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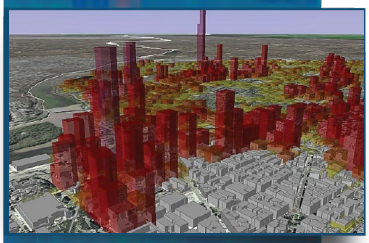

Edge Computing and Cloud Connectivity for Unmanned Systems

ORNL is developing edge computing hardware and cloud architectures to support research and development of next-generation unmanned systems. Future unmanned systems will require advanced autonomy, swarming capabilities, on-board computer vision, mapping, artificial intelligence and more. To accomplish these tasks, unmanned systems need the ability to ingest large amounts data, process it onboard, run computational-intense algorithms, operate anywhere, and distribute data quickly to users. Additionally, these functions must be performed on trusted hardware with secure communications.

Image credit: ORNL (Brad Stinson)
PixC4-Jetson hardware provides control and compute resources for unmanned systems.

To support these needs, ORNL has developed an unmanned system support ecosystem, collectively called the Multimodal Autonomous Vehicle Network (MAVNet). MAVNet is a suite of technologies and software which enable next-generation unmanned systems research. The MAVNet suite provides trusted hardware, onboard GPU-accelerated compute resources, communication pathways for beyond visual line of sight (BVLOS) operation and robust cloud connectivity.

Unmanned Systems Hardware. The PixC4-Jetson hardware (shown above) is the latest generation of unmanned system control hardware developed at ORNL. The hardware provides a complete NDAA-compliant vehicle control and compute solution aimed at Group 1 and 2 unmanned systems. Its small size and light weight make it highly adaptable, allowing researchers to add advanced capabilities to almost any existing unmanned platform. The PixC4-Jetson is based on an open-hardware flight management unit design and runs the popular ArduPilot open-source firmware, which provides control and autonomy solutions for VTOL platforms, planes, boats, rovers, and submersibles.

The PixC4-Jetson hardware includes integration of the Nvidia Jetson line of system on modules, enabling GPU-accelerated computer vision, artificial intelligence, machine learning and other computationally intensive applications to run directly onboard the vehicle.

Communication. Operating in any environment, including austere locations or areas with damaged infrastructure is critical for next-generation unmanned systems. The patented MAVNet communication system provides support for multiple link types and allows them to coexist on the same vehicle. For example, a mesh network, cellular/5G and satellite radio can all coexist, and the vehicle communications can fall forward or backwards between them to maintain connectivity anywhere in the world.

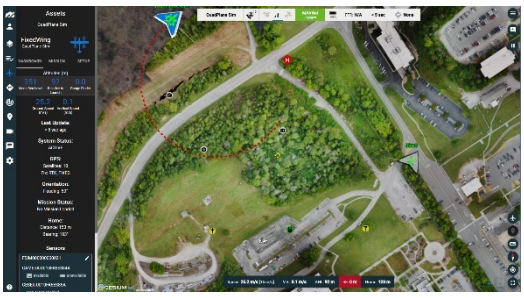

Image credit: ORNL (Brad Stinson)
Screenshot of the web-based control and data distribution system.

Data Distribution. Data distribution is critical to making informed decisions based on the data-products created by unmanned systems. As part of the MAVNet ecosystem, ORNL has designed and implemented a cloud architecture to support data distribution, video-distribution, and a web-based ground control system (shown right)

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