Airgain®)))

The Hidden Costs of First Responder Fleet Complexity

Learn how simplifying your tech stack
is the key to operational readiness

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Executive Summary

Today's patrol cars, ambulances, and fire trucks roll out as mobile data centres, streaming computer-aided dispatch (CAD) updates, body-cam footage, patient vitals, and situational video in real time. To make that happen, agencies have bolted on cellular routers, Wi-Fi gateways, GPS pucks, external antennas, SIM trays, and metres of cabling—each a potential single point of failure.

First responder crews feel the strain

64% of first responders say an unreliable network is their biggest concern.[1]

65% identified a reliable and resilient network as the most important factor in day-to-day communications.[2]

75% report that outdated or fragmented IT systems cause outages and delays that directly impede mission work.[3]

67% have experienced dispatch outages, and **88%** have experienced other IT malfunctions.[4]

[1] T-Mobile   [2] Verizon   [3] U.S. Public Safety Trends Survey   [4] Police Mag

Complex hardware = lost hours and lost dollars

A full refit of a police cruiser can run to 39 staff-hours and three miles of wiring, before the vehicle ever hits the street.[5] When something breaks (e.g., a melted defective SIM card or a loose RF connector), every maintenance dispatch costs US$448 to $760 in downtime per vehicle, per day.[6]

Every extra device component widens the attack surface

The automotive sector logged 215 cybersecurity incidents in 2024 alone—a 50% jump year-on-year. Connected emergency vehicles share that same risk profile. One misplaced firmware patch or factory password can ground a fleet faster than any mechanical fault.

Consolidation is key

Moving 5G modem, Wi-Fi 6 Router, GPS/GNSS, and high-performance antennas into an *all-in-one* ultra-rugged, low-profile unit rewrites the cost equation:

One unit, one firmware stream: agencies report install times cut by more than half.

No vehicle downtime to change carriers: eSIM profiles load over-the-air, so network pivots happen in minutes, not service-bay hours.

Smaller attack surface: fewer devices, fewer open ports.

The chapters ahead dig into the real numbers behind installation labour, truck-rolls, security exposure, and officer confidence, then show how a fully integrated rooftop platform—AirgainConnect Fleet—turns connectivity complexity into round-the-clock operational readiness.

Failure Points in Your Current Fleet Tech Stack

Mission-critical data now moves through patrol cars, ambulances, and fire trucks as routinely as fuel. Yet the underlying architecture that carries that data has grown organically over successive procurement cycles, leaving most frontline vehicles with a multi-component stack of fragmented devices, components, and miles of cabling.

A multi-layer system assembled over time

Vehicle zone	Typical connectivity components	Vulnerabilities
Roof	• Multi-band LTE/5G antenna array • Wi-Fi 6 antennas • Multi-GNSS patch • Occasionally VHF/UHF or satellite elements	• Weather exposure • Vibration-induced connector fatigue • RF-cable signal loss (≈ 1–1.5 dB per m)
Dashboard or console	• Cellular router • Wi-Fi gateway • MDT cradle • DVR/NVR for body- and dash-cam streams • SIM trays • USB/RF splitters • Land mobile radio	• Space constraints • Heat • Overlapping power draws • Manual firmware management

A California Highway Patrol study found that completing a full police-cruiser up-fit requires approximately 39 staff-hours and three miles of wiring.[8]

[8] Government Fleet

Why the stack continues to grow

A handful of structural and operational realities continues to drive the steady accumulation of components inside emergency-service vehicles:

Incremental procurement cycles

New mission requirements (body-cams, high-definition video backhaul, telemedicine) arrive as separate vendor packages, each with its own "black box."

Carrier lock-in

Physical SIM trays can bind hardware to a single network; and changing SIM cardsproviders can require physical partial removal or disassembly of equipment.

Asynchronous firmware schedules

Routers and Wi-Fi gateways follow different update cadences, increasing maintenance windows and overtime.

Cumulative power and thermal load

Additional components raise current draw and enclosure temperatures, shortening component life and elevating failure rates.

Key Takeaway

A first-responder vehicle's tech stack was never designed as an ecosystem—it grew organically, one mission requirement at a time.

This layered approach delivers capability, but at a cost measured in installation labor, recurring maintenance, cybersecurity exposure, and—most importantly—connectivity issues that affect mission readiness.

CHAPTER 2

The Business Case for an Integrated System Current Fleet Tech Stack

Fragmented, multi-box architectures deliver connectivity but at a price that compounds over the vehicle lifecycle and that leads to multiple potential failure points.

An integrated rooftop unit—combining modem, Wi-Fi, GNSS, high-performance antennas, multi-carrier eSIM, and remote management in one enclosure—changes that cost curve in several quantifiable ways.

Preserving signal strength by eliminating RF-cable loss

The longer the RF cable, the greater the resistance, and consequently, the more significant the signal loss. The baseline loss for a standard RG-58/RG-174 coax loses ≈0.46 dB per metre at 850 MHz. Even premium LMR-195 grades drop ≈ 0.36 dB per metre.[9]

An all-in-one integrated design eliminates signal degradation typically caused by long RF cables, ensuring strong wireless performance. Locating the modem directly beneath the antenna array removes 4-6 metres of cable in a typical installation, recovering up to 2 dB of uplink power—equivalent to a >50 % gain in weak-signal zones.

[9] Telco Antennaes

Accelerating deployment and lifecycle upgrades

Activity	Multi-device stack	Integrated unit	Reduction
Initial installation	Minimum of 2 technician-hours (router, antennas, cabling, console power)	< 1 hour (single bolt-mount, two cables)	At least 50% reduction in install time
Troubleshooting & Diagnostics	Multi-device fault isolation (router, antenna, cable, SIM)	Single-unit health checks via the AC-Cloud portal	At least 40% reduction in truck/vehicle rolls
Carrier change	Physical SIM swap, 60–90 min service time	Remote eSIM reprovisioning <10 min	Near-zero downtime

Ensuring carrier continuity and geographic reach

Remotely provisioned eSIMs support up to four live profiles, enabling automatic failover when a network degrades and simplifying roaming or remote area coverage. Remote profile updates cut the operational delays and logistics costs of traditional SIM management significantly.

Integrated units should also have public-safety network readiness and support AT&T, FirstNet, Verizon, and T-Mobile for redundancy. Multi-carrier capability via the eSIMs provides automatic fail-over and geographic redundancy without a physical SIM swap, ensuring continuous connectivity during large-scale incidents or regional outages.

What is an eSIM?

An embedded SIM (eSIM) is a tamper-resistant microchip soldered to the modem's circuit board. Unlike a traditional plastic SIM card, it:

- **Stores multiple carrier profiles:** up to four at once in AC-Fleet so the device can switch networks automatically or on command.
- **Loads profiles over-the-air (OTA) via an encrypted provisioning session:** no dash-dives, tray ejectors, or hardware swaps.
- **Eliminates heat-related failures:** the chip is rated –40 °C to +105 °C and has no plastic carrier or spring contacts, so extreme cabin heat can't warp it or break connectivity.
- **Enhances security:** because the identifier cannot be removed, cloned, or lost in transit.
- **Ensures connectivity:** when coverage maps shift or a new public-safety network comes online, you push a new SIM profile with no truck roll required.

Lowering total cost of ownership (TCO)

Cost driver	Fragmented approach	Integrated unit impact
Initial installation	Separate router, antennas, GPS, and power conditioner	One SKU; fewer spares
Labor	Multiple installation and service disciplines	Single install, single skill set
Training & support	Vendor-specific interfaces	Unified UI, cloud or on-premise options
Lifecycle	Mixed MTBF values and the weakest component governs	Tested to ISO MIL-STD-810G with a 30-year calculated MTBF

Improving connectivity reliability in every environment

Integrated rooftop units are purpose-built for exposure: IP67/IP69K sealing, -30 °C to +70 °C operating range, and SAE J1455 shock compliance. By eliminating chassis-length cabling and dashboard mounting brackets, they also cut the number of vibration-prone connectors,and components classed as high-risk for intermittent contacts in automotive vibration testing.

Simplifying security and compliance

A single integrated unit ensures fewer default credentials to manage and a smaller external attack surface, reducing the likelihood of the kinds of on-board router breaches that rose 50% year-on-year in 2024.

Optional centralised cloud management further enforces consistent policy across the fleet while providing an auditable trail for CJIS and NIST 800-171 requirements.

Key Takeaway

Moving to an integrated "all-in-one" integrated device is not just a hardware refresh—it is a structural reduction in cost, risk, and administrative overhead.

CHAPTER 3

Case Study:
Chatham-Savannah Counter Narcotics Team (CNT)

Chatham-Savannah Counter Narcotics Unit from Chatham County, GA, has over 50 agents in the field tasked with mobile surveillance, rapid-deployment operations, and major-event response.

The team found that conventional in-vehicle routers required long RF-cable runs, several hours of installation, and offered no carrier redundancy—problems that limited effectiveness during covert surveillance rotations and large public gatherings where cellular networks are congested.

Integrated solution from Airgain

The task force equipped unmarked vehicles with an integrated vehicle gateway unit, AC-Fleet, and supplemented coverage with battery-powered Go-Kit Pro units for discreet, cable-free deployments. Both platforms support up to four active eSIM profiles (T-Mobile, AT&T/FirstNet, Verizon) for automatic failover.

The CNT is now evaluating the same integrated gateway for helicopter and drone down-link streams, leveraging the hardware's IP69K, MIL-STD-810G-rated construction for airborne use.

Key Results

Installation time cut by >50%

Full vehicle installs completed quickly.

Reliable connectivity in high-density environments

Maintained live video, MDT access, and secure comms throughout Savannah's St Patrick's Day weekend (>500,000 attendees).

Rapid, covert deployments environments

AC Go-Kit Pro delivered plug-and-play broadband in unmarked vehicles with no visible wiring.

Seamless multi-carrier coverage

Automatic signal-strength prioritisation kept agents online while crossing coverage zones.

Instant contingency backup

The rooftop unit restored the wire-tap monitoring centre within minutes after a fixed-line outage.

> **"** We used the Go-Kit and AC-Fleet in the middle of a crowd of half a million people—and we stayed connected the entire time. No signal loss. No delays. This gear just works. **"**

LT. CHRIS HINSON
Operations & Support Services, CNT

CHAPTER 4

The ROI of AC-Fleet

This chapter outlines the return on investment (ROI) of adopting AirgainConnect Fleet (AC-Fleet™). It explains the methodology, inputs, and sample scenarios you can adapt for an ROI calculator or a board-level business case.

Introducing AirgainConnect® Fleet™ (AC-Fleet)

AC-Fleet™ is a compact, 2-inch-tall rooftop gateway that combines a 5G modem, Wi-Fi 6 router, multi-GNSS receiver, and high-performance antennas in a single IP67/IP69K-rated housing.

Designed for simplicity and resilience, the unit:

- Supports up to four eSIM profiles with automatic multi-carrier failover
- Provides both cloud and local web-based management
- Meets MIL-STD-810G certification for rugged environments
- Installs with just one power lead and a single Gigabit-Ethernet cable

These capabilities form the baseline for the ROI analysis that follows, measured against both traditional multi-component solutions and the closest integrated competitor.

ROI of AC-Fleet vs. traditional multi-component-based solution

Baseline prices used in this ROI model are illustrative and based on a traditional multi-component solution (i.e., legacy router and external antenna). The actual return on investment should be recalculated using your fleet's own component costs, labor rates, cloud subscription, support, and ongoing maintenance assumptions.

Metric	AC-Fleet	Traditional Multi-Component Solution	Efficiencies
Average install time per vehicle (hours) for modem, router, GPS, antennas, cabling	1	2	50% faster installs
Average service calls per year	0.6	1.5	60% reduction in truck/vehicle rolls
Time per service call (hours)	2	2	0% (same duration per call)
Local technician hourly rate ($USD)	US$95/hour	US$95/hour	0% (same rate)
Hardware cost per vehicle (modem, router, GPS, antennas, cabling)	US$1,999	US$1,450.00-$2,400 (i.e., legacy router, external antenna, etc.)	Higher upfront hardware, offset by install + service efficiencies and cloud management subscription included in Year 1
Software fees for cloud management platform	Free in Year 1 and US$85 per year thereafter	US$204 per year	~58% lower software fees
5-Year Total Cost of Ownership	US$3,004	US$4,085-$5,035	~26%-40% lower TCO

ROI of AC-Fleet vs. competitive integrated solutions

Baseline prices used in the ROI model are illustrative and based on the closest integrated competitor. The actual return on investment should be recalculated using your fleet's own component costs, labor rates, cloud subscription, support, and ongoing maintenance assumptions.

Metric	AC-Fleet	Closest Integrated Competitor	Efficiencies
Average install time per vehicle (hours) for modem, router, GPS, antennas, cabling	1	2	50% faster installs
Average service calls per year	0.6	1	40% reduction in truck/ vehicle rolls
Time per service call (hours)	2	2	0% (same duration per call)
Local technician hourly rate ($USD)	US$95/hour	US$95/hour	0% (same rate)
Hardware cost per vehicle (modem, router, GPS, antennas, cabling)	US$1,999	US$2,399	~17% lower hardware cost*
Software fees for cloud management platform	Free in Year 1 and US$85 per year thereafter	US$204 per year	~58% lower software fees
5-Year Total Cost of Ownership	US$3,004	US$4,559	~34% lower TCO

Scenario Analysis

Based on the numbers above and a conservative labor rate of $95 per hour, the following example calculates the savings on a 50-unit fleet.

Metric (50 vehicles)	AC-Fleet	Multi-Component Solution	Closest Integrated Competitor
Hardware	$99,950 (1,999 × 50)	$72,500-$120,000 (1,450-2,400 × 50)	$119,950 (2,399 × 50)
Install	$4,750 (1 hr × $95 × 50)	$9,500 (2 hrs × $95 × 50)	$9,500 (2 hrs × $95 × 50)
Service (5 yrs)	$28,500 (0.6 × 2 hrs × $95 × 50 × 5)	$71,250 (1.5 × 2 hrs × $95 × 50 × 5)	$47,500 (1 × 2 hrs × $95 × 50 × 5)
Software (5 yrs)	$17,000 (free Y1, then 85 × 50 × 4)	$51,000 (204 × 50 × 5)	$51,000 (204 × 50 × 5)
5-Year TCO	**$150,200**	**$204,250-$251,750**	**$227,950**
Savings with AC-Fleet	—	$54,050-$101,550	$77,750

Intangible but material benefits

Beyond the costs, an integrated rooftop unit delivers qualitative gains that directly impact frontline effectiveness:

))) **Officer / medic confidence:** Fewer connectivity drop-outs; quicker CAD/AVL response times

))) **Procurement simplicity:** One part number, single RMA process

))) **Training overhead:** Single UI and remote cloud portal streamlines onboarding

))) **Reduced downtime:** More units on patrol means improved community coverage and satisfaction

Key Takeaway

Even under conservative assumptions, AC-Fleet's integrated rooftop unit generates strong double-digit ROI across a standard five-year lifecycle. Beyond the hard cost savings, it also drives operational efficiencies that are harder to quantify but have a direct impact on mission readiness.

Fleet Efficiency Checklist

Is your current connectivity setup costing you performance?

Use this quick self-audit to spot hidden labour, downtime, and security costs in your existing vehicle tech stack. Keep this checklist with your next budget submission or grant application.

*(Answer **Yes** or **No** to each item; three or more "Yes" responses indicate a strong business case for consolidation.)*

#	Assessment question	Cost or risk signal	Yes/No
1	Do most vehicles carry three-plus separate components for broadband, Wi-Fi, GPS, and antennas?	Excess installation hours & cable failure points	_____
2	Does changing a SIM card or switching carriers require physically touching every vehicle?	Scheduled downtime & technician call-outs	_____
3	Are annual firmware updates spread across four or more vendors?	Multiple maintenance windows; patch gaps	_____
4	Do you log one or more connectivity-related service tickets per vehicle each year?	Recurring labor + lost utilization	_____
5	Is your average vehicle downtime cost ≥ US$ 500 per day?	High financial impact from even minor outages	_____
6	Do RF-cable runs inside the cabin exceed 3m / 10 ft?	1–2 dB signal loss; weaker uplink in fringe areas	_____
7	Are there different management interfaces for routers, Wi-Fi APs, and GPS receivers?	Higher training overhead; config drift	_____
8	Have you experienced any onboard router or modem cyber incident in the past 24 months?	Enlarged attack surface; compliance exposure	_____
9	Do vehicle installs typically take 20+ technician hours to complete?	Delayed deployment; overtime costs	_____

Interpretation guide

- **0–2 "Yes" answers:** Your stack is relatively lean; focus on targeted improvements (e.g., eSIM adoption).
- **3–5 "Yes" answers:** Connectivity complexity is eroding uptime and budgets—an integrated rooftop unit could deliver rapid payback.
- **6–10 "Yes" answers:** The business case for consolidation is compelling; consider a pilot deployment to quantify savings immediately.

Further Resources

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