Airgain®))))

Why Utility Fleets Pay More than They Should for Connectivity

Cut fleet and operational costs, accelerate restoration, and simplify everything

Contents

Executive Summary

Utility service vehicles have become mobile field offices.

Line trucks, bucket trucks, and service vehicles now support GIS mapping, work orders, telemetry, damage assessments, and crew coordination, often in real time. To enable this, most fleets have accumulated layers of connectivity hardware over time: routers, Wi-Fi gateways, GPS units, external antennas, SIM trays, and metres of cabling.

Individually, these components solve specific needs. Together, they create complexity.

That complexity shows up most clearly where utility work is hardest: rural service areas, fringe coverage zones, and storm or fire-damaged regions. Connectivity drops, uploads fail, and crews lose access to critical systems mid-job. Vehicles return to service bays for fixes that should have been avoidable.

The result is slower restoration, repeat truck rolls, and higher operating costs across the fleet.

The cost of a fragmented connectivity stack

Most utility fleets were never designed as integrated connectivity systems. They evolved incrementally as new digital requirements emerged, each arriving as a separate component with its own installation, maintenance, and lifecycle demands.

Over time, this layered approach leads to:

- Longer vehicle install and upgrade cycles
- Multiple failure points across cables, connectors, and devices
- Increased service calls and truck rolls
- Weaker performance in rural and low-signal areas
- Higher total cost of ownership over the vehicle lifecycle

When even a small component fails (*i.e.*, a degraded RF cable, a loose connector, or a network handoff issue), crew productivity drops and restoration timelines slip.

A simpler approach to fleet connectivity

Utilities under pressure to restore faster and operate more efficiently are beginning to rethink this model.

Instead of continuing to add components, many are consolidating connectivity into integrated rooftop vehicle gateways that combine cellular, Wi-Fi, GNSS, high-performance antennas, and multi-carrier capability in a single rugged unit.

This approach delivers practical, measurable benefits:

- Stronger edge and rural connectivity by eliminating RF-cable signal loss
- Faster installs and upgrades, reducing vehicle downtime
- Fewer maintenance events and truck rolls
- Greater resilience during storms and regional outages through multi-carrier failover
- Lower total cost of ownership across a standard vehicle lifecycle

Most importantly, it keeps crews connected and productive during outage response when connectivity matters most.

What this ebook covers

This ebook is written for utility leaders responsible for fleet operations, outage response, and field connectivity—including electric, water, gas, and telecom utilities operating across rural and mixed-coverage territories.

It also provides a practical ROI framework to support planning and budgeting decisions.

The goal is not to introduce new technology for its own sake, but to show how simplifying fleet connectivity can support faster restoration, lower operating costs, and more resilient field operations before the next storm puts systems to the test.

CHAPTER 1

Failure Points in Utility Fleet Tech Stacks

Most utility fleets rely on a layered collection of connectivity components accumulated over time: cellular routers, Wi-Fi gateways, GPS receivers, external antenna arrays, SIM trays, splitters, and long RF-cable runs routed through the vehicle cabin. Each component was added to address a specific requirement. Together, they form a complex, multi-component stack. This architecture was assembled incrementally rather than designed as a system.

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 • SIM trays • USB/RF splitters • Land mobile radio	• Space constraints • Heat • Overlapping power draws • Manual firmware management

How complexity accumulates in utility vehicles

Fleet connectivity stacks typically grow in response to evolving operational needs, including:

- Mobile GIS and digital work orders
- Real-time telemetry and asset reporting
- Safety cameras and diagnostics
- Increased data volumes during outage response

Because these capabilities often arrive through separate procurement cycles, components are sourced from multiple vendors and installed as discrete systems rather than as part of a unified architecture.

Over time, vehicles carry overlapping hardware, each with its own cabling, SIM data plans, power requirements, firmware schedules, and management interfaces. The result is not just technical complexity, but increased operational risk and cost.

Structural weak points in multi-component architectures

Fragmented connectivity stacks introduce failure points that are inherent to the architecture itself.

- **RF-cable loss**

  Rooftop antennas connected to cellular routers or laptop-based modems installed in the vehicle cab require long RF-cable runs. Even high-quality coax introduces signal loss over distance, reducing uplink strength in areas where coverage margins are

- **Connector density and vibration exposure**

  Each additional cable, splitter, and connector increases exposure to vibration-related fatigue. Utility vehicles operate in demanding conditions with uneven terrain, frequent stops, or weather exposure, making intermittent connectivity failures more likely over time.

- **Disjointed firmware and configuration management**

  Routers, Wi-Fi gateways, and GNSS units often follow different update schedules. Managing configuration and security updates across multiple components increases maintenance effort and introduces the risk of drift or misconfiguration.

- **Physical SIM constraints**

  Traditional SIM trays bind hardware to a specific carrier profile. Responding to coverage gaps or network changes may require physical access to vehicles, increasing service overhead and downtime.

Why issues surface at the edge

Connectivity weaknesses tend to remain latent in strong coverage areas. They surface in environments where margins are thin:

- **Rural service territories**
- **Fringe coverage zones**
- **Storm-affected regions**

In these conditions, small inefficiencies like signal loss, delayed handoffs, and unstable connections have an outsized impact on performance. The architecture that works acceptably in urban areas quickly breaks down at the edge of the network.

Key Takeaway

The core limitation of today's utility fleet connectivity stack is not age or vendor choice. It is fragmentation. Multi-component architectures introduce predictable failure points, signal loss, and management overhead, especially in low-signal environments. Addressing these issues requires reducing complexity at the system level, not adding more layers of components.

The next chapter examines how integrated fleet connectivity architectures address these structural weaknesses and why utilities are moving toward consolidation.

CHAPTER 2

The Business Case for an Integrated System

Multi-component 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 greater the signal loss. The baseline loss for a standard RG-58/RG-174 coax is ≈0.46 dB per meter at 850 MHz. Even premium LMR-195 grades drop ≈ 0.36 dB per meter[1].

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 meters of cable in a typical installation. Recovering up to 2 dB of uplink power can mean the difference between a successful damage assessment upload and a failed job report—especially in rural service territories.

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[1] Telco Antennaeeliminates 4-6 meters of cable in a typical installation, recoverings up to 2 dB of uplink power

Accelerating deployment and lifecycle upgrades

Activity	Multi-device stack	Integrated unit	Efficiencies
Initial installation	Minimum of 2 technician-hours (router, antennas, cabling, console power)	< 1 hour (single bolt-mount, two cables)	Up to 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

These labor savings scale linearly; a 150-unit fleet recovers ~3,000 technician-hours over a five-year refresh cycle.

Ensuring carrier continuity and geographic reach

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

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
Hardware	Separate router or laptop modems, antennas, GPS, and power conditioner	One SKU; fewer spares
Labor	Multiple installation and service disciplines	Single install, single skill set
Downtime	US$448-$760 per vehicle per day during repairs	50-70% fewer service events
Training & support	Vendor-specific interfaces	Unified UI, cloud or on-premise options
Lifecycle	Mixed MTBF values = the weakest component governs	Tested to ISO MIL-STD-810G with a 30-year calculated MTBF

Over a 10-year period, integrated units deliver 20-30 % lower TCO, driven chiefly by labor and outage avoidance.

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 reduces the number of default credentials to manage and the external attack surface. Optional centralized cloud management further enforces consistent policy across the fleet while providing an auditable trail for NIST 800-171 requirements.

Key Takeaway

Moving to an integrated "all-in-one" device results in a significant reduction in cost, risk, and administrative overhead.

CHAPTER 3

Case Study:

Improving Field Connectivity and Outage Response at a Large Midwestern Electric Utility

A large Midwestern electric utility operates across rural and low-coverage areas and relies on service vehicles and bucket trucks for maintenance, outage response, and damage assessment. Crews depend on reliable connectivity for GIS, VPN-secured applications, telemetry, and field reporting, often in locations where cellular coverage is weakest.

The challenges

- Dropped GIS, VPN, and telemetry connections in rural and fringe areas
- Slow or failed uploads during damage assessments
- Unstable cellular performance during storm response
- Repeat truck rolls caused by incomplete or delayed field data

These issues were most acute during outages, when crews were operating at the edge of network coverage.

What they did

The utility replaced traditional router-and-external-antenna setups with AC-Fleet, a single, rooftop-mounted 5G vehicle gateway featuring:

- Integrated high-gain antennas (eliminating RF-cable signal loss)

- Multi-carrier eSIM failover across FirstNet, Verizon, and T-Mobile

- Low-profile (~2") rooftop mount suitable for bucket trucks

- Single-hole installation with minimal cabling

- Ruggedized design for harsh field conditions

Key Results
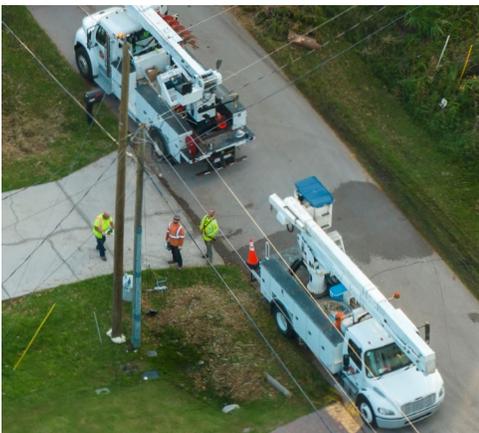
More stable connectivity in rural and outage zones

Reliable VPN and GIS performance for field workflows

Service vehicles operating as secure Wi-Fi hubs for nearby crews

Fewer connectivity-related disconnects

Faster restoration and fewer repeat truck rolls

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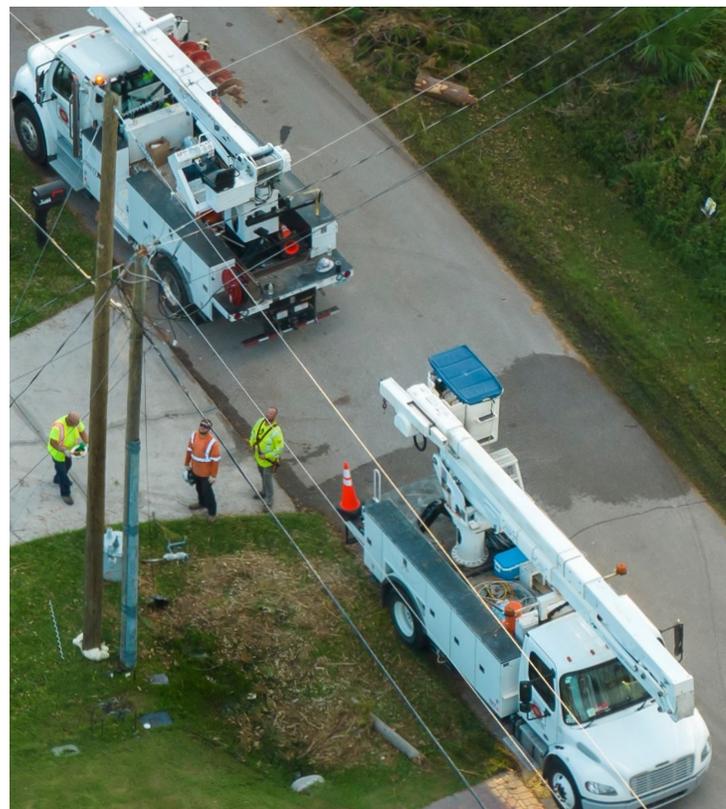
ROI of AC-Fleet vs. traditional multi-component-based solution

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

Intangible but material benefits

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

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

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

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

))) **Reduced downtime:** More fleet vehicles in service means improved coverage and greater operational efficiencies

Key Takeaway

Even under conservative assumptions, AC-Fleet's integrated rooftop unit generates a 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 fleet readiness.

Fleet Efficiency Checklist

Is your current connectivity setup costing you performance?

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

*(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 cellular, 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 labour + 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 3 m / 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 cyber incidents involving your onboard router or modem 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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