

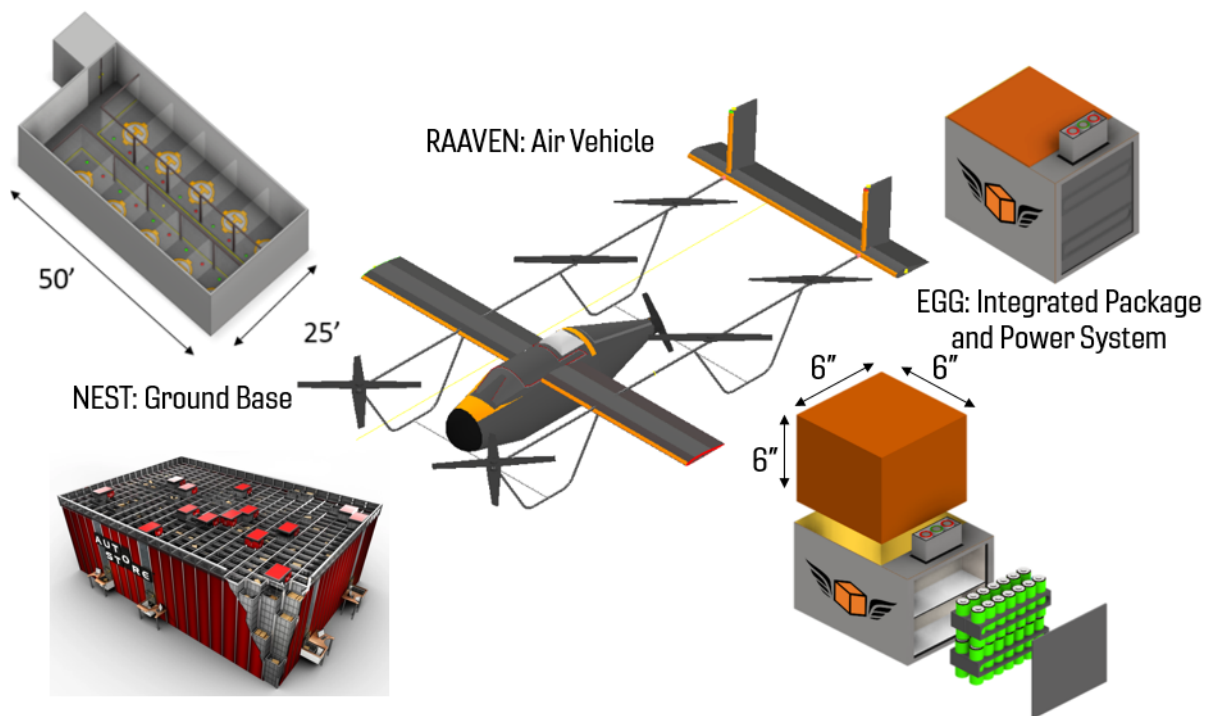
2019-2020 NASA AERONAUTICS UNIVERSITY DESIGN
CHALLENGE: URBAN AIR MOBILITY

VIRGINIA POLYTECHNIC INSTITUTE AND STATE
UNIVERSITY

AVIATE

Built for today, designed for the future!

June 15, 2020



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Abstract

2019-2020 NASA Aeronautics University Design Challenge: Urban Air Mobility

AVIATE is proud to offer a safe, reliable, profitable, low noise, small package, and autonomous UAS delivery service for the urban environment. AVIATE's unique solution specializes in delivering five-pound packages every two minutes between automated ground bases ten miles apart. The air vehicle, or RAAVEN, is FAA compliant, UTM compatible, equipped with DAA for avoiding UTM noncompliant objects, and estimated to have a very low $10E-11$ failures per flight. The ground base, or NEST, can launch a loaded air vehicle every two minutes from each of ten landing pads and autonomously load, unload, and re-energize the air vehicles for continuous operation. The business case is profitable and versatile to fit any urban environment's needs. AVIATE will partner with industry leaders such as FedEx[®], UPS[®], and USPS[®] for an endless supply of deliverable packages and Uber[®] and Lyft[®] for the capability to deliver to the doorstep. Using drone delivery like AVIATE will help reduce last mile delivery costs per package from \$6 using traditional methods to \$1 (including operating costs) with AVIATE. Future technology advancements in battery energy density, electric propulsion, and more reliable low-cost avionics will continue to drop this cost.

Safety, reliability, autonomy, cost effectiveness, and performance are key design drivers of the AVIATE system. The system uses COTS components allow for improvements to be made easily as new technologies such as high energy density batteries and powerful but low weight and low power avionics are developed. The critical AVIATE systems and layout is shown in Figure 1. A more detailed walk around of each part of the system will be discussed in the main body of this report.

Each package delivery begins with packages being brought to the NEST ground base by FedEx[®]/UPS[®]/USPS[®]. At these NEST bases, the packages are processed utilizing an autonomous package loading and unloading AutoStore[™] system. When ready for delivery, the packages are loaded into EGG modules which act as the package housing and power supply for the delivery drone. These EGGs are then loaded into a RAAVEN drone which takes off, flies to the receiving NEST, and lands. After touchdown, the RAAVEN unloads the package, but not the EGG into the AutoStore[™]. The package will remain here until the customer picks up their package at the NEST or has their package brought to their home utilizing a third-party service such as Uber[®] or Lyft[®]. The RAAVEN returns to the original NEST, drops off the empty EGG, and picks up a new EGG with a loaded package for another delivery.

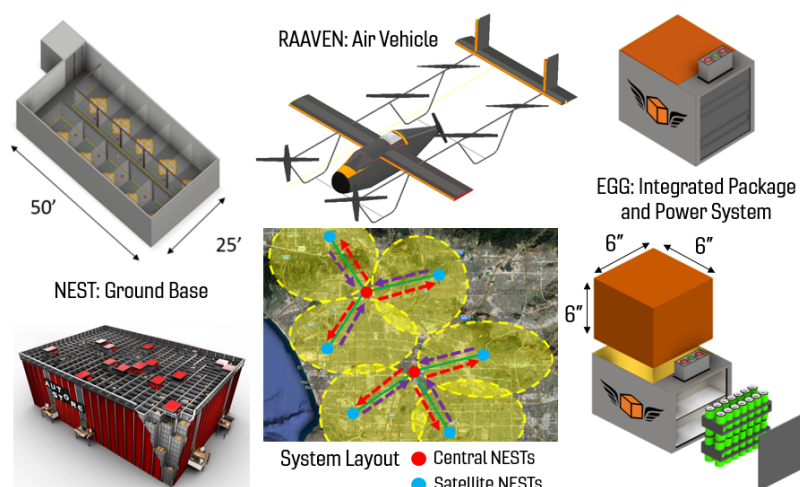


Figure 1: Critical AVIATE systems, including the RAAVEN air vehicle, NEST Ground Base, and EGG Module that link the two into one complete system