DTC

A CODAN COMPANY

DTC Assured VaaN 2.0

Ready Now. Future-Ready.

Firefighter Communications

Summary

Modern emergency response agencies operate across a wide range of complex environments, responding to fires, rescues, hazardous materials incidents, medical emergencies, and community first-response events at significant scale. The diversity and tempo of these operations demand a resilient, fully networked command, control, and communications capability that functions reliably in urban, regional, remote, and infrastructure-degraded environments.

Second Generation Vehicle as a Node (VaaN 2.0) delivers assured voice and data connectivity through the integration of the Edge Spark Connect Pod (vehicle-mounted) and Connect Lite portable deployable units. Together, these provide incident-site Wi-Fi with satellite and cellular (4G/5G) backhaul, integrated with the DTC BluSDR mesh radio system. This architecture delivers an immediately deployable ("ready now") capability while also providing a "future-ready" foundation that enables the operational and safety benefits of mobile ad-hoc networking (MANET).

DTC's VaaN 2.0 is **ready now and future-ready**, to enable next-generation responder applications and uncrewed systems across the full breadth of operational environments.

The Communications Challenge in Emergency Operations

Operational crews routinely face communications-denied conditions:

- Concrete, steel, plant rooms, and basements block RF penetration
- High-rise stairwells, tunnels, and underground car parks degrade legacy UHF/P25 systems
- Rural terrain and extended fire or incident lines are often beyond mobile network coverage
- Public cellular networks become congested during major incidents or disasters
- Multi-agency deployments introduce incompatible equipment, networks, and protocols

The consequences of communications loss are well understood: degraded situational awareness, reduced responder safety margins and an increased threat to life, loss of accountability and visibility of personnel, and slower decision-making that creates command blind spots when voice or data links fail.

At the same time, operational demands are evolving. Incident commanders and headquarters increasingly require access to real-time data, video, telemetry, and situational awareness tools at the edge. This drives the need for communications systems that are immediately deployable ("ready now") while also providing a "future-ready" foundation capable of exploiting the operational and safety benefits of mobile ad-hoc networking (MANET).

Self-forming, self-healing, infrastructure-independent mesh networks enable resilient voice and data connectivity and deliver real-time situational awareness to responders and commanders—whether operating inside RF-hostile structures, in remote terrain, or in environments where cellular infrastructure is unavailable or has failed.

DTC's VaaN 2.0 is **ready now and future-ready**, enabling next-generation responder applications and uncrewed systems across a broad range of operational environments.

Key capabilities include:

- Rich live video streaming, embedded with metadata for real-time geolocation, from helmet-, body-, vehicle-, or drone-mounted cameras to enhance situational awareness and decision-making
- Accurate responder location, both outdoors and indoors
- Telemetry from breathing apparatus and biometric sensors, including heart rate, temperature, motion, and status indicators
- Uncrewed system (UxV) command and control (C2) for reconnaissance, monitoring, and response platforms, including drones deployed as first responders
- Geospatial information overlays, including hazard mapping, building plans, and environmental or air-quality data
- Integrated multi-agency connectivity, enabling interoperability across organisations and jurisdictions

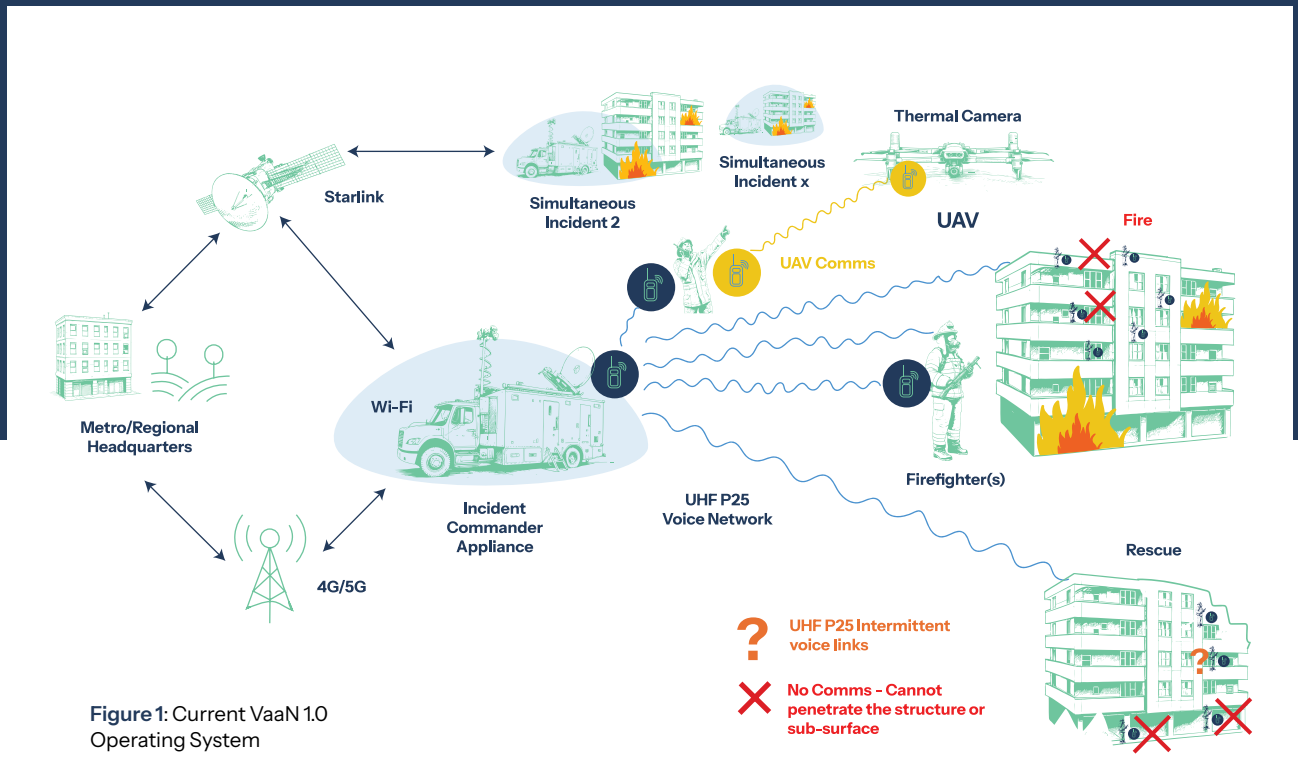


Figure 1: Current VaaN 1.0 Operating System

As illustrated in **Figure 1**, traditional voice-centric systems—such as legacy P25 UHF waveforms—are unable to support these data-intensive requirements on their own. Meeting modern operational demands requires a new communications architecture: one that is infrastructure-independent, resilient, and capable of extending deep into complex and communications-challenged environments. This is the rationale for DTC's VaaN 2.0 capability solution.

DTC VaaN 2.0 enables frontline vehicles—such as pumpers, tankers, specialist response, and command vehicles—to be repurposed as mobile communications, backhaul, and sensor platforms. Each vehicle can operate as a node within a dynamic, self-forming, self-healing digital mesh network, providing local connectivity at an incident site and wide-area reach back to central or regional command locations.

When available, the system leverages 4G/5G infrastructure for backhaul; when terrestrial networks are unavailable or degraded, satellite communications provide assured connectivity. This architecture enables resilient operations across urban, regional, remote, and infrastructure-denied environments.

The DTC VaaN 2.0 architecture is built on two core pillars:

1

Edge Spark Connect Pod (vehicle backhaul):

A vehicle-mounted backhaul solution integrating Starlink Mini and 4G/5G connectivity. The Connect Pod creates a Wi-Fi 6 connectivity bubble at the incident site and provides uplink for mesh network traffic to central or regional operations centres when clear sky or cellular line-of-sight is available.

2

Edge Spark Connect Lite (portable deployable forward node):

A battery-powered, portable Starlink Mini, 4G/5G, and Wi-Fi 6 hub designed for deployment in remote or RF-denied areas. Connect Lite enables the establishment of a forward incident command post and serves as a backhaul point for DTC mesh radios, uncrewed system control and telemetry, and operational data links back to command locations.

Together, these components deliver a scalable, resilient Vehicle-as-a-Node capability that supports both immediate operational needs and future digital transformation.

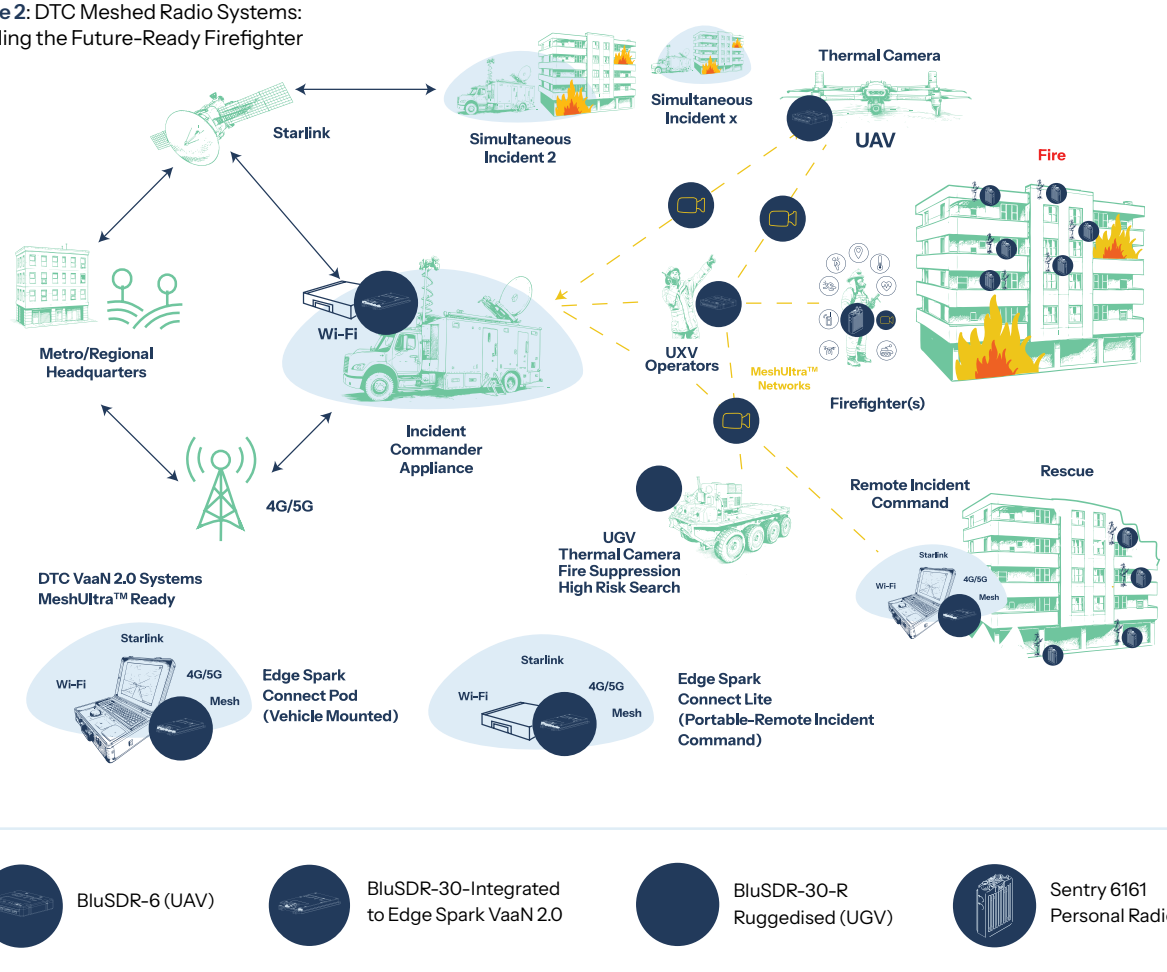
DTC BluSDR-30 Mesh Radio System (Future-Ready Mesh Communications) Both the Connect Pod and Connect Lite systems are integrated with the DTC BluSDR-30 mesh radio system. The inclusion of BluSDR-30 enables access to a wideband, mobile ad-hoc network (MANET) mesh waveform that delivers significant voice and data performance advantages over legacy UHF P25 systems in complex urban and rural operating environments where direct line-of-sight to fixed infrastructure may be lost.

As illustrated in **Figure 2**, DTC's family of mesh radios includes a range of small, lightweight form factors suitable for personnel, unmanned aerial vehicles (UAVs), and unmanned ground vehicles (UGVs), all operating on DTC's MeshUltra™ waveform. MeshUltra™ provides a secure, multi-hop, self-forming mesh network capable of delivering non-line-of-sight (NLOS) voice, video, data, and localisation—both indoors and outdoors.

The system supports up to 32 encrypted talk groups and enables simultaneous connectivity for up to 144 nodes, providing a **scalable and resilient communications foundation for data-driven operations in infrastructure-challenged environments**.

With these three components, assured communications are maintained even when telecommunications infrastructure is compromised or geography blocks traditional RF signals.

Figure 2: DTC Meshed Radio Systems: Enabling the Future-Ready Firefighter



Multi-Hop Mesh: Assured NLOS Incident-Site Connectivity

DTC is a global leader in tactical mesh radio technology, with its MeshUltra™ waveform mission-proven to deliver reliable and robust communications in the most demanding operational environments. DTC solutions leverage MIMO (Multi-Input Multi-Output) architecture to significantly improve throughput, link resilience, and overall performance in complex RF conditions typical of dense urban, industrial, and structurally challenging incident sites.

MIMO radios use multiple antennas to transmit and receive data across separate channels simultaneously, reducing interference and increasing signal stability. This capability is particularly valuable in environments where RF signals reflect, scatter, or attenuate due to steel, concrete, and subterranean structures. The MeshUltra™ mobile ad-hoc network (MANET) is the central enabler of this capability.

Unlike conventional radio systems that depend on fixed infrastructure or continuous line-of-sight, MeshUltra™ operates as a fully distributed mesh network:

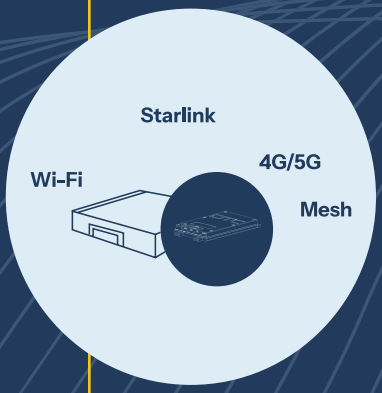
- **Peer-to-peer:** every radio—wearable or vehicle-mounted—relays traffic for other nodes
- **Self-forming:** radios automatically join the network when powered on
- **Self-healing:** if a node is obstructed, degraded, or lost, traffic dynamically re-routes through alternative paths
- **Non-Line-of-Sight (NLOS) optimised**: Designed to perform in steel, concrete, smoke, fire, and multipath RF conditions commonly encountered in complex operational environments.

- **Urban canyons and tunnels**: Mesh radios relay traffic hop-to-hop until it reaches a VaaN 2.0 vehicle node or Connect Lite forward node with access to open sky or 4G/5G connectivity. Network connectivity is restored automatically, without requiring personnel to reposition to find improved signal conditions.
- **Remote terrain and extended incident line**s: As vehicles reposition along ridgelines, access roads, or incident perimeters, they form a mobile mesh backbone that extends connectivity well beyond the limits of cellular coverage.
- **Seamless incident-site connectivity**: Personnel operating at the incident site maintain continuous voice and data connectivity through DTC mesh radios, dynamically linking to forward or central command posts via multi-bearer communications systems and into mission-critical command-and-control consoles, delivering resilient situational awareness across the entire response network.
- **Mesh as the primary VaaN layer**: Mesh connectivity forms the foundational layer of the Vehicle-as-a-Node architecture, maintaining local connectivity among deployed responders even when all wide-area backhaul links are unavailable.

This multi-hop capability enables:

- **Indoor structures**: Personnel operating deep inside high-rise buildings, stairwells, industrial facilities, or basements maintain digital communications even where legacy UHF/P25 signals cannot penetrate. Helmet- or body-worn cameras can stream real-time optical or infrared video to command elements, while responder biometrics and alarm states remain visible—without reliance on cellular network coverage.

Backhaul Survivability: Edge Spark and VaaN 2.0 Positioning



Once deployed, the vehicle-mounted Edge Spark Connect Pod provides operators with resilient backhaul access to wide-area networks through multiple complementary bearers:

- Starlink Mini for satellite connectivity when clear sky visibility is available
- 5G/4G for terrestrial connectivity where line-of-sight to cellular infrastructure exists
- Wi-Fi 6 to support local personnel, vehicle, and edge devices at the incident site
- DTC BluSDR-30 mesh radio system, enabling future-ready mesh-based voice, data, and sensor connectivity

This multi-bearer approach ensures continuity of communications across a wide range of operational environments, supporting both immediate mission needs and future digital capabilities.

The Connect Pod delivers a critical operational benefit: a vehicle can be positioned where clear sky visibility or cellular coverage is available and provide backhaul for all data and communications generated across the incident. This includes personnel operating underground, inside tunnels, or deep within structures, with connectivity maintained via multi-hop mesh links.

This approach enables continuous voice and video communications in situations where local telecommunications infrastructure is damaged, congested, or unavailable, as well as in communications-denied environments such as basements and subterranean spaces.

In short, DTC MeshUltra™ brings the incident to the vehicle; Edge Spark extends the incident from the vehicle to command and coordination centres—locally, regionally, or globally.

Edge Spark Reach Lite, integrated with the BluSDR-30 mesh radio, can be positioned between a Vehicle-as-a-Node (VaaN) platform and forward-deployed personnel to extend communications coverage into challenging environments such as buildings, basements, tunnels, caves, and other RF-denied spaces.

Deployable Forward Nodes: Edge Spark Connect Lite

Some incidents—such as remote wildfires, landslides, structural collapses, or inaccessible industrial sites—prevent response vehicles from positioning within effective communications range of the incident area. The man-portable Edge Spark Connect Lite capability addresses this gap by providing rapidly deployable forward connectivity.

Key features include:

- Battery-powered and ruggedised for operation in austere environments
- Creates local Wi-Fi connectivity with satellite and 4G backhaul, independent of vehicles
- Deployable at forward locations such as tunnel entrances, remote staging areas, helipads, or elevated terrain
- Acts as a forward-facing backhaul point or local mission hub
- Seamlessly integrates with DTC mesh radio systems to extend communications coverage even further

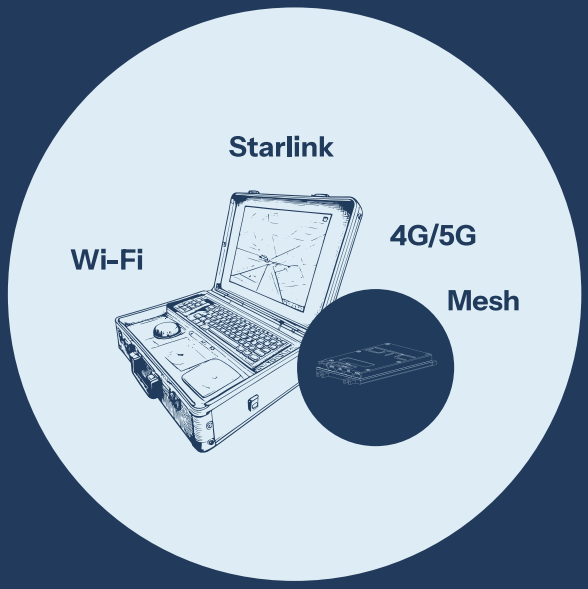
Where vehicle-based VaaN platforms cannot operate, Connect Lite delivers satellite-enabled, meshed communications directly to the incident site, ensuring continuity of voice, data, and situational awareness.

Deployable Wi-Fi and Mesh Network Range Extension: Edge Spark Reach Lite

In addition to the deployable Connect Lite remote incident communications system, certain complex operational scenarios may require repeater or relay nodes to further extend the reach of local Wi-Fi and mesh networks. Edge Spark Reach Lite fulfills this role by providing flexible range extension in challenging environments.

The effective range of the local Wi-Fi connectivity bubble is approximately 200 metres. While the DTC MeshUltra™ waveform delivers point-to-point ranges comparable to legacy P25 UHF systems, its true advantage lies in its ability to relay voice and data across multiple hops between radios. This multi-hop capability enables resilient non-line-of-sight (NLOS) communications inside buildings, underground spaces, and other RF-denied environments where traditional UHF systems cannot penetrate.

By combining deployable Wi-Fi, mesh networking, and relay nodes, the architecture ensures scalable and resilient connectivity deep into complex operational areas.



UxV Connectivity: Future Operational Capability Multipliers

The DTC VaaN 2.0 MeshUltra™ network is designed to enable a new generation of uncrewed systems (UxV) that enhance safety, situational awareness, and effectiveness across high-risk response and recovery operations.

Potential applications include:

- Small unmanned aerial vehicles (UAVs) equipped with optical and infrared sensors for real-time interior and exterior reconnaissance
- Larger UAV platforms capable of delivering payloads such as water streams or suppression agents to elevated or hard-to-reach locations
- Unmanned ground vehicles (UGVs) for applying suppression or operating in areas too hazardous for personnel
- Autonomous sensing and surveillance, including hotspot detection, plume tracking, and hazardous gas monitoring

Because UAVs and UGVs rely on digital communications, the DTC mesh network enables:

- Real-time video and data feeds back to command elements
- Command and control links without direct line-of-sight
- Seamless handover between mesh nodes as assets move through complex environments
- Edge compute capabilities to support AI inference, hotspot identification, and automated hazard detection

Together, these capabilities position the MeshUltra™-enabled VaaN architecture as a scalable foundation for integrating uncrewed systems into future operations.

Future Operational Applications Enabled by VaaN 2.0

VaaN 2.0 enables a range of real-time, next-generation operational capabilities by delivering assured digital connectivity at the incident site, independent of public mobile infrastructure.

Real-time voice communications:

VaaN 2.0 provides encrypted push-to-talk voice over mesh radios, supporting multiple talk groups and multi-agency interoperability via command or coordination vehicles.

Wearable video:

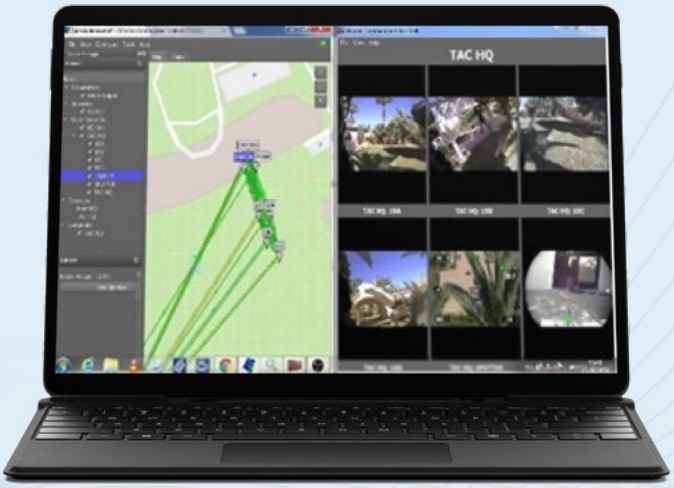
The DTC mesh supports continuous optical or infrared video streams from body-worn or helmet-mounted cameras to command elements, enhancing real-time situational awareness and enabling post-incident analysis.

Personnel location tracking:

Outdoor GPS combined with MeshUltra™ ranging and inertial navigation indoors delivers real-time positional awareness, improving personnel safety, accountability, and emergency response.

Biometric and breathing apparatus telemetry:

Health, status, and breathing apparatus data can be transmitted live to command, enabling early detection of heat stress, low air supply, fatigue, or other risk conditions.



Sensor and hazard data fusion:

Environmental, gas, air quality, structural, and thermal sensors report over the mesh network to command elements, even when public communications networks are unavailable.

Incident command and control (C2):

All sensor, location, video, and biometric data can be integrated into an incident command and control system, providing a live, map-based operational picture.

Enhanced command decision-making:

Commanders gain a real-time view of deployed personnel, vehicles, and uncrewed systems. Video feeds, location beacons, and sensor data reduce reliance on delayed voice reports, supporting faster decisions, improved safety, and more effective incident management.

Mesh-first resilience:

All future operational applications rely on VaaN 2.0's mesh-first architecture. If backhaul or Wi-Fi connectivity is degraded or lost, the local mesh network continues to operate, preserving critical on-scene safety and coordination services.

Security and Multi-Agency Interoperability

As operations become increasingly data-driven and multi-agency in nature, VaaN 2.0 incorporates robust security and interoperability features to protect sensitive information and enable trusted collaboration across organisations and jurisdictions.

Key features include:

- AES-256, FIPS-certified encryption for data at rest and in transit
- Support for multi-agency and joint operations, enabling interoperability across emergency services, law enforcement, defence, and other response organisations
- End-to-end encrypted voice, video, and telemetry streams
- Secure backhaul via Edge Spark systems, preserving data integrity between forward-deployed units and command or coordination centres

These measures ensure that sensitive information—such as live video feeds, casualty details, and hazardous materials data—remains protected throughout the operational network, even in complex, distributed response environments.

Deployment Path

A phased rollout aligned to existing fleets, systems, and training frameworks enables VaaN 2.0 to be introduced progressively while delivering measurable and sustainable capability improvements at each stage.

Vehicle Nodes:

Install Edge Spark Connect Pods with integrated BluSDR-30 mesh radios on selected response vehicles to provide extended mesh coverage, local Wi-Fi for tablets and sensors, and resilient backhaul routing.

Wearable Nodes:

Equip personnel with mesh-enabled radios to deliver encrypted voice, video, location, and telemetry at the incident site.

Forward Deployable Nodes:

Position Edge Spark Reach or Connect Lite units with integrated BluSDR-30 mesh radios in regional, remote, or RF-denied areas to extend network coverage and provide satellite backhaul where vehicles cannot operate.

UxV Integration:

Fit unmanned aerial and ground systems (UAVs/UGVs) with BluSDR mesh radios to enable live video and command-and-control (C2). Autonomous relay nodes or deployable repeaters can be used to extend connectivity into interior or hazardous environments.

Conclusion

Modern frontline operations require assured communications that remain operational despite fire-damaged infrastructure, urban RF shadowing, and remote or infrastructure-degraded environments. DTC VaaN 2.0 delivers this capability by integrating vehicle-mounted Edge Spark Connect Pods with BluSDR-30 mesh radio nodes, alongside deployable Edge Spark Reach and Connect Lite units with integrated mesh radios.

The result is a future-ready assured communications system: a self-healing, multi-hop network that:

- Maintains continuous voice, video, and data connectivity at the incident site
- Delivers resilient satellite and 4G/5G backhaul from optimally positioned vehicles
- Extends communications reach using forward-deployable systems in terrain inaccessible to vehicles
- Enables next-generation operational applications, including live video, indoor positioning, biometrics, and uncrewed system control
- Enhances personnel safety, accelerates decision-making, and strengthens multi-agency interoperability

DTC VaaN 2.0 is ready now to provide assured communications for current operations and future-ready to support advanced situational awareness, remote and autonomous assistance, and high-risk response and recovery missions.