Ruston Public Works employees in real time via a Smart City of Ruston Online Dashboard program. Using this dashboard, public officials can make the most well-informed decisions possible about critical issues, and act upon them with shorter delays. In addition, public data will be released to citizens of Ruston via a Smartphone App, so that local residents can keep up-to-date about the progress of potentially damaging weather patterns (e.g. tornadoes) and transit information (e.g. traffic congestion and parking availability). Documentation about how public officials in other cities and university researchers can replicate our testbed will be provided on the Louisiana Tech University website.

In prior research, I have already prototyped many of these capabilities on the Louisiana Tech University campus using commercially available off-the-shelf equipment from Libelium company. I have used the Libelium Waspmote and Plug-and-Sense sensor mote hardware for collecting sensor data related to air quality (gaseous concentrations), weather and agricultural conditions, water quality, security events and water levels. I have used the Meshlium server to collect data from local, low-power wireless sensor networks and upload the data to a public cloud infrastructure. I have used Amazon Web Services (AWS) IoT Core, database, storage, and compute services to collect long-term sensor readings and display them online. I have published results from these experiments in the IEEE 2019 Green Technologies conference. Thus, I believe that using similar equipment and software utilities, the City of Ruston can easily incorporate a Smart City infrastructure on a larger scale.

In summary, this innovative testbed will provide a repeatable, scalable, and sustainable platform by which the safety, health, and quality of life of the local populace will be improved. Please give the utmost consideration to the City of Ruston's application. If you have further questions about the technologies, please feel free to contact me at droz@latech.edu.

Sincerely,

Dr. Benjamin Drozdenko

Assistant Professor of Cyber Engineering and Computer Science, Louisiana Tech University