

Produced in partnership by the National Research Council and Defence Research and Development Canada

Emerging technology snapshot

First responder technological advancements

As natural disasters increase in frequency and intensity, firefighters, paramedics, and police officers play crucial roles as first responders. Technological innovations such as artificial intelligence, virtual reality, and wearables enhance their efforts and enable improved response times, communication, and coordination. Drones and robots aid in multiple tasks, while advances in protective equipment significantly improve occupational safety. Additionally, social media and image analyses provide valuable data to help manage crises more effectively. These advancements are pivotal in safeguarding Canada's communities.



Enabling Science & Technology

Artificial intelligence (AI)

AI powers a large array of applications. Machine learning and neural networks algorithms are being developed to forecast natural disasters, crime and fires. AI-assisted data analysis can provide real-time information to first responders, enabling them to react more effectively. Image analysis and data mining are frequently used in conjunction with AI.

Virtual reality (VR)

VR is instrumental in first responder training. Advancements in VR make it possible to simulate hazardous situations that represent real-world dangers. Simulated fires and chemical hazards sharpen firefighters' skills, while police officers can be virtually trained to investigate crime scenes. Virtual disaster scenes allow paramedics to practise triage.

Uncrewed aerial systems (UAS)

UAS are increasingly used by first responders in critical situations. They enable emergency personnel to remotely access harsh environments and locate survivors in hard-to-reach locations. UAS conduct surveillance and improve firefighters' efficiency and safety. They are also used to deliver medical supplies, such as defibrillators, to remote locations.

Wearables

Wearables have attracted considerable research interest in recent years. These include sensors embedded in smart protective equipment to monitor temperatures and hazardous gases. In the context of policing, research focuses on body-worn cameras (BWCs), with progress being made to enhance connectivity between BWCs and police vehicles.

Image analysis

Image analysis techniques often combine AI algorithms, such as You-Only-Look-Once (YOLO), with images provided by surveillance cameras, drones or satellites. Applications for first responders are diverse: traffic monitoring to optimize emergency vehicles routes, wildfire or flood monitoring, licence plate recognition, damage assessment and weapon detection.

In 2025, leading public safety agencies will embrace cloud-native systems and AI to enhance efficiency, strengthen cybersecurity and resilience, improve mobility, and optimize resource allocation – ultimately enabling them to serve their communities more effectively.

Bob Hugues, CEO of Mark43 (Industry leader in public safety technology),
[Press release for 2025 US public safety trends report](#), December 11, 2024.

Signals



Academic

The University of California, a leading organization in the field, has expertise in communications, training and AI technologies tailored to all types of first responders in disaster management scenarios.



Government

The public healthcare system of the UK, the National Health Services, is the leading organization for paramedic research, with a particular focus on training and decision-making.



Collaboration

Complex emergency management operations require coordinated efforts across organizations. These efforts can be supported by shared information systems and efficient communication networks, enabling better collaboration between all responders.



Defence

Many innovations used by firefighters, paramedics and police officers can also benefit military personnel. These include improved protective equipment, augmented reality for situational awareness and resilient communication in unstable networks.



Corporate

Thales Canada participated in studies on wearable sensors capable of monitoring the mental workload of first responders. This research will provide a better understanding of the stress they experience, ultimately improving their safety.

Our upcoming research into AI-assisted call handling is expected to represent a significant step forward in enhancing emergency response capabilities while addressing the increasing workload on call takers. Similar capabilities have shown promising results [...], potentially improving response times for these critical situations.

Norman Speicher, Office of Mission Capability and Support Program Manager for the Science and Technology Directorate of the US Department of Homeland Security, [Feature Article: Artificial Intelligence Means Better, Faster and More for First Responders](#), October 31, 2024.

Impact



Social

Social media contribute to disaster management by communicating with the public as well as collecting information on damages and location. It also enables police services to engage communities and open a dialogue with citizens.



Policy

Research results should guide policymakers to improve decision-making processes and enhance the effectiveness and efficiency of emergency services, ultimately increasing public safety.



Economic

Disaster relief organizations increasingly integrate connected devices into their operations, highlighting the need to strengthen communications infrastructures. Companies are investing in research and development to ensure seamless connectivity during emergency response.



Environmental

First responders' interventions play a crucial role in mitigating events threatening the environment. For instance, containing hazardous material spills prevent contamination, and fighting wildfires helps protect ecosystems.



Defence

Canadian army personnel increasingly provide assistance to ensure civilian safety. Military organizations can support domestic operations during large-scale crises by leveraging their capabilities in operational planning, communications, and search and rescue.

Our Drone as First Responder program has been instrumental in critical life-and-death situations by providing aerial awareness or helping officers de-escalate incidents by delivering real-time, vital information.

Roxana Kennedy, Chief of Police at Chula Vista Police Department in California, [Nokia and Motorola Solutions announce drone technology integration for public safety and mission-critical industries](#), December 12, 2024.

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