CITY OF WILSON DRONE-SUPPORTED EMERGENCY MANAGEMENT APP

A US Ignite Smart Gigabit Communities Service Development Fund Project by

WILSON NORTH CAROLINA

Triangle UAS LLC

Parks, Recreation And Cultural Resources TOWN OF CARY www.townofcary.org

CITY OF FIRE DEPT. 1808

TOWN OF CHAPEL HILL

NC NORTH CAROLINA NEXT GENERATION NETWORK NGN

NGAT

Introduction

Unmanned aircraft systems, commonly referred to as UAS, or drones, are enabling government agencies to reduce costs and time associated with the daily operations of all manner of essential public services. One of the most promising areas for drone-supported applications is in the municipal public safety arena. Communities that can support a high-bandwidth networking environment, like that available in Wilson County, North Carolina (near the Research Triangle) can accelerate the development and utility of drone-supported applications.

Led by US Ignite member, the North Carolina Next Generation Network (NCNGN), the City of Wilson and its partners pursued a Service Development Fund application project in 2018 that uses novel drone system infrastructure and remote streaming to support situational awareness in emergency response. The solution developed by the team improves the ability of government agencies and first responders to coordinate and collaborate using drone-collected sensor analytics via a standard protocol.

Application Development

Custom drone application startup, Triangle UAS, worked closely with the partners to develop a real-time HDMI video streaming application that is robust, secure and easily deployable from municipal UAS equipment to any device with internet connectivity. The application is currently being used in City of Wilson operations for disaster response, public safety, publicity and routine infrastructure inspections.

NCNGN member communities offered valuable input during the project, including the Town of Cary, the Town of Chapel Hill, the NextGen Air Transportation Consortium of NC State University and the Fire Department of the City of Greensboro. Along with the app, the team created a set of standard operating procedures, best management practices and flight checklists for the US Ignite Smart Gigabit Community network. These documents are meant to help other municipal governments bypass months of consulting and trial runs when standing up a drone program.

Application Specifications

Prior to development of this solution, there were limited options for viewing drone-generated video in real time that were not expensive, insecure or difficult to deploy. The team's goal was to develop a solution that is robust and secure enough for government use, including law enforcement, affordable for mass deployment and plug-and-play with most drones on the market.

The solution components include a hardware encoder, server and viewing portal enabled by a local gigabit network. The hardware unit is commercially available, enables ultra-low-latency streaming, and enables plug-and-play integration with other drones. (The application can also interface directly with a DJI Go application if a user does not wish to purchase the hardware encoder, but this will introduce latency.)

A server backend was developed with an off-the-shelf but customizable live streaming software that can receive the data, transcode it securely and serve the video stream. (Certain licenses may be required.) The client portal handles user authentication and video stream viewing in a secure environment. The viewing portal is based in Javascript, HTML, and PHP and can be installed on an onsite server or one that is hosted remotely. Onsite implementation will provide the best performance and security.

This application's measured latency is approximately one second, which meets the standard definition for real-time video. With Wilson's widely available gigabit network, 4K streaming is locally possible. The team anticipates 1080p is the highest supported resolution by 4G LTE.

Lessons Learned

There are many protocols available for streaming video: RTMP, HLS, HDS, RTSP, WebRTC, etc. The project team had a goal of running the application on any device (Windows, iOS, Android, and Linux) and chose an application programming interface that is almost universally supported for low-latency streaming. After extensive development, the team was able to make the application work on the framework to enable a universally compatible experience.

The team also initially planned to use a high-performance server (GENI) for the application, but discovered that it required very little computing power. Instead, a stable, high-bandwidth internet connection was essential. The stability and infrastructure of the underlying data network directly impacts the video delay. Further, each device that a data stream must pass through adds delay. To minimize the impact of additional devices, the server was located internally on the City of Wilson's network and hardwired directly into the fiber optic infrastructure. Utilizing remote servers for processing may be necessary in some applications, but it is likely to greatly impact latency.

Finally, regarding hardware design, it is important to acknowledge that real-time functionality does not scale down to smaller devices easily. The team anticipated utilizing a micro device attached to the drone controller. However, the amount of computing power required to handle the encoding workload exceeded the capabilities of any current microcomputer. This was circumvented by developing a Field Programmable Gate Array (FPGA). FPGAs are expensive and require more specialized expertise to configure, but they provide significant computing power in a small package as well as the ability to customize hardware architecture to speed up specific processing tasks.

Triangle UAS welcomes any inquiries for commercial or government deployment of this application. The City of Wilson will also gladly provide additional information about its experience with the development and deployment of the application to interested local governments.

Image Credits: Historic downtown Nash Street by night, City of Wilson
Vollis Simpson Whirligig Park & Museum, Doug Shoemaker