## System: **Package Delivery Drone**

## Requirements Traceability Table:

| # | Name | Text | Derived | Derived From |
|---|------|------|---------|--------------|
| 1 | REQ.1 Provide Package Delivery | Direct to consumer deliveries for small packages are still not effectively handled. There are unpredictable fluctuations in gig-economy drivers and delivery costs are often too expensive to make more use of the faster direct-to-consumer approach. There is need for an autonomous system that is readily available to handle direct-to-consumer deliveries more effectively than the conventional multi-stop route and the cost and unreliability of gig-economy workers. A system is needed to provide, quicker more effective, and autonomous direct-to-consumer delivery of small packages. | REQ.1.12 Competitive Operating Cost REQ.1.1 Encrypted Communication REQ.1.7 Maneuver Autonomously REQ.1.2 User Command Interface REQ.1.8 Operate in Moderately Harsh WX REQ.1.3 Communication Interface REQ.1.4 Store Customer Packages REQ.1.9 Recover from Impact REQ.1.10 Assembly/Disassembly REQ.1.11 Energy Storage REQ.1.5 Store Customer Data REQ.1.6 Store Route Data | |
| 2 | REQ.1.1 Encrypted Communication | The system shall be capable of receiving and delivering encrypted data | REQ.1.1.1 Server Connection Requests REQ.1.1.2 Remote Connection Access REQ.1.1.3 Unique System Identifier | REQ.1 Provide Package Delivery |
| 3 | REQ.1.1.2 Remote Connection Access | The system shall be able to communicate remotely to within 20 ft (T) or 30 ft (O) | | REQ.1.1 Encrypted Communication |
| 4 | REQ.1.1.1 Server Connection Requests | The system shall provide encrypted server connection requests. | | REQ.1.1 Encrypted Communication |

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| 5 | REQ.1.1.3 Unique System Identifier | The system shall have a unique identifier for authentication during connections. | | REQ.1.1 Encrypted Communication |
| 6 | REQ.1.2 User Command Interface | The system shall provide an interface to facilitate commands from the user. | REQ.1.2.1 User Power Control<br>REQ.1.2.3 Package Delivery Confirmation<br>REQ.1.2.2 Package Loaded Confirmation | REQ.1 Provide Package Delivery |
| 7 | REQ.1.2.1 User Power Control | The system shall provide encrypted user control to power on and off all subsystems. | | REQ.1.2 User Command Interface |
| 8 | REQ.1.2.2 Package Loaded Confirmation | The system shall receive confirmation from facility personnel that a package has been loaded. | | REQ.1.2 User Command Interface |
| 9 | REQ.1.2.3 Package Delivery Confirmation | The system shall receive confirmation that the package was received by the customer. | | REQ.1.2 User Command Interface |
| 10 | REQ.1.3 Communication Interface | The system shall provide a communication interface with facility personnel and customers. | REQ.1.3.1 Visual Display<br>REQ.1.3.2 Power Status Display | REQ.1 Provide Package Delivery |
| 11 | REQ.1.3.1 Visual Display | The system shall provide a display to print notification messages. | | REQ.1.3 Communication Interface |
| 12 | REQ.1.3.2 Power Status Display | The system shall provide display of its current power status. | | REQ.1.3 Communication Interface |
| 13 | REQ.1.4 Store Customer Packages | The system shall be capable of storing customer packages for delivery. | REQ.1.4.1 Weight of Packages<br>REQ.1.4.2 Package Bay Lock<br>REQ.1.4.3 Package Volume | REQ.1 Provide Package Delivery |
| 14 | REQ.1.4.1 Weight of Packages | The system shall be capable of lifting 3 lb (T) 5 lb (O) packages. | | REQ.1.4 Store Customer Packages |

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| 15 | REQ.1.4.2 Package Bay Lock | The system shall secure packages during delivery. | | REQ.1.4 Store Customer Packages |
| 16 | REQ.1.4.3 Package Volume | The system shall be capable of holding a package volume of 2" X 4" X 6" (T)  4" X 4" X 8" (O) | | REQ.1.4 Store Customer Packages |
| 17 | REQ.1.5 Store Customer Data | The system shall be capable of securely storing sensitive customer transaction data. | REQ.1.5.1 Customer Identification REQ.1.5.2 Package Identification | REQ.1 Provide Package Delivery |
| 18 | REQ.1.5.1 Customer Identification | The system shall be capable of securely storing customer identification | | REQ.1.5 Store Customer Data |
| 19 | REQ.1.5.2 Package Identification | The system shall be capable of securely storing package identification | | REQ.1.5 Store Customer Data |
| 20 | REQ.1.6 Store Route Data | The system shall be capable of securely storing planned route data. | REQ.1.6.1 Package Delivery Waypoints REQ.1.6.2 Return to Facility Waypoints | REQ.1 Provide Package Delivery |
| 21 | REQ.1.6.1 Package Delivery Waypoints | The system shall be capable of storing route way points for delivery to the customer. | | REQ.1.6 Store Route Data |
| 22 | REQ.1.6.2 Return to Facility Waypoints | The system shall be capable of storing route way points for return to the facility. | | REQ.1.6 Store Route Data |
| 23 | REQ.1.7 Maneuver Autonomously | The system shall be capable of maneuvering autonomously. | REQ.1.7.4 Avoid Collisions REQ.1.7.3 Execute Landing REQ.1.7.1 Maintain Delivery Course REQ.1.7.2 Request Position Data | REQ.1 Provide Package Delivery |

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| 24 | REQ.1.7.1 Maintain Delivery Course | The system shall be capable of staying within 5 feet (T) 3 feet (O) of its planned flight trajectory | | REQ.1.7 Maneuver Autonomously |
| 25 | REQ.1.7.2 Request Position Data | The system shall be capable of gathering positional data to within at most 10 feet (T) 5 feet (O) of its actual location. | | REQ.1.7 Maneuver Autonomously |
| 26 | REQ.1.7.3 Execute Landing | The system shall be capable of autonomously landing at the facility and at the package drop location. | | REQ.1.7 Maneuver Autonomously |
| 27 | REQ.1.7.4 Avoid Collisions | The system shall be capable of avoiding collisions with obstacles along its flight trajectory. | | REQ.1.7 Maneuver Autonomously |
| 28 | REQ.1.8 Operate in Moderately Harsh WX | The system shall be capable of handling moderately harsh weather conditions in the continental united states. | REQ.1.8.1 Wind Conditions REQ.1.8.2 Relative Humidity REQ.1.8.3 Minimum Temperature REQ.1.8.4 Maximum Temperature | REQ.1 Provide Package Delivery |
| 29 | REQ.1.8.1 Wind Conditions | The system shall be capable of maintaining flight following 2 second wind gusts at 10 mph (T) 20 mph (O). | | REQ.1.8 Operate in Moderately Harsh WX |
| 30 | REQ.1.8.2 Relative Humidity | The system shall be capable of sustained operation in environments with a relative humidity of 85% (T) 95% (O) | | REQ.1.8 Operate in Moderately Harsh WX |
| 31 | REQ.1.8.3 Minimum Temperature | The system shall be capable of sustained operation at a minimum temperature of 0°F (T) -10°F (O). | | REQ.1.8 Operate in Moderately Harsh WX |

| 32 | REQ.1.8.4 Maximum Temperature | The system shall be capable of sustained operation at a maximum temperature of 125°F (T) 135°F (O). | | REQ.1.8 Operate in Moderately Harsh WX |
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| 33 | REQ.1.9 Recover from Impact | The system shall be capable of recovering from impact during flight operations. | REQ.1.9.2 Drop Impact REQ.1.9.1 Head on Collisions | REQ.1 Provide Package Delivery |
| 34 | REQ.1.9.1 Head on Collisions | The system shall be capable of recovering from head on inelastic collision at 10 mph (T) 15 mph (O). | | REQ.1.9 Recover from Impact |
| 35 | REQ.1.9.2 Drop Impact | The system shall be capable of recovering from height of drop collisions at 20 feet (T) 30 feet (O) | | REQ.1.9 Recover from Impact |
| 36 | REQ.1.10 Assembly/Disassembly | The system shall be capable of assembly/disassembly. | REQ.1.10.1 Replacement Cycle REQ.1.10.2 Tamper Proofing | REQ.1 Provide Package Delivery |
| 37 | REQ.1.10.1 Replacement Cycle | The system shall be capable of part replacement cycles within 10 minutes (T) 5 minutes (O) during maintenance. | | REQ.1.10 Assembly/Disassembly |
| 38 | REQ.1.10.2 Tamper Proofing | The system shall not be easily tampered by criminals. | | REQ.1.10 Assembly/Disassembly |
| 39 | REQ.1.11 Energy Storage | The system shall be capable of storing energy to satisfy package delivery mission durations. | REQ.1.11.1 Energy Reserve REQ.1.11.2 Energy Resupply | REQ.1 Provide Package Delivery |
| 40 | REQ.1.11.1 Energy Reserve | The system shall reserve more than 30% (T) 50% (O) the amount of energy required for package delivery and return to the facility. | | REQ.1.11 Energy Storage |

| 41 | REQ.1.11.2 Energy Resupply | The system shall be capable of receiving energy for storage at a rate of 1.25%/minute (T) 1.75%/minute (O) where percentage is a measure with respect to total battery capacity. | | REQ.1.11 Energy Storage |
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| 42 | REQ.1.12 Competitive Operating Cost | The system shall match (T) or operate at less than 20% (O) the cost of gig-economy direct-to-consumer deliveries. | | REQ.1 Provide Package Delivery |