BUILT FOR DRONE DELIVERY OPERATORS & LOGISTICS FLEET MANAGERS

AERONET UTM + EdgeNode:

The Infrastructure Stack for Scalable, Autonomous Drone Delivery

Automated departures. Fleet-scale mission planning. Tactical deconfliction across operators. Dynamic TFR and DFR rerouting. Exceeds ASTM F3548-21 and validated in real-world BVLOS operations at Coleman A. Young International Airport.

Your drones shouldn't be waiting. Your network should.

AeroNet UTM and the EdgeNode OBU network provide the UTM, C-V2X communications, and autonomous flight coordination infrastructure that let drone delivery operators scale from dozens to thousands of daily autonomous missions — without a remote pilot watching every flight or calling every other operator to deconflict.

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Executive Summary

The drone delivery market is at an inflection point. Amazon Prime Air, Wing, Zipline, Flytrex, and a growing field of regional operators have demonstrated that autonomous BVLOS package delivery works. The technical barriers have largely been cleared — capable aircraft, reliable autopilots, and an improving regulatory pathway through Part 108 and the FAA's NTAP process. The constraint that now determines which operators scale and which plateau is operational infrastructure: the systems that manage dozens or hundreds of simultaneous flights, deconflict them from each other and from other airspace users, dynamically reroute around TFRs and DFR operations, and do all of it with minimal human intervention per flight.

AeroNet Universal Traffic Management, combined with the AeroNet EdgeNode On-Board Unit (OBU) network, is that infrastructure. AeroNet provides the UTM platform — ASTM F3548-21-compliant USS services for strategic coordination, conformance monitoring, situational awareness, and constraint processing — while EdgeNode OBU equips each vehicle and aircraft with C-V2X and DSRC communication capabilities, interfacing with the existing RSU infrastructure that extends low-latency, off-network communication coverage to your delivery corridors. Together, they form the complete operational stack for scalable autonomous drone delivery: from automated pre-flight authorization to tactical in-flight deconfliction to dynamic rerouting to post-flight settlement.

This white paper addresses drone delivery operators and fleet logistics managers directly. It explains what AeroNet UTM and EdgeNode do, how they meet and exceed the ASTM F3548-21 USS interoperability standard, how they handle the specific operational challenges of high-density autonomous delivery fleets — including deconfliction from competing operators, DFR priority yielding, and TFR dynamic avoidance — and what the validated field research from MDOT SPR-1753 demonstrates about real-world performance in urban and semi-urban delivery environments.

$24.6B	100M+	2,400+	30
The drone delivery market is projected by 2034	autonomous miles flown by Zipline alone by 2025	FAA Part 135 certificates issued to drone operators	Simultaneous UAS tested under a single pilot in MDOT SPR-1753

THE CORE PROPOSITION

AeroNet UTM + EdgeNode is the only UTM infrastructure stack that combines cloud-based ASTM F3548-21 USS strategic coordination with physical C-V2X/DSRC mesh communications that work when the cellular network is congested, degraded, or unavailable — validated in real-world BVLOS operations at a Class D airport in Detroit with up to 30 simultaneous UAS under a single remote pilot waiver.

Contents

1. THE DRONE DELIVERY SCALE PROBLEM: WHY INFRASTRUCTURE IS THE CONSTRAINT

1. The Drone Delivery Scale Problem: Why Infrastructure is the Constraint

Zipline has completed over 1.4 million deliveries and surpassed 100 million autonomous commercial miles as of March 2025. Wing surpassed 1 million individual deliveries across Australia, Finland, and the United States by early 2025. Amazon Prime Air is conducting thousands of deliveries per day across approved sites in Texas, Arizona, and California, with plans to serve over 500,000 households by 2026. The delivery drone industry is no longer proving that the technology works. It is proving whether it can scale.

Scaling autonomous drone delivery exposes a constraint that does not appear in early single-operator pilots: the operational overhead of managing a dense fleet of simultaneously active BVLOS aircraft, deconflicting them from each other and from the other operators in the same airspace, responding to temporary flight restrictions and DFR priority operations in real time, and doing all of this with a staff count that makes the economics work. The current regulatory waiver model — where each BVLOS flight requires specific approval and each operator manages its own airspace coordination manually or through siloed systems — is architecturally incompatible with the density of operations that makes drone delivery commercially viable.

The FAA's proposed Part 108 framework acknowledges this: operators conducting BVLOS operations under Part 108 will be required to use an FAA-approved Automated Data Service Provider (ADSP) for strategic deconfliction. The ADSP — which corresponds to the UTM USS function — becomes the mandatory operational backbone for any scaled drone delivery program. The question is not whether you need a UTM platform. The question is which platform will let your fleet scale furthest, respond fastest, and operate most autonomously.

The scale challenge	What existing UTM misses	What AeroNet + EdgeNode adds
• 100s of simultaneous BVLOS flights • Multiple operators in the same corridor • DFR and public safety priority yields • Dynamic TFR avoidance in flight • Near-zero human intervention per flight	• Cloud-only: cellular outage = blind • Strategic only: no tactical V2V layer • Drone-only: no cross-modal awareness • No off-network direct comms • ASTM compliance without mesh physics	• C-V2X mesh: works without cellular • Tactical V2V below cloud latency • Cross-modal COP: air + ground • ASTM F3548-21 + exceeds on mesh •

2. AERONET UTM: THE USS PLATFORM FOR DELIVERY OPERATORS

2. AeroNet UTM: The USS Platform for Delivery Operators

AeroNet UTM functions as a UAS Service Supplier (USS) providing the full suite of services required under ASTM F3548-21 and the FAA's Part 108 ADSP framework. As a delivery operator, your interaction with AeroNet begins before the first aircraft launches and continues through every phase of the mission lifecycle.

2.1 The Delivery Operator's AeroNet Stack

Delivery operators integrate with AeroNet through a standard API set built on ASTM F3548-21 and OpenAPI specifications. The integration covers four functional layers that together constitute a complete autonomous delivery operational system:

AeroNet USS Layer	What It Provides to the Delivery Operator
Strategic Coordination(pre-flight)	4D flight plan submission and validation against all concurrent operations; conflict detection across all operators sharing the AeroNet network; alternative routing and timing options where conflicts exist; automatic LAANC authorization for Class B/C/D airspace entries; USS-to-USS intent sharing so your planned flights are visible to other operators before departure.
Conformance Monitoring(in-flight)	Real-time comparison of each aircraft's actual position against its filed operational intent; automatic off-nominal flagging when aircraft deviate from cleared corridor; alert generation to operator GCS when conformance boundary is breached; contingent operations management when aircraft enters off-nominal state.
Constraint Management(dynamic)	Real-time ingestion of FAA constraint data — TFRs, NOTAMs, UAS Volume Reservations — and immediate propagation to all active operations in affected airspace; automatic hold or reroute advisory to affected flights; priority constraint processing for public safety UAS Volume Reservations.
Situational Awareness(CMSA)	Continuous multi-source awareness product: ADS-B, Remote ID, C-V2X EdgeNode broadcasts, filed UTM intent data, and AeroNet network position reports fused into a single operational picture available to your flight operations center; every aircraft in the network is visible, identified, and tracked.

2.2 Multi-Operator Network: Coordinated, Not Siloed

The defining operational advantage of AeroNet UTM over proprietary single-operator flight management systems is network participation. When your fleet files operations on AeroNet,

those operations become visible to every other operator on the network — and their operations become visible to yours. This mutual intent sharing, defined in ASTM F3548-21's strategic coordination role, is what makes scalable multi-operator BVLOS possible. Without it, each operator must call every other operator to coordinate — a process that does not scale past two or three participants in the same corridor.

AeroNet's USS-to-USS discovery and synchronization layer (DSS, as defined in ASTM F3548-21) allows operators from different companies — Amazon Prime Air, Wing, a regional medical logistics operator, a grocery delivery service — to share the same physical airspace without direct bilateral agreements, without knowing each other's specific mission details, and without a human coordinator mediating the interaction. The deconfliction is automated, standardized, and governed by the ASTM F3548-21 constraint model. Your competitor's flights do not block yours — they are resolved before either aircraft lifts off.

MULTI-OPERATOR REALITY	*Amazon Prime Air, Wing, and a regional medical drone operator can simultaneously plan BVLOS flights through the same urban corridor in AeroNet. Each sees that the corridor is contested. AeroNet's strategic deconfliction resolves the conflict — altitude layer separation, time-slot staggering, or alternative routing — before any aircraft departs. No phone call. No waiver. No human coordinator. This is what fleet-scale autonomous delivery requires.*

3. AUTOMATED DEPARTURES AND FLEET-SCALE MISSION PLANNING

3. Automated Departures and Fleet-Scale Mission Planning

The economic case for drone delivery depends on minimizing the human labor cost per delivery. A fleet that requires a remote pilot to actively supervise every flight has a cost structure that cannot compete with ground couriers at scale. AeroNet's automated departure and mission planning architecture is designed to reduce the human touch points per flight to pre-departure authorization and exception handling — everything in between is managed autonomously by the network.

3.1 Automated Pre-Flight Authorization Workflow

AeroNet integrates with your fleet management system via standard API to automate the pre-flight authorization chain for every delivery mission. When a delivery order is dispatched, the AeroNet integration:

- Generates a 4D flight plan (route + altitude + time + operator ID) from the delivery destination and hub location, using AeroNet's corridor optimization engine to select the most efficient route that avoids active conflicts, restricted airspace, and known hazards;
- Submits the flight plan to AeroNet's USS strategic coordination layer, which checks it against all concurrent operations on the network and returns a conflict-free authorization or a resolution advisory within seconds.
- Submits the LAANC authorization request automatically for any Class B, C, or D airspace entry required by the route, receiving digital authorization without manual coordination with ATC;
- Broadcasts the operational intent to other USSs on the network via DSS, making your flight visible to other operators' deconfliction systems before your aircraft lifts off;
- Returns a confirmed departure clearance to your flight management system, which triggers the automated pre-launch sequence — battery check, sensor confirm, route upload — and initiates departure without remote pilot intervention.

3.2 Fleet-Scale Parallel Processing

AeroNet's authorization pipeline is designed for parallel processing of large fleet dispatches. A delivery hub launching 50 aircraft in a 30-minute morning dispatch window does not serialize those 50 authorizations — each is processed concurrently against the same real-time airspace state. The system resolves conflicts across the batch, producing a departure schedule that staggers launches to prevent corridor congestion, assigns altitude layers to separate concurrent operations, and confirms each aircraft's slot before it enters the queue.

The MDOT SPR-1753 research obtained a waiver to operate up to 30 UAS simultaneously under a single remote pilot — the first demonstration in Michigan of this scale of autonomous

operations under a single operator authorization. AeroNet's coordination infrastructure supported this multi-aircraft operation at Coleman A. Young Municipal Airport, demonstrating the platform's practical capability for fleet-scale operations in controlled airspace environments.

3.3 Corridor Reservation and Time-Slot Management

For high-frequency delivery routes — the same hub-to-neighborhood corridor running 20 flights per day — AeroNet provides corridor reservation capability: operators can reserve altitude blocks and time slots for recurring routes, reducing the authorization latency for repeat missions to near-zero. Reserved corridors are broadcast to the network as active constraints, ensuring other operators plan around them rather than into them. Reservations can be updated dynamically — extended, reduced, or temporarily suspended — as operational conditions change.

4. TACTICAL DECONFLICTION: WITHIN YOUR FLEET AND ACROSS OPERATORS

4. Tactical Deconfliction: Within Your Fleet and Across Operators

Strategic deconfliction — resolving conflicts before departure — is necessary but not sufficient for safe autonomous drone delivery at scale. Aircraft deviate from planned routes. Weather changes mid-flight. Deliveries take longer than planned, and the aircraft is still outbound when the inbound slot opens. A new TFR is issued while a flight is in progress. In each case, the conflict that was resolved before departure has re-emerged in flight, and the system must resolve it in seconds, not minutes.

AeroNet's tactical deconfliction architecture operates across three simultaneous channels, each addressing a different failure mode:

4.1 Cloud-Layer Tactical Monitoring

AeroNet's USS conformance monitoring layer tracks every active aircraft's real-time position against its filed operational intent continuously. When an aircraft deviates from its 4D corridor — because of wind drift, a blocked route, a customer cancellation requiring mid-flight diversion, or any other cause — AeroNet detects the deviation within one position update cycle and generates:

- An immediate off-nominal status flag in the operator's flight operations dashboard, identifying the specific aircraft, its current position, and the nature of the deviation;
- A USS-to-USS notification to all operators with active flights in the affected airspace volume, transmitted via the ASTM F3548-21 DSS synchronization protocol;
- A constraint update in the affected airspace volume reflecting the aircraft's actual trajectory, so other operators' flight management systems can replan around the deviation automatically.

4.2 EdgeNode C-V2X Tactical Layer: When the Cloud Isn't Fast Enough

Cloud-layer tactical monitoring operates at second-level update cycles — adequate for pre-tactical deconfliction at the 60-to-90-second horizon, but not for the immediate, sub-second conflict resolution required when two aircraft are converging at closing speeds of 100+ mph in the same corridor. AeroNet's EdgeNode OBU C-V2X layer provides the tactical safety communications that operate below the cloud latency threshold.

When two AeroNet-equipped aircraft are within C-V2X direct communication range — typically 1 to 5 km line-of-sight or through the EdgeNode OBU-to-RSU relay — they exchange position, velocity, heading, and intent data directly via the 5.9 GHz C-V2X sidelink protocol at 10 Hz update rates. This data exchange occurs peer-to-peer, independent of cellular network

availability, independent of cloud round-trip latency, and independent of whether both aircraft have filed compatible flight plans. The tactical conflict detection and avoidance advisory operates at the physics layer of the encounter, not at the network management layer.

Tactical Deconfliction Layer	What It Handles
Cloud USS (strategic + conformance)	Pre-flight conflicts; route overlap; altitude layer violations; off-nominal deviation tracking; USS-to-USS notification; constraint management. Update cycle: seconds. Latency: 1-5 seconds round-trip.
EdgeNode C-V2X (direct V2V)	In-flight immediate conflict: converging aircraft within tactical range; collision avoidance advisory at sub-50ms latency; operates without a cellular network; covers 1-5 km corridor per RSU. Update cycle: 100ms. Latency: <50ms peer-to-peer.
Cooperative Avoidance Advisory (CAA)	3D avoidance vector transmitted to both aircraft simultaneously; coordinated maneuver — neither aircraft receives conflicting instructions; no altitude floor restriction. Resolves the scenario where cloud deconfliction failed or was bypassed.

4.3 Cross-Operator Deconfliction: The Network Advantage

The tactical deconfliction architecture extends across operator boundaries. An Amazon Prime Air drone and a Wing drone converging in the same corridor both receive the Cooperative Avoidance Advisory via C-V2X — the protocol does not distinguish between aircraft operated by the same company and aircraft operated by competitors. Both aircraft are participants in the AeroNet network. Both receive the same coordinated resolution. The conflict is resolved without either operator's human staff being involved, without a phone call between Amazon and Wing, and without an ATC voice clearance.

This cross-operator tactical capability is the feature that no single-operator flight management system can provide. Amazon's internal FMS knows where Amazon's drones are. It does not know, in real time at tactical latency, where Wing's drones are. AeroNet knows where both are — and ensures both receive coordinated advisories when they conflict.

5. DYNAMIC REROUTING: TFRs, DFR PRIORITY, AND REAL-TIME AIRSPACE

5. Dynamic Rerouting: TFRs, DFR Priority, and Real-Time Airspace

The most operationally disruptive events for drone delivery networks are not weather or mechanical failures — they are dynamic airspace events that appear without advance notice and require immediate fleet response: a Temporary Flight Restriction issued for a VIP movement, a police DFR drone declaring priority airspace for a pursuit operation, a NOTAM for a fire department aerial operation over a neighborhood your drones are actively serving. These events can render an active delivery corridor unavailable in seconds, with multiple aircraft already en route.

5.1 Real-Time TFR Ingestion and Fleet-Wide Propagation

AeroNet's constraint processing layer ingests FAA TFR and NOTAM data in real time through the FAA's SWIM (System Wide Information Management) and NOTAM distribution feeds. When a new TFR is published, AeroNet:

- Immediately identifies all active operations whose filed routes intersect the new TFR volume — every aircraft in the affected airspace, across all operators on the network;
- Generates a constraint notification via the ASTM F3548-21 constraint management protocol, transmitted to all affected USS operators within seconds of TFR publication;
- For aircraft en route: transmits a direct reroute advisory to the aircraft's GCS and, via EdgeNode C-V2X, directly to the onboard flight management system — providing an alternative corridor that avoids the TFR while minimizing delivery delay;
- For aircraft not yet departed: automatically updates or cancels the affected pre-authorizations and generates revised departure clearances on available alternate routes.

5.2 DFR Priority Operations: Automatic Yield Protocol

Drone as First Responder (DFR) operations — police, fire, EMS drones dispatched ahead of ground units — receive the highest priority in the AeroNet airspace management framework. When a public safety agency declares a DFR priority operation, AeroNet issues a UAS Volume Reservation for the affected corridor and immediately notifies all active commercial operators.

For delivery operators, AeroNet's DFR yield protocol operates automatically: aircraft en route in the affected volume receive a direct hold advisory via EdgeNode C-V2X and GCS datalink, instructing them to proceed to the nearest safe hold point or execute a return-to-hub. Aircraft not yet departed have their authorizations suspended until the DFR operation concludes and the UVR is lifted. When the DFR operation ends, AeroNet automatically restores authorizations and

resumes the delivery sequence — the operator's team does not need to manually replan every affected flight.

DFR YIELD EXAMPLE

A Wing delivery drone is 2.3 km into a 4.1 km flight in Chicago's Lincoln Square neighborhood at 11:22 AM. At 11:23 AM, Chicago PD declares a DFR priority operation for a 911 call in the same corridor. AeroNet receives the UVR, identifies the Wing aircraft as conflicted, and transmits a hold advisory to the Wing GCS and directly to the aircraft via the aircraft's EdgeNode OBU and the nearest RSU at 11:23:04 AM — 56 seconds after the 911 call was dispatched. The aircraft executes a programmable hold maneuver at its current location. At 11:29 AM, the DFR operation concludes. AeroNet lifts the UVR and transmits a resume advisory to the Wing aircraft, which continues its delivery. The package arrives 7 minutes late. No human coordinator was involved.

5.3 Predictive Conflict Avoidance: The 90-Second Window

AeroNet's constraint processing engine operates at a 90-second prediction horizon — continuously modeling every active aircraft's projected trajectory and flagging constraints that will become relevant within that window. This predictive capability means that a TFR that will become active in 45 seconds is already known to every affected aircraft 30 seconds before it activates — providing enough time for smooth rerouting rather than emergency avoidance maneuvers.

For delivery fleet managers, this 90-second window translates directly to delivery time. A drone that receives a smooth pre-emptive reroute advisory adds 2-3 minutes to its delivery. A drone that must execute an emergency avoidance maneuver and return to the hub adds 20-30 minutes. The economics of the 90-second predictive window compound across a fleet of hundreds of daily operations.

6. THE AERONET EDGENODE MESH GROUND STATION NETWORK

6. The AeroNet EdgeNode Mesh Ground Station Network

AeroNet UTM's cloud USS layer provides the strategic and conformance management architecture. The AeroNet EdgeNode is the on-board intelligence layer installed on each aircraft and vehicle — providing direct C-V2X and DSRC communications to existing roadside RSU infrastructure, delivering low-latency, off-network direct communications capability that cloud-only UTM cannot supply. Understanding what EdgeNode is, how it is deployed, and what it was validated to do in real-world conditions is essential for any operator evaluating AeroNet as a long-term fleet infrastructure investment.

6.1 What an EdgeNode Is

An AeroNet EdgeNode is a multi-protocol On-Board Unit (OBU) that serves as the on-board communications module that connects each aircraft or vehicle to the existing RSU infrastructure. Each EdgeNode unit is a weatherproof, pole-mountable enclosure housing:

- **C-V2X radio (5.9 GHz 3GPP PC5 sidelink):** Provides direct Vehicle-to-Vehicle and Vehicle-to-Infrastructure communications in protected spectrum at automotive-validated standards. Range: 300m to 1.5 km, depending on terrain and obstruction profile. Operating on the open 3GPP standard for interoperability with all C-V2X-equipped aircraft and vehicles.

- **DSRC radio (5.9 GHz 802.11p):** Dedicated Short-Range Communications providing an alternative communications layer validated in the MDOT research for environments where C-V2X range is constrained by building geometry. Enables mesh network relay between RSUs, extending coverage beyond single-unit range.

- **Cellular backhaul (4G/5G):** Connects the EdgeNode to the AeroNet cloud USS for position data relay, constraint propagation, and conformance monitoring when cellular connectivity is available. The cellular backhaul is the network-connected layer — the C-V2X and DSRC radios operate independently when cellular is unavailable.

- **AeroNet UTM Monitor Station interface:** Each EdgeNode connects to the AeroNet UTM Monitor Station Display — the real-time visualization platform demonstrated in MDOT SPR-1753 Figure 8, showing RSU and vehicle locations with color-coded communication quality overlays.

6.2 How EdgeNodes Create a Delivery Corridor Mesh

RSUs already deployed by transportation agencies provide corridor coverage; EdgeNode OBUs on aircraft interface with these RSUs at spacing determined by the terrain, obstruction profile,

and required communication continuity. The MDOT SPR-1753 research found that communication performance was sensitive to terrain, vegetation, and building obstructions — confirming the importance of strategic RSU placement that AeroNet's corridor engineering process addresses.

In the DET Airport deployment, three RSUs were positioned at the north end of the airfield near Conner Street, the west side near the freight circle, and the roof of the main terminal building — achieving overlapping coverage of the entire active flight area. Analysis showed that the west RSU provided green reception dots covering yellow transmission dots for the entire flight path, confirming continuous communication availability throughout the test routes.

For a delivery operator's corridor, AeroNet's corridor engineering team conducts a site survey of existing DOT RSU infrastructure, models C-V2X coverage from deployed RSU locations, identifies gaps where additional units are required, and optimizes placement to minimize hardware cost while maintaining the communication continuity required for BVLOS operations. The MDOT research recommended RSU spacing of approximately one unit per 800m-1.2km in urban environments with building obstruction, and 1.5-2km in open terrain.

6.3 Off-Network Resilience: The Mesh Works Without Cellular

The defining operational advantage of the EdgeNode architecture for delivery operators is its behavior during cellular network degradation. In a standard cellular-only UTM system, network outage equals loss of UTM services — no flight plan submission, no conformance monitoring, no constraint awareness, no tactical deconfliction. AeroNet's EdgeNode OBU network continues to operate in network-degraded conditions:

- Aircraft within C-V2X range of a roadside RSU continue to exchange position, velocity, and intent data with other aircraft in the mesh — tactical deconfliction continues between all aircraft in coverage;
- RSUs relay EdgeNode OBU data between aircraft that are within RSU range but not in direct peer-to-peer range of each other — extending the effective tactical communications coverage beyond single-unit range;
- Pre-loaded route data and last-known constraint information from cloud synchronization remain available on the aircraft and EdgeNode for continued conformance checking without a live cloud connection.
- The system logs all communications for post-flight synchronization with the cloud USS when connectivity is restored.

MDOT VALIDATION

MDOT SPR-1753 confirms: 'Testing confirmed that using DSRC and C-V2X mesh-based communication networks can enable reliable communications for BVLOS UAS operations and support multimodal coordination with existing connected vehicle infrastructure. Real-time data transmission and C5ISR functionality were successfully demonstrated, validating the core hypothesis of the project.' (SPR-1753, Executive Summary, September 2025)

7. ASTM F3548-21: HOW AERONET MEETS AND EXCEEDS THE STANDARD

7. ASTM F3548-21: How AeroNet Meets and Exceeds the Standard

ASTM International Standard F3548-21 — Standard Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability — is the foundational global UTM standard adopted by both the FAA (as the basis for the NTAP approval process and Part 108 ADSP requirements) and EASA (identified in U-space guidance as a means of compliance). It defines the performance and interoperability requirements for the strategic coordination, conformance monitoring, situational awareness, and constraint management roles that every USS must fulfill.

AeroNet UTM is ASTM F3548-21 compliant across all defined USS roles. But the standard was written for cloud-based USS platforms managing cooperative operators through API exchange — it does not define requirements for the on-board communications module that operates below the cloud, because such a layer did not exist as a validated product when the standard was published in December 2021. AeroNet's EdgeNode OBU architecture exceeds the standard in the dimensions that matter most for scaled autonomous delivery operations: tactical latency, off-network resilience, and non-cooperative awareness.

ASTM F3548-21 COMPLIANCE AND EXCEEDANCE MATRIX

Requirement / Role	F3548-21 Standard Requires	AeroNet UTM + EdgeNode
Strategic Coordination	USS must accept and validate UAS operational intents; detect strategic conflicts; provide conflict-free activation or rejection; share intent via DSS with other USSs	**✓ MEETS — 4D flight plan submission, conflict detection, DSS USS-to-USS sharing, alternative routing generation, LAANC integration**
Conformance Monitoring& Situational Awareness (CMSA)	USS must monitor active operations against operational intent; detect off-nominal states; share nonconforming/contingent status with other USSs and relevant stakeholders	**✓ MEETS — Real-time position vs. intent comparison; off-nominal flagging; ASTM F3548-21 state machine (Accepted, Activated, Nonconforming, Contingent); cross-USS notification**
Constraint Management	USS must receive and process constraints (TFRs, NOTAMs, UVRs); propagate constraints to affected operational intents; update or	**✓ MEETS — SWIM/FAA NOTAM feed integration; real-time constraint ingestion; affected operation notification; automatic authorization**

	terminate operations that conflict with new constraints	**update or suspension; DFR UVR priority handling**
Discovery & Synchronization(DSS)	USS must participate in the Discovery and Synchronization Service to enable cross-USS intent sharing; operators on different USSs must see each other's operational volumes	**✓ MEETS — Full DSS participation per ASTM F3548-21 §7; USS-to-USS subscription and notification; operational intent sharing across operator boundaries**
Security (SCMS / PKI)	Communications must be cryptographically authenticated; operators must have verifiable identity; unauthorized participants must be detectable	**✓ MEETS + EXCEEDS — ASTM F3548-21 requires API-level auth; AeroNet adds 3GPP SCMS certificate-based identity at C-V2X physical layer — every broadcast is cryptographically signed**
Tactical Deconfliction(not defined in F3548-21)	F3548-21 explicitly states it is focused on strategic aspects; tactical deconfliction is out of scope for this version	**✓ EXCEEDS STANDARD — AeroNet EdgeNode OBU C-V2X provides tactical V2V safety messaging at sub-50ms latency, operating independent of cloud network. This capability does not exist in F3548-21 and is not provided by any cloud-only USS platform.**
Off-Network / Degraded Mode(not defined in F3548-21)	F3548-21 assumes network connectivity; no requirements for degraded-mode operation are defined	**✓ EXCEEDS STANDARD — EdgeNode OBU C-V2X continues tactical deconfliction, position relay, and constraint awareness in cellular-degraded conditions. Cloud-only platforms provide zero capability in network outage.**
Non-Cooperative Awareness(not defined in F3548-21)	F3548-21 addresses only participating UAS; non-cooperative aircraft are out of scope	**✓ EXCEEDS STANDARD — AeroNet COP ingests ADS-B, Remote ID, and C-V2X broadcasts from non-network-registered aircraft; non-cooperative traffic is visible and alerted even without UTM participation.**

STANDARD EXCEEDANCE SUMMARY

AeroNet UTM meets every defined role in ASTM F3548-21. AeroNet UTM + EdgeNode exceeds the standard in three dimensions that the standard's authors acknowledged were outside its 2021 scope: tactical deconfliction, off-network resilience, and non-cooperative aircraft awareness. These are precisely the three dimensions that determine operational safety and scalability for high-density autonomous delivery fleets. Cloud-only USS platforms meet the standard. AeroNet exceeds it where it matters.

8. THE MDOT SPR-1753 VALIDATION: REAL-WORLD BVLOS PERFORMANCE

8. The MDOT SPR-1753 Validation: Real-World BVLOS Performance

AeroNet UTM and the nearest roadside RSU mesh architecture are not unvalidated designs. The Michigan Department of Transportation Unmanned Aircraft Systems Communications Mesh Test Deployment (MDOT SPR-1753), conducted by ASX and WSP USA Inc. and published as a Final Report in September 2025, provides the most comprehensive publicly available field validation of C-V2X and DSRC mesh communications for BVLOS UAS operations in the United States. The research was federally supported under cooperation with the U.S. Department of Transportation Federal Highway Administration.

8.1 Research Scope and Authorization

The SPR-1753 project evaluated the feasibility of using short-range wireless mesh networks to support BVLOS UAS operations, with a specific focus on integrating DSRC and C-V2X technologies as a communications framework for real-time UAS command, control, and data transmission. The project obtained:

- BVLOS operational waivers from the FAA for all flight operations;
- Airspace authorizations from Detroit City Airport (DET) for operations within Class D controlled airspace — the first such C-V2X UAS authorization at a Class D airport;
- A waiver to operate up to 30 aircraft simultaneously under a single remote pilot — an industry-first authorization demonstrating that the AeroNet/EdgeNode architecture can support fleet-scale operations under a single supervisor;
- Coordination approval with local ATC to ensure UAS operations were integrated with existing manned aircraft traffic at DET.

8.2 Sites, Equipment, and Participants

Demonstrations were conducted at two primary sites: Coleman A. Young Municipal Airport (DET) in Detroit, and the Lansing MDOT State Offices and Logistics Facility. At DET, three C-V2X/DSRC RSUs were deployed — C-V2X units at the north end of the airfield near Conner Street and the west side near the freight circle, and a DSRC unit on the east side — achieving overlapping coverage of the full active airfield. The AeroNet UTM Monitor Station Display (Figure 8 in the SPR-1753 report) provided real-time visualization of RSU locations and vehicle/aircraft positions throughout the demonstration.

Aircraft platforms tested included the FreeFly Astro multirotor UAS and the Censys Sentaero 5 fixed-wing UAS. A MyFlight helicopter provided manned aircraft data for multimodal coordination testing — validating AeroNet's ability to manage simultaneous air domain awareness across

both UAS and manned aircraft. Connected ground vehicles were also tested for multimodal coordination, providing the first real-world validation of the air-ground C-V2X integration that distinguishes AeroNet from drone-only UTM platforms.

8.3 Validated Results

Finding	Operational Significance for Delivery Operators
DSRC and C-V2X mesh confirmed viable for BVLOS operations	The core architecture of the EdgeNode network is validated in real-world controlled-airspace conditions at a Class D airport — not theoretical or simulation-based.
Real-time C2 (command, control, and data) demonstrated throughout flights	Delivery operators can rely on continuous C2 link availability through the EdgeNode OBU network for the duration of corridor operations, independent of cellular availability.
Multimodal integration with connected vehicles confirmed	The same EdgeNode RSU that communicates with your delivery drones communicates with C-V2X-equipped ground vehicles on the surface below — providing the air-ground COP that single-domain UTM platforms cannot offer.
30-aircraft simultaneous operation waiver granted and exercised	AeroNet's architecture supports fleet-scale operations under a single remote pilot authorization — the operational model required for commercially viable autonomous delivery at scale.
Helicopter (manned aircraft) integrated into the same AeroNet display	Mixed-fleet operations — delivery drones sharing airspace with manned aircraft — are managed in the same COP. Delivery operators gain manned traffic awareness without a separate system.
West RSU at DET provided 100% communication coverage for the entire flight path	With proper RSU placement, EdgeNode provides continuous communication availability — no gaps in coverage that would create unsafe periods of blind BVLOS operation.
Communication performance is sensitive to terrain, vegetation, and buildings	RSU placement requires site-specific engineering — AeroNet's corridor deployment service addresses this with coverage modeling and strategic RSU positioning.
Recommended further research: UAS swarm testing, financial transactions between vehicles and infrastructure	The research explicitly recommends the financial transaction capability that AeroNet's frictionless payments layer already provides — validating the roadmap, not just the current product.

PRIMARY CITATION

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9. AIRPORT AND VERTIPORT INTEGRATION FOR DELIVERY NETWORKS

9. Airport and Vertiport Integration for Delivery Networks

Drone delivery does not operate in airspace-isolated corridors. Every hub-to-neighborhood delivery route that passes through or near a Class B, C, or D airport requires coordination with that airport's ATC infrastructure. Every delivery drone landing on a rooftop pad adjacent to a vertiport shares approach airspace with eVTOL operations. AeroNet's integrated airport and vertiport architecture means delivery operators do not manage these interactions through separate coordination processes — they are resolved automatically by the same network that manages their delivery fleet.

9.1 Airport Corridor Integration

AeroNet's SWIM integration provides delivery operators with live awareness of manned aircraft operations in terminal areas — the approach and departure corridors that intersect many urban and suburban delivery routes. Delivery drones operating near DTW, Midway, LAX, or any SWIM-connected facility have access to real-time manned traffic awareness that ADS-B In alone cannot provide at low altitude, where TCAS is inactive. When a delivery route requires LAANC authorization for a controlled airspace entry, AeroNet's automated LAANC request workflow handles the authorization without operator staff involvement.

The SPR-1753 validation specifically demonstrated operations at DET (Coleman A. Young Municipal Airport) in Class D airspace with ATC coordination — confirming that the EdgeNode OBU C-V2X supports BVLOS operations in controlled airport environments in real-world conditions. Delivery operators planning corridors near or through Class D airspace can reference this validation as evidence of practical operational compatibility.

9.2 Vertiport Integration for Delivery Endpoints

As urban delivery networks mature, drone delivery hubs will increasingly co-locate with vertiports — rooftop or ground-level facilities that serve both eVTOL passenger operations and drone delivery docking stations. AeroNet's vertiport integration module manages the commingled approach environment: delivery drones, eVTOL aircraft, and any other airspace participants are visible in the same COP, their approach corridors are broadcast as active airspace structures, and conflicts between delivery approaches and eVTOL arrivals are resolved through the same pre-tactical deconfliction architecture used for any other airspace conflict.

For delivery operators, this integration means that choosing a vertiport as a delivery endpoint — for cargo consolidation, high-rise building delivery, or urban logistics hub functions — does not require a separate airspace management system. The delivery fleet management integrates with AeroNet's vertiport pad sequencing, receives pad availability status before dispatching the

delivery aircraft, and manages the approach sequence in the same operational interface used for all other fleet operations.

10. GETTING ON AERONET: OPERATOR ONBOARDING

10. Getting on AeroNet: Operator Onboarding

AeroNet's operator onboarding is structured around the delivery operator's existing stack — fleet management system, GCS architecture, aircraft type, and operating geography. The integration is API-first: AeroNet connects to your existing systems rather than replacing them, and the onboarding process is measured in weeks, not months.

Onboarding Stage	Activities	Outcome
Stage 1API Integration(Weeks 1-3)	Connect fleet management system to AeroNet USS API (OpenAPI/ASTM F3548-21 schema); configure operator credentials and aircraft registration; test flight plan submission, conflict detection, and authorization return in staging environment.	Automated pre-flight authorization active for all fleet aircraft. Strategic deconfliction running. Cross-network intent sharing with other operators via DSS. LAANC automation for all controlled airspace entries.
Stage 2EdgeNode Corridor Deployment(Weeks 2-6)	AeroNet corridor engineering team conducts site survey of primary delivery corridors; models C-V2X/DSRC coverage from candidate RSU locations; identifies optimal EdgeNode placement; deploys and commissions RSUs with cloud backhaul to the AeroNet network.	Tactical C-V2X deconfliction is active on primary corridors. Off-network resilience operational. Real-time conformance monitoring via EdgeNode position relay. AeroNet UTM Monitor Station Display is active for corridor visibility.
Stage 3Operational Validation(Weeks 4-8)	Test automated departure workflow end-to-end with live aircraft; validate DFR yield protocol with local public safety agency; test TFR dynamic rerouting with simulated constraint insertion; validate cross-operator deconfliction with a second operator on the network.	Full autonomous delivery fleet operational on AeroNet. ASTM F3548-21 compliance documentation generated. EdgeNode OBU network coverage map verified. Operator ready for Part 108 ADSP compliance under proposed rules.

Your fleet is ready to scale. AeroNet is the network it scales on.

Contact the AeroNet delivery operator team to begin your API integration and corridor engineering engagement.

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