UAS Drone-Swarm Coordination

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What Drone-Swarm Coordination Requires

Drone operations span fully cooperative (commercial delivery drones operating under registered FAA UTM with cooperative-broadcast protocols), partially cooperative (recreational drones registered with the FAA but not broadcasting full intent), non-cooperative (unregistered drones operating without protocol participation), and adversarial (drones whose presence indicates hostile intent — restricted-airspace incursion, critical-infrastructure targeting, hostile-actor reconnaissance).

Each population requires different coordination treatment. Three-tier intent fusion provides the architectural primitive that handles all four within the same framework. Cooperative drones broadcast Tier 1; partially-cooperative drones contribute Tier 2 (Remote ID broadcasts, transponder data); non-cooperative and adversarial drones produce Tier 3 inferred-intent observations, with hostile classification triggering the expanded admissibility envelope.

Why Current UTM Architecture Has Structural Gaps

FAA UTM specifies cooperative-protocol behavior for participating drones. Remote ID specifies broadcast requirements for some drone classes. NASA AAM addresses urban air mobility coordination. Each addresses a slice of the problem; none provides

the full architectural primitive that handles cooperative + partially-cooperative + non-cooperative + adversarial in a single framework.

The gaps surface at deployment scale. A delivery-drone operator coordinating across a metropolitan area encounters all four populations every flight. The current architecture handles each separately — cooperative through UTM, partially-cooperative through Remote ID, non-cooperative through visual detection, adversarial through counter-UAS systems. The four don't compose architecturally.

How Three-Tier Fusion Composes Across Drone Populations

The composite admissibility evaluator runs per-drone within the operating airspace. Cooperative drones contribute Tier 1 broadcasts; partially-cooperative drones contribute Tier 2 (Remote ID + transponder); non-cooperative and adversarial drones contribute Tier 3 (radar, visual, RF detection).

Adversarial classification triggers due-process credentialing through the relevant authority chain (FAA, DHS, DOD depending on context). The classification expands the operating drone's admissibility envelope: defensive maneuvers, alerts to allied units, and (in defense contexts) escalation to authorized counter-measures become admissible candidates, with composite admissibility selecting the actual response.

What This Enables for Commercial and Defense Drone Operations

Commercial drone delivery (Wing, Zipline, Amazon Prime Air, emerging operators) becomes structurally feasible at metropolitan scale. The architecture handles the realistic mixed-population airspace rather than the idealized cooperative-only airspace that current architectures assume.

Defense and critical-infrastructure-protection drone operations gain integrated cooperative + counter-UAS capability. The same architectural primitive serves both, with counter-UAS escalation governed through the same admissibility framework that governs cooperative coordination. The patent positions the primitive at the layer that scaled drone operations require as both commercial and defense use cases mature.