

SITUATIONAL AWARENESS REQUIRES RELIABLE CRITICAL COMMUNICATIONS

In this paper, we'll share best practices and technology insights in critical communications and introduce a planning principle that can help fire departments make the right decisions for their future critical comms setup.

CONTENTS

FOREWORD BY KEN REHBEHN

Firefighting decisions depend on communication capabilities.

Page 2



SITUATIONAL AWARENESS IMPROVES WITH WIRELESS COVERAGE

Situational awareness depends on human skills, training, and experience, and is supported by technology. If technology fails, firefighters are left with a much harder task.

Page 8

INTRODUCING PACE PLANNING FOR CRITICAL COMMS

How can fire chiefs and other decision makers develop adequate strategies ensuring reliable critical communications to support situational awareness all through the chain of command?

Page 10



COMMUNICATION BEGINS AND ENDS WITH **COVERAGE**

Improving your fire department's coverage can be achieved in different ways, but careful consideration must be paid to each method's strengths and weaknesses.

Page 16



INTEROPERABILITY IS CRITICAL IN MASS EMERGENCIES

When several emergency response agencies have to work together, their efforts are often hampered by a lack of network interoperability.

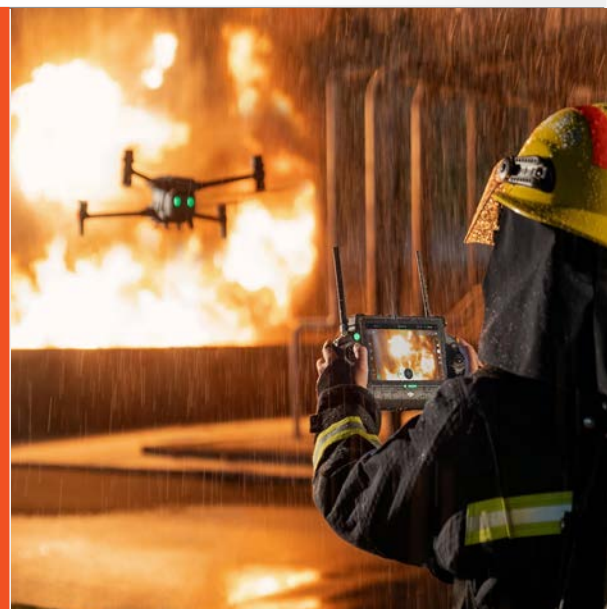
Page 20

NEW TOOLS TO SUPPORT **SITUATIONAL AWARENESS**

The development of new digital tools for personnel accountability, command, and control will transform the way firefighters work and train.

Page 24

5





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Ken Rehbehn
Principal Analyst, CritComm Insights

FIREFIGHTING DECISIONS DEPEND ON COMMUNICATION CAPABILITIES



Establishing comprehensive situational awareness is essential for modern all-hazards fire service operations. At the basic operational level, the individual firefighter, the concept refers to the crucial practice of paying active attention to the changing environment on the fireground. At higher operational levels, incident command and division supervisors must also embrace the active discipline of absorbing and understanding information flowing from this dynamic environment. In this realm, incident commanders benefit from updates delivered by firefighters operating on the fireground. And firefighters work effectively and safely thanks to information and direction that flows down the command chain.

Ensuring the highest levels of situational awareness demands solid communications infrastructure linking the control room to local incident command and local incident command to firefighters operating at the scene. The land mobile radio systems provide resilient wireless links delivering voice traffic between incident command and firefighters. But regardless of how well a system is designed, it can fail. Failure can arise from disasters, such as a high-wind event, or system issues due to coverage gaps, software faults, or hardware problems. Fire service leadership must factor in the potential for communications failure and ensure layers of resilience support graceful communications degradation. By planning for both sunny and rainy communications days, agencies provide a strong foundation for lifesaving situational awareness.

In this paper, critical communications specialists explore the link between communications architectures and situational awareness. They offer a valuable perspective on the considerations that fire service leadership must factor into communication system design and operation. New advances in mission-critical LTE, satellite technology, mesh communications, and trunked land mobile radio systems open opportunities for change that can save lives and protect property. Now is the time to make the promise of this future a reality.

Ken Rehbehn

Principal Analyst, CritComm Insights

1

SITUATIONAL AWARENESS DEPENDS ON **WIRELESS COVERAGE**



No matter what kind of emergency firefighters are responding to, situational awareness is critical to protect firefighters, citizens, and property. Knowing what's going on, who's doing what, where and why, and what is about to happen is key to mission success. Situational awareness begins with what each firefighter and incident commander can see and hear, and what they can learn from bystanders. Being able to communicate observations and orders – between firefighters, between firefighters and incident commanders, and between firefighter agencies and other emergency response organizations – helps to improve situational awareness. New digital tools like drones and thermal imaging cameras can provide further information to the big picture. Situational awareness depends on human skills, training, and experience, and is supported by technology. If technology fails and wireless coverage is lost, communication can be cut off and video streams lost, leaving firefighters with a much harder task.

Human skills, training, and experience – supported by technology.

This paper addresses the technological aspect of critical communications planning with a focus on maintaining network connectivity and coverage at all times. It is intended to help

decision makers ensure that the critical communications solutions they make available to firefighters and other public safety agencies will not let them down. Fire chiefs and other decision makers need to ensure that the systems provide the right coverage, capabilities, and interoperability to give firefighters and incident commanders an information flow to support situational awareness.

SITUATIONAL AWARENESS IS A TEAM EFFORT

Successful decision-making in firefighting operations is contingent on situational awareness. Inadequate situational awareness is one of the primary factors in accidents. According to the National Fire Chiefs Council*, command situational awareness 'represents the perception and understanding an incident commander has of an incident, including its hazards, risks, and operational activities. It also consists of how a commander anticipates the incident will develop taking into account their actions.' In our opinion, situational awareness is a team effort. The incident commander relies on the observations of frontline firefighters and other agencies operating on the scene to form a mental image of the situation. And firefighters rely on their incident commander to warn them if the situation starts to unfold in a new or dangerous way, they are unaware of.

¹ <https://www.climatecentral.org/news/weather-related-blackouts-doubled-since-2003-report-17281>



GETTING HIT BY WEATHER



28 years of power outage data that utility companies supplied to the US federal government and the North American Electric Reliability Corporation, as analyzed by Climate Central¹, shows:

- A tenfold increase in major power outages between the mid-1980s and 2012
- The average annual number of weather-related power outages doubled
- Weather caused 80% of all outages between 2003–2012

The main causes of these weather-related outages were:

- Storms and severe weather 59%
- Cold weather and ice storms nearly 19%
- Hurricanes and tropical storms 18%
- Tornadoes 13%
- Extreme heat events and wildfires 2%

Mass emergencies caused by extreme weather events can happen at any time and anywhere. They often require firefighters to be deployed to remote places and to cooperate with other emergency response agencies in large numbers, sometimes across state or national borders. Operating outside their regular operational area, firefighters may suddenly find themselves without sufficient wireless coverage – or completely cut off, due to power outages.

¹ <https://www.climatecentral.org/news/weather-related-blackouts-doubled-since-2003-report-17281>

COMMUNICATION FAILURES HAPPEN

The incidents firefighters are dealing with are becoming more intense, more unpredictable – and more dangerous. Changing weather is making natural disasters like floods and wildfires more common. Firefighting agencies increasingly co-operate in large numbers with massive mutual aid responses, and are deployed and must be able to act effectively in remote areas. This makes adequate coverage a pressing issue. Firefighters can usually rely on coverage in densely populated areas, where radio towers or cellular networks are part of the urban infrastructure. But what happens when they must respond to a wildfire, flooding, or other emergencies in remote and sparsely populated areas?

Most people have experienced ‘no bars’ on their cell phone when venturing into the wild – as LTE towers usually follow the highways through unpopulated areas. Traditional land mobile radio only reaches so far, without massive investments in radio towers and repeater stations. And the terrain itself can wreak havoc on your coverage. For example, when operating below a cliff face, in a ravine, a well, a mine, etc., fire crews can experience loss of radio coverage, as signals do not follow the terrain. At the same time, coverage can also be lost in urban mass emergencies, where signal overload, power outages and destruction of infrastructure is a worry. In short, when bad things happen, they also happen to your coverage.

BE PREPARED FOR COVERAGE TO FAIL

Every emergency area offers its own communication challenges. Radio towers can be put out of action, and fire-

fighters operating deep inside a burning building can find their LMR (Land Mobile Radio) signals blocked by concrete walls. This makes it imperative that those responsible for firefighting operations take steps to ensure that their critical communications setup plans for the failure of one or more of their communication approaches. Making sure alternatives are available even before the first firefighters arrive at the fireground is critical.

COMMUNICATION BLACKOUT PRECEDES TRAGEDY



19 members of the Granite Mountain Hotshots crew died on June 30th, 2013, while fighting a lightning-sparked wildfire in Arizona. An investigation found improperly programmed radios and a 30-minute communication blackout just before the brave men perished. How did this 30-minute blackout affect the Hotshots’ situational awareness? And could anything have been done to avert this tragedy if the communication blackout hadn’t occurred?

¹ <https://www.dailylocal.com/2013/09/28/radio-communication-failure-led-to-19-firefighter-deaths/>



“A lack of effective communication will have a negative impact on the safety and performance of response personnel and the overall effectiveness of the response.”

Roger Lunt, retired Fire Chief, writing for Fire Engineering

<https://www.fireengineering.com/firefighting/communication-broke-down/#gref>



'Extreme weather events – including powerful heat waves and devastating floods – are now the new normal'

World Meteorological Organisation in its State of the Climate report for 2021



2

INTRODUCING PACE FOR CRITICAL COMMS

How can fire chiefs and other decision makers develop adequate strategies to ensure that frontline personnel will not be let down and cut off by their critical communications solutions? The armed forces and some firefighting agencies use PACE planning¹. PACE is a framework for evaluating risks and options, requiring decision makers to identify possible threats, and to put contingency actions in place when planning operations. PACE planning is applied to a wide aspect of operational planning in the military, including communication. Just like firefighting operations, military operations also rely heavily on communication to ensure mission success.

PACE is an acronym for Primary, Alternate, Contingency and Emergency. It is a planning principle that calls for having not only a Plan B in place, but also

Plans C and D before committing to a mission and putting personnel in harm's way. Adopting the PACE planning principle, fire chiefs and other decision makers need to ask themselves: Does our critical comms setup incorporate and train for Primary, Alternate, Contingency and Emergency communication approaches? If not, it is high time to start planning, as the consequences of inaction can be disastrous. Your plan should be based on the equipment and solutions already in use, and then add the fallback options that best suit your department and the scenarios you face.

¹ <https://www.benning.army.mil/infantry/magazine/issues/2013/Jul-Sep/pdfs/Ryan.pdf>

Does our critical comms setup incorporate and train for Primary, Alternate, Contingency and Emergency communication approaches?

WHAT COULD A PACE PLAN LOOK LIKE?



Just like you have plans A, B and C in place for tackling a fire or other emergency situations, PACE planning for your critical communications means having alternative communication approaches in place. A real-life example of a PACE plan today could look like this:

- Primary: Trunked LMR
- Alternate: Vehicle Repeater
- Contingency: Direct Mode
- Emergency: Face-to-face runners

With a PACE plan for communication in place, firefighters will be able to seamlessly transition from one communication approach to another, staying able to exchange vital information no matter how the situation unfolds.

FOUR CRITICAL QUESTIONS FOR A GOOD PACE PLAN

When assessing your critical communications PACE plan, you need to think beyond providing a Primary, Alternate, Contingency and Emergency communication approach. For any plan to be successful, it also needs to be easy to execute by the people it concerns. And whether directly involved on the scene, directing the operation, or providing support from dispatch, firefighters and commanders already have their work cut out without having to worry about switching communication approaches. A fireground or disaster area is a dangerously busy place, and a firefighting operation is complex and demanding. It follows that critical communications equipment should be simple and easy to use.

DECISION MAKERS MUST ASK THEMSELVES:

1 TO WHAT EXTENT IS HANDOVER BETWEEN COMMUNICATION APPROACHES DONE AUTOMATICALLY?

Does your system require firefighters to switch to alternate communications systems manually, or to switch between different handsets? In our view, the system should be able to perform the switch automatically, with no action needed by users and no additional handsets. This principle applies to all communication approaches in the PACE plan.

2 TO WHAT EXTENT DOES YOUR COMMUNICATION PACE PLAN WORK IN ALL SCENARIOS?

Will firefighters have to start by mulling over what comms equipment to bring along every time the alarm sounds? Ideally, it would be best if your critical communications system is able to function in every scenario your firefighters can face throughout your operational area. From fires deep within concrete buildings, to wildfires and flooding in remote areas, rescue missions down mines, wells, or ravines, or any other situations that will make coverage an issue. There are many different scenarios – and being well prepared for the 90% of incidents that make up the bulk of your department's work is scant consolation if disaster strikes while responding to one in the remaining 10%.

3 TO WHAT EXTENT DO YOU HAVE TO CONFIGURE YOUR PLAN BEFORE EACH EMERGENCY?

It is important that your critical communications system is set up to work 'out of the box'. Incident commanders and firefighters do not have the time to configure and set up the system from scratch before every use. Our belief is that your agency's communication setup should serve as many mission types as possible without any changes in the core configuration.

4 IS YOUR COMMUNICATION PACE PLAN TRAINING INTENSIVE OR EASY TO USE?

To what degree will your firefighters require additional training to safely operate new equipment, or will they be able to pick up and use their PTT handsets like they've already learned how to? The more complex the PACE setup is, the more training it requires. Ideally, upgrading your critical comms strategy with a PACE plan shouldn't require any additional training of your firefighters before they can use it. That way, you can keep operating under your existing training and radio discipline, and not have to spend time on the technical aspects of various solutions.



HANG ON TO WHAT YOU ALREADY HAVE



Firefighters know and trust their LMR push-to-talk (PTT) handsets. Your critical comms setup shouldn't interfere with years of practice by replacing well-known equipment or adding new gizmos to firefighters' already burgeoning arsenal of personal equipment. There are solutions available on the market today that provides seamless switching between different communication approaches without replacing or in any way interfering with how firefighters use their PTT radios.

PERSONAL CELL PHONES ALREADY IN USE BY FIREFIGHTERS



According to a recent article¹, incident commanders in some fire departments utilize their personal cellphones to supplement their critical communications systems. In our view, 'bring your own device' is far from an optimal PACE plan: It doesn't offer automatic switching between communication lines. It requires firefighters to carry two different handsets with them. And finally, the firefighters' personal cell phones use the public cellular network – leaving them cut off if that network becomes unavailable due to traffic overload or power outages. Do your department's fire crews have to resort to bring-your-own-device?

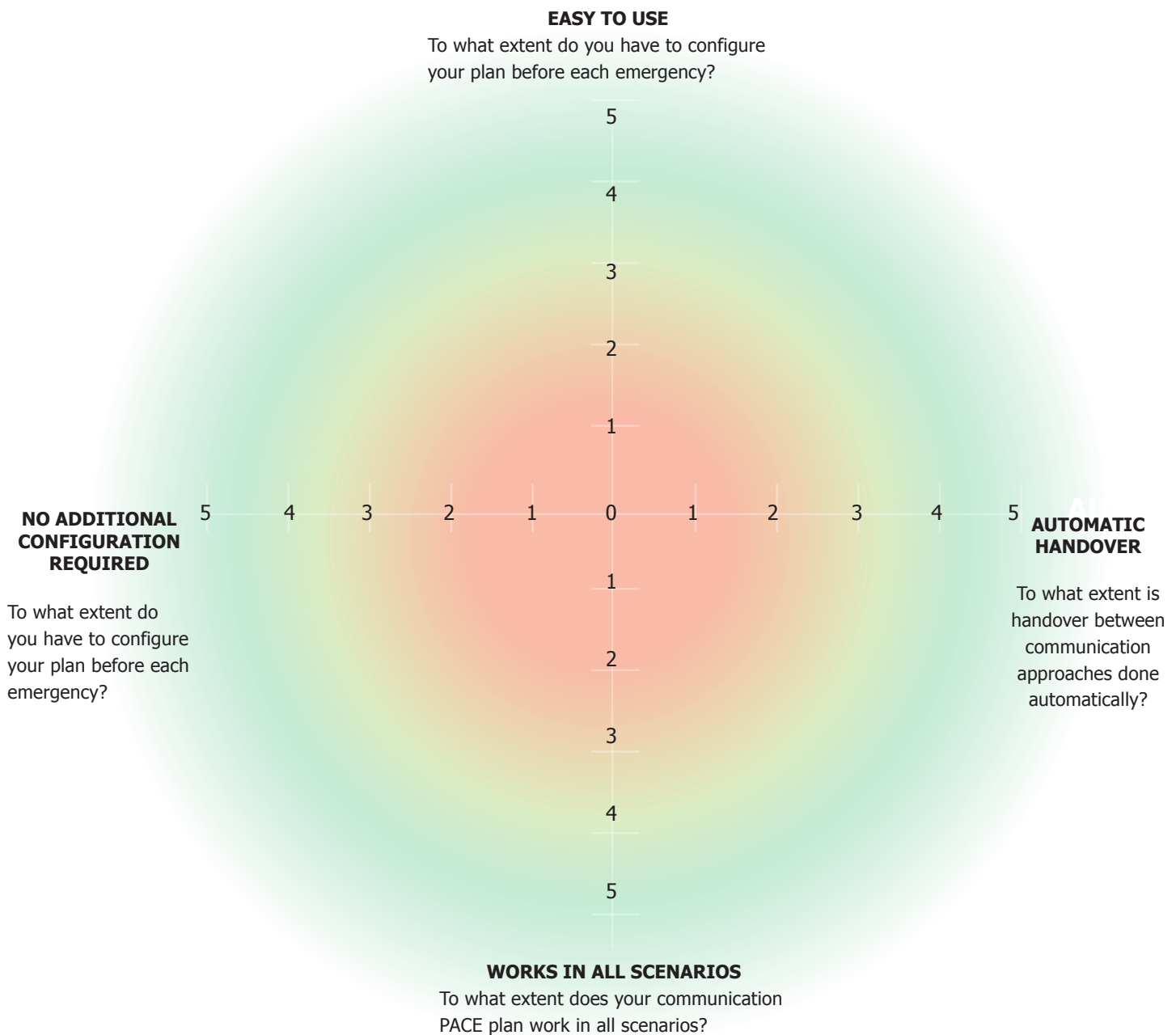
¹ <https://www.firehouse.com/leadership/article/21141754/fire-studies-the-four-cs>



WHERE ARE YOU ON THE PACE CONTINUUM?

As long as your communication setup does not provide the optimum PACE plan, we suggest that you review it frequently to identify areas of improvement. For that use, we have developed a tool for you to evaluate how well your PACE plan performs when measured by four critical questions. Use each axis to score how well you believe your current critical comms setup performs on each of the four key parameters.

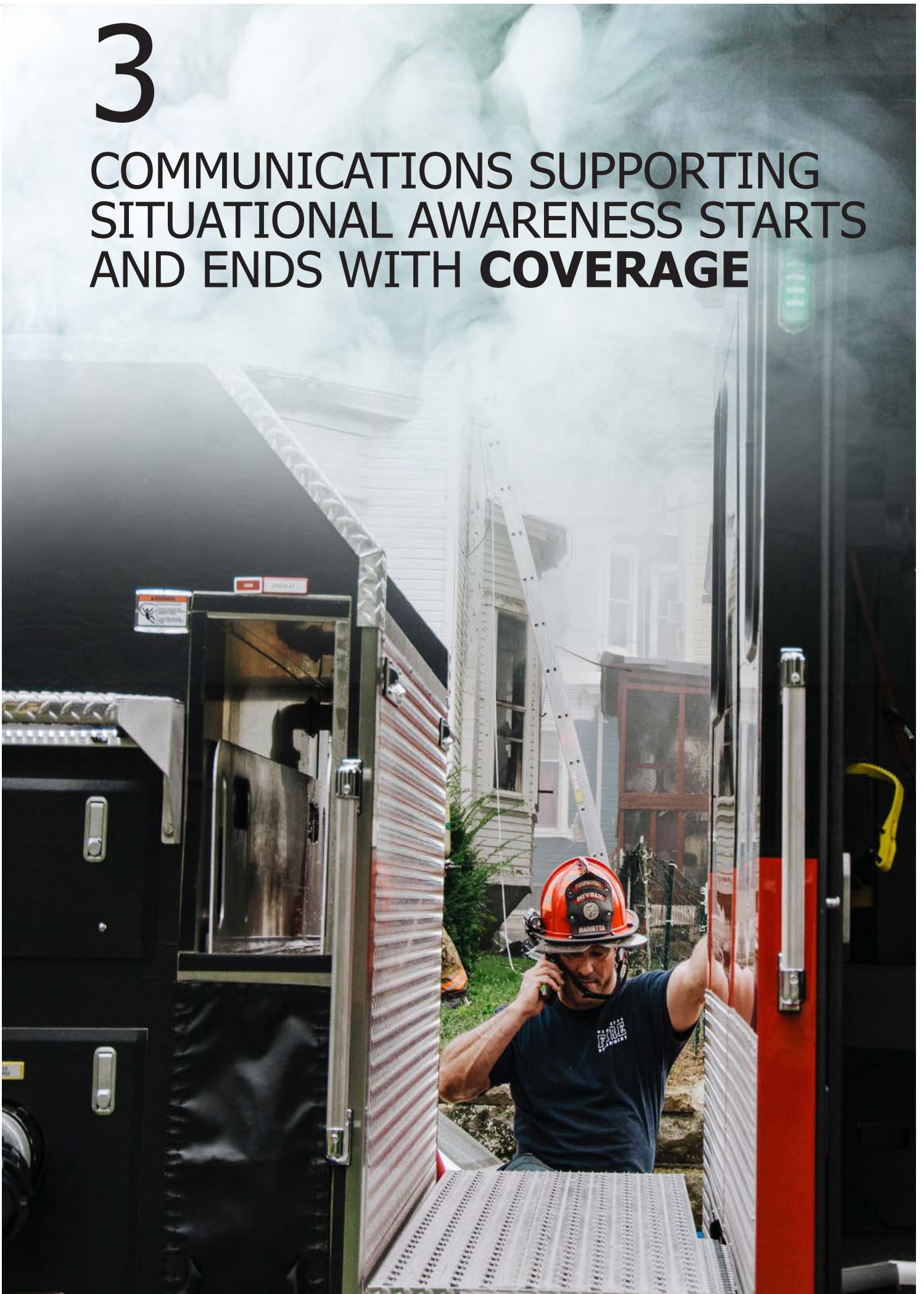
Drawing a line between each mark, the size of the resulting spiderweb is an indication of how well prepared your critical comms setup is – and where there is room for improvement. Please revisit the figure to continuously update your appraisal as your system evolves.



Rate your current system – ideally, your solution should cover as much of the green area as possible

3

COMMUNICATIONS SUPPORTING SITUATIONAL AWARENESS STARTS AND ENDS WITH **COVERAGE**



In firefighting, safe, effective operations depend on situational awareness: knowing what is happening, where, and when. Control, coordination, decision-making, and orders are vastly improved by effective, reliable, wireless communication – regardless of where your teams are and the conditions they’re facing. This requires your communication approaches to always perform, anywhere. Between personnel on the ground. And from the front line to the command center. If technology fails and coverage is lost, firefighters are left with a much harder job. The risk increases. Their voice communication could be hampered, making it harder to communicate what they see and hear, and more sophisticated devices such as drones and wireless-connected thermal cameras would be rendered useless.

Control, coordination, decision-making, and orders all depend on effective, reliable communication.

Firefighting agencies face several challenges when it comes to providing dependable coverage. If the operational area they cover is large, sparsely populated areas may be outside of coverage – but still populated by taxpayers expecting the same firefighting excellence provided in the cities.

Improving your fire department’s coverage can be achieved in different ways, but careful consideration must be paid to each method’s feasibility as well as its vulnerabilities in an emergency. From flooding to wildfires and hurricanes, every scenario needs to be carefully thought through.

LAND MOBILE RADIO

Land mobile radio, LMR, is still the mainstay of most fire departments’ critical comms setup. And with good reason. It has been purpose-built for reliability and resilience and has been around for years. People know and trust their two way radios. Using their PTT radios, frontline firefighters can stay connected to each other and to incident command and exchange the information required for improved situational awareness. But even LMR has its limitations and can fail,

too, which is why the best practice and learnings from other sectors is to have more communication approaches available. LMR networks rely on repeaters installed in buildings with an antenna on the roof or on a tower or mast to extend coverage. But radio towers can be vulnerable in mass emergency situations like high wind events or wildfires. This means you’ll risk losing coverage when you really need it the most. Losing coverage, you’ll risk degraded command and control, as well as a reduction in the information flow that is valuable to situational awareness. In our opinion, there is no need to scrap existing LMR setups. But forward-looking decision makers need to ensure that alternative communication approaches are made available. .

DON'T MAKE FIREFIGHTERS WAIT FOR COMPLETE SIGNAL LOSS BEFORE A SYSTEM SWITCH.



The quality of wireless coverage changes as you change position, moving through an area. Just think of how radio reception or mobile phone coverage can change as you drive. But different signals tend to change at different times. The quality of your cellular coverage goes up and down independently of the quality of LMR coverage, as many different factors affect different signals. As stated in our PACE plan recommendations, your critical comms solution should be able to automatically switch between different signals, always providing users with the best possible signal quality. Firefighters on the scene of a mass emergency shouldn’t have to wait for complete loss of one signal before the system switches to another. The switch should take place automatically, always opting for the best quality signal – without users even noticing.



LMR OUTAGE LEAVES DETROIT FIRST RESPONDERS CUT OFF



In August 2013, Detroit lost LMR coverage, leaving all police officers, firefighters, and EMS crews out on the streets without a central way to communicate. Some police officers resorted to using their private cell phones to stay connected while serving the city's 600,000+ residents.¹ One can only wonder how well any city's emergency response agencies would be able to handle a mass emergency, if first responders had to rely on their personal cell phones for communication. For one thing, firefighter gloves are not compatible with touch screens. As stated previously, we do not believe adding additional handsets to critical comms solutions and having to manually switch between communication approaches is desirable. What is your department's plan for handling the sudden loss of LMR coverage?

¹ <https://detroit.cbslocal.com/2013/08/20/detroit-police-emergency-radio-system-goes-offline-again/>

¹ <https://detroit.cbslocal.com/2013/07/05/detroit-police-emergency-radio-system-down/>

PRIVATE AND PUBLIC LTE

Long-Term Evolution (LTE) is a standard for wireless broadband communication for cellular phones and other mobile devices. Having your firefighting communications carried via commercial LTE networks supporting Quality-of-Service, Priority, and Preemption (QPP) makes a lot of sense. After all, commercial mobile phone networks already cover most of the globe with reliable 4G and 5G connectivity. So why insist on building the necessary infrastructure and taking care of maintenance yourself, when others already do it better and will let you use theirs for a modest fee? Adding mission-critical LTE to their critical comms setup could see fire departments increase their coverage without breaking the bank. And when it comes to situational awareness, LTE opens the door to new digital tools like dash mounted cameras, drones, and incident log-keeping.

To avoid the risk of getting cut off by network congestion during a mass emergency, some countries have set up private LTE networks reserved for emergency response agencies. Unfortunately, LTE towers and relay stations are as vulnerable in an unpredicted emergency scenario as radio towers. In fact, in a large-scale natural disaster or other mass emergency, traditional radio and mobile phone infrastructure is often the first to go, leaving firefighters and other emergency services in the blind if LTE is all they have.



MESH

Whether operating far from headquarters or deep inside a burning building, mesh networks are a clever way of extending coverage and keeping firefighting teams in touch with dispatch and each other. Mesh is also a good way of carrying IP (Internet Protocol) to the fire ground, enabling the use of digital tools by firefighters even in sparsely populated areas. By dropping relay nodes along the way, fire crews deployed in remote locations can establish a data connection back to dispatch. This will allow them to use IP-based tools and hardware away from their fire apparatus. However, resilience is a worry, as is the time necessary to set up the network. If digital backhaul to dispatch is lost, your firefighters could be cut off and only able to communicate with each other.

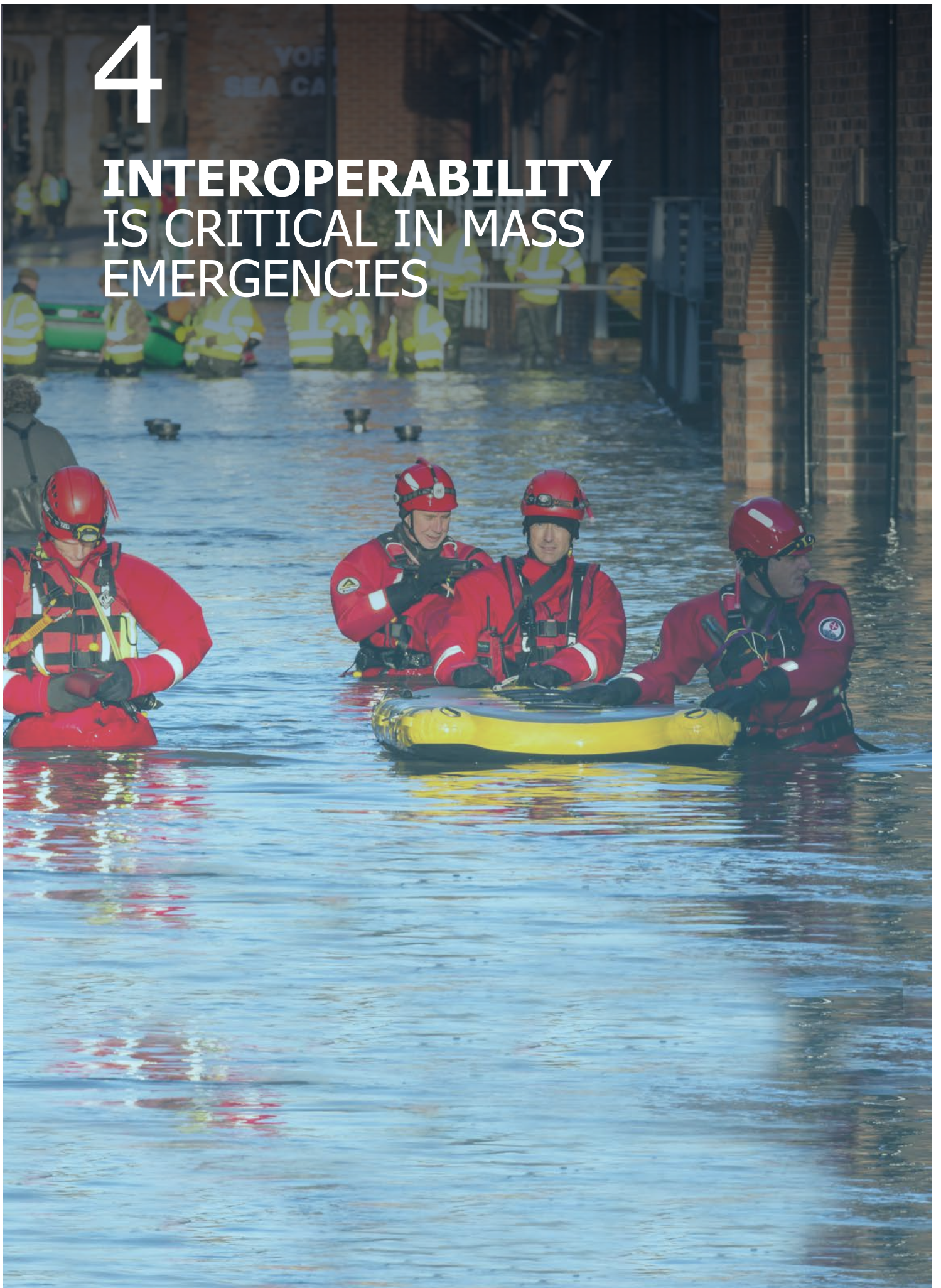
SATELLITE

Satellites can provide a wireless connection safely out of reach of hurricanes, wildfires, and other manmade or natural disasters. Adding satellite connectivity to their critical comms setup, firefighting agencies can achieve close to 100 percent coverage of their operational area without having to wait for – or pay for – building new radio towers. Satellite solutions come with little to no maintenance costs or initial investments, and only using satellite as a last resort will help keep monthly bills down. Choosing a service provider with a sensible concept for signal compression and access to flat rate subscription fees will also help to keep your department from running up unpleasant tabs.

Traditional radio and mobile phone infrastructure is often the first to go, leaving firefighters and other emergency services in the blind if LTE is all they have.

4

INTEROPERABILITY IS CRITICAL IN MASS EMERGENCIES



Extreme weather and other forces of nature increasingly cause mass emergencies, with fire departments being called upon to help each other provide emergency services, often crossing state or national borders to do so. In large scale operations such as these, situational awareness is just as critical as when a single fire crew is at work. This makes issues of communication and coverage take center stage. But when several emergency response agencies have to work together, their efforts are often hampered by a lack of network interoperability.

The floodings in Germany and her neighboring countries in the summer of 2021¹ gave a stark example of this. Here, rescue and relief efforts were hampered not only by the loss of coverage due to power outages, but also by critical comms solutions unable to communicate with each other. In our opinion, being able to switch between existing networks using the equipment you already have should be a part of any emergency response agency's critical comms PACE plan. Not only will it increase the efficiency and safety of rescue efforts, but it is also the easiest and least costly way for fire-fighting operations to ensure mission critical interoperability and situational awareness in any given location.

¹ <https://www.nytimes.com/live/2021/07/16/world/europe-flooding-germany>

VULNERABILITIES REVEALED



Events such as the 9/11 attacks in the US, the Boston Marathon bombing, the AT&T Tennessee bombing on Christmas Day 2020, and the massive river flooding in Germany in summer 2021 did much to highlight the practical deficiencies of traditional radio-based communication systems and their near-total lack of interoperability. Just imagine what would have happened if the emergency services had had sufficient communication capabilities during such events. Decision makers need to take questions of interoperability to heart and include them in their planning. The lives of firefighters and civilians depend upon it.

Being able to switch between existing networks using the equipment you already have should be a part of any emergency response agency's critical comms PACE plan.

LACK OF INTEROPERABILITY SLOWS DOWN OPERATIONS

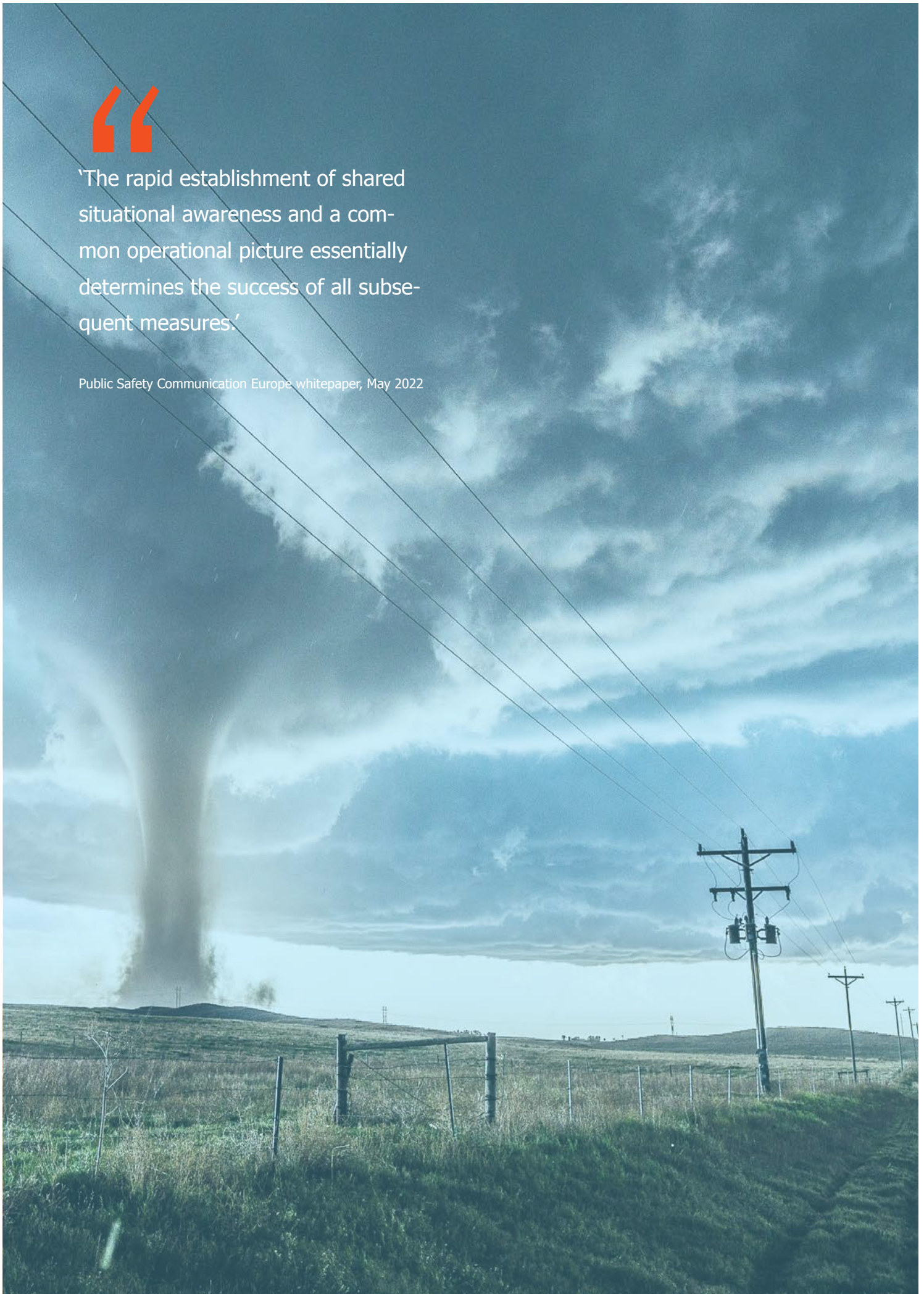
From the moment the alarm sounds, time is the enemy. Mass emergencies are no exception. Every second wasted having to figure out how to relay orders or information between different emergency response agencies is a second we would do well to claw back. As it is, emergency services sometimes resort to runners, or to have their messages relayed by a third party operating two or more handsets to pass the word along. This not only adds delays to the operation, but also the risk of human error. Emergency service agencies need to look at how prepared their critical comms setup is to seamlessly integrate with other networks to better serve their personnel and communities.

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'The rapid establishment of shared situational awareness and a common operational picture essentially determines the success of all subsequent measures.'

Public Safety Communication Europe whitepaper, May 2022



PROBLEMS BEGIN AT HOME

Like the United States, the European Union¹ has recognized the need for improved technical interoperability across national borders between emergency response agencies: 'There is a need for secure, legal, and ethical communications infrastructures and data interoperability ... These are vital, because in any crisis that needs to be managed across borders, the rapid establishment of shared situational awareness and a common operational picture essentially

determines the success of all subsequent measures.' Is your department's critical comms system designed with interoperability in mind – or are you running the risk of hampering rather than helping mass relief efforts?

¹ <https://www.psc-europe.eu/wp-content/uploads/2022/05/PSCE-Whitepaper-Transboundary-Resilience-1.pdf> P.11

RECOMMENDATION: PLAN FOR INTEROPERABILITY



Many NIOSH recommendations* published following Line-of-Duty Death investigations address critical comms issues. They frequently point to the importance of keeping up with the demands of the incident, even as incidents increase in size. In case of a mass emergency tomorrow, how hard, or easy, would it be for your department's communications system to interoperate with other fire departments, police, and EMS agencies? Would your people be able to effectively save lives and property if called upon to help in another state or country? Or would they just be in the way – and possibly in danger?

<https://www.cdc.gov/niosh/fire/pdfs/face201419.pdf>

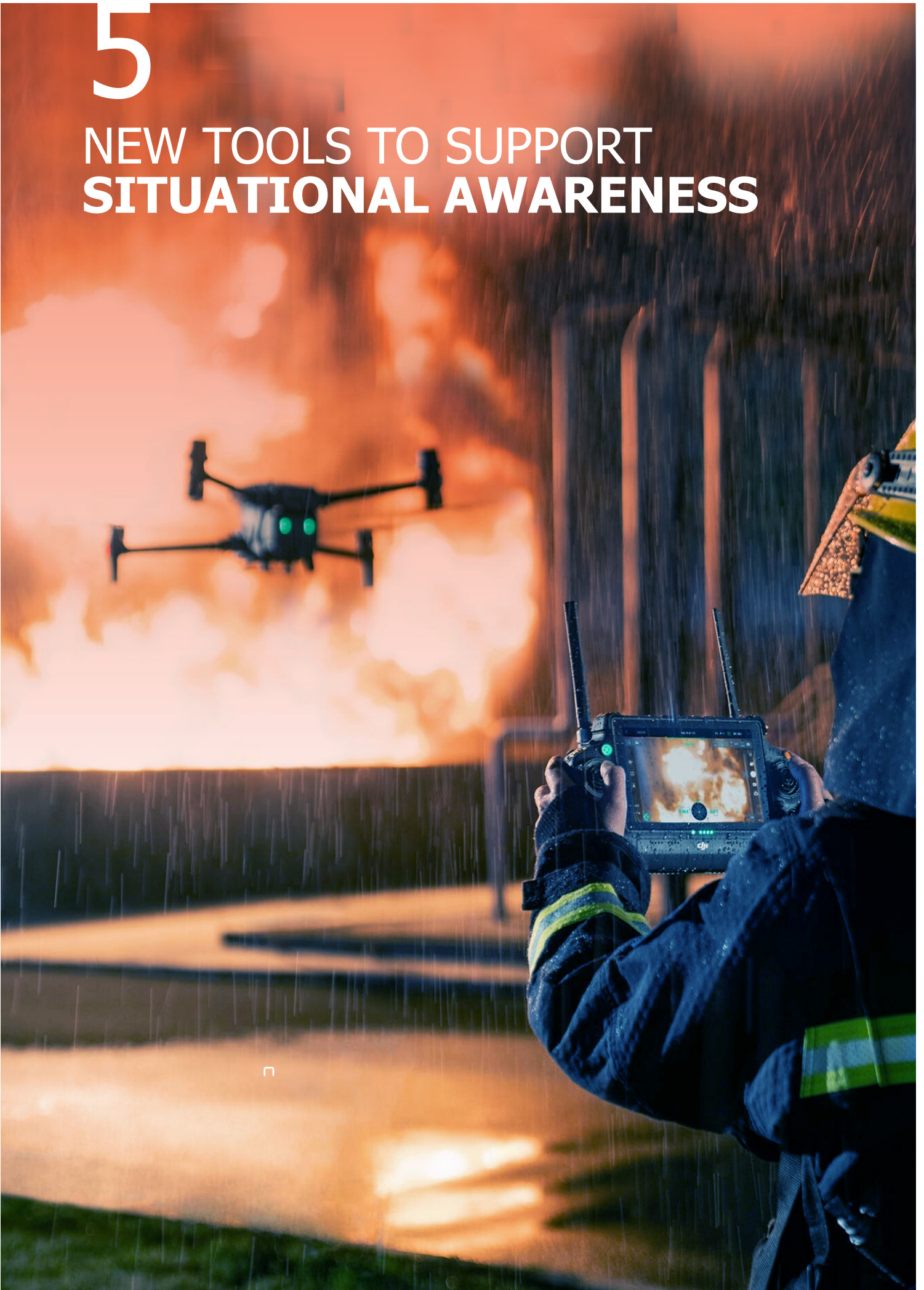
THE DIGITAL SHORTCUT TO INTEROPERABILITY



In our opinion, fire departments should look to digital technology to add new dimensions of interoperability. By augmenting – instead of expensively replacing – communication equipment with digital gateways in firefighting vehicles and other equipment, going digital does not have to be ruinous. In fact, routing signals through a digital gateway is the easiest and least costly way for firefighting operations to ensure reliable and interoperable voice and data services in any given location.

5

NEW TOOLS TO SUPPORT SITUATIONAL AWARENESS



Operating in the noisy, stressful, and chaotic environment of a fireground or an emergency scene, observations and estimations of the unfolding situation can be hard to make, even for experienced firefighters and incident commanders. The development of new digital tools for personnel accountability, command, and control will transform the way firefighters work and train. In the face of increasing mass emergencies due to extreme weather events, and of the number of annual civilian and firefighter fatalities, fire chiefs and other decision makers must make these tools available to firefighters to make them safer and more effective.

KILLER WEATHER



According to the National Safety Council, the number of direct and indirect deaths from weather events has increased 35% from 2017 to 2021. The deadliest weather events in the United States over the past five years include Hurricane Irma and the California wildfires.* To keep firefighters safe, new digital tools and capabilities are needed to support situational awareness when dealing with these types of mass emergencies.

¹ <https://injuryfacts.nsc.org/home-and-community/safety-topics/weather-related-deaths-and-injuries/>

A PICTURE IS WORTH A THOUSAND WORDS

Using body-mounted cameras, firefighters on the front line can potentially live-stream footage of everything that's going on around them – virtually putting incident commanders in their boots while they work. A picture is worth a thousand words, and that is a lot more than proper radio discipline allows. Meanwhile, dash mounted cameras in fire apparatus could help provide an additional outside perspective, as well as a useful overview of everything that's going on at the fireground or emergency scene.

AN EYE IN THE SKY

Unmanned aerial vehicles – UAVs or drones for short, can vastly improve information gathering to support situational awareness. Drones can provide a visual overview to assess incident scope and severity before dispatch and arrival. Aerial footage makes it easier to assess what resources are likely to be needed for any emergency and can help highlight potential hazards and incident developments. UAVs are also useful for gathering data and video footage about incident sites, conditions, and developments, providing the big picture that can prevent firefighters from being caught off guard.

INCIDENT LOGS IMPROVE TRAINING AND DIGITAL FORENSICS

Another useful capability is the ability to create a digital incident log, recording and timestamping every message exchanged during an operation. After the conclusion of an emergency response operation, firefighting departments and other authorities may wish to revisit the timeline of the operation to establish exactly what happened and why. Combined with equally timestamped digital footage from drones or dash mounted cameras, these logs can prove a valuable training tool, adding to the department's continuous improvement. And in the event of firefighter injuries or death, a comprehensive and timestamped digital log can prove indispensable to finding out what went wrong to prevent it from happening again.

IT IS TIME TO TAKE ACTION



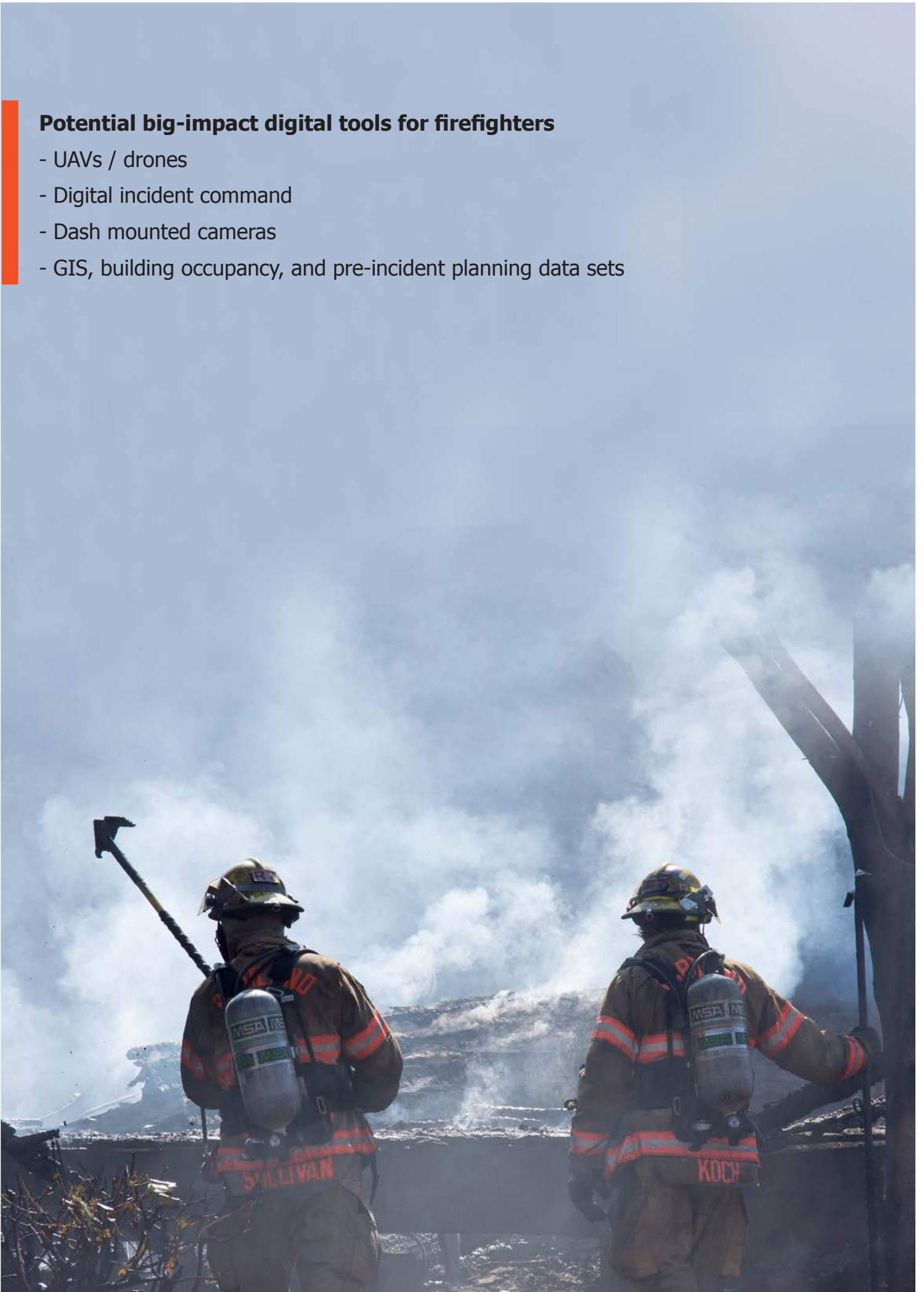
1,388,500 fires resulted in 3,500 civilian deaths and 62 on-duty firefighter deaths¹ in 2020, according to The National Fire Protection Association (NFPA). Fire chiefs and other decision makers need to constantly ensure that volunteer and professional fire brigades have the best possible tools available to help bring down these numbers through improved situational awareness.

¹ <https://www.nfpa.org/News-and-Research/Data-research-and-tools/Emergency-Responders/Firefighter-fatalities-in-the-United-States>

¹ <https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Fire-loss-in-the-Unit->

Potential big-impact digital tools for firefighters

- UAVs / drones
- Digital incident command
- Dash mounted cameras
- GIS, building occupancy, and pre-incident planning data sets



NEXT UP: SMART CYBER FIREFIGHTING?

It sounds like science fiction, but the Fire Protection Research Foundation, an affiliate of the NFPA, recently published a report outlining a proposed Next Generation Smart and Connected Fire Fighter System: 'This research aimed at proposing a situational awareness system that uses the information from the firefighter gear to extract the necessary knowledge about the fire fighter environment and transmit it to the command.' Among other things, the system would combine fireground sound recognition, prediction of firefighter exhaustion, and human/object/event recognition with thermal imaging through Augmented Reality goggles. The system relies on a communications backbone enhanced to enable the massive flow of data collected from all the various sensors in firefighters' equipment.

<https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Emergency-responders/RFNextGenSmartFFSystem.pdf>

CELLULAR NETWORKS CAN BE MOST VULNERABLE EXACTLY WHEN THEY'RE MOST NEEDED

In emergencies like floods, disasters and wildfires, cellular networks are just as vulnerable as traditional radios, because the antennas and towers they rely on often get damaged or destroyed. Some mobile networks are fully dependent on fiber links that are quickly destroyed by flame. Furthermore, terrestrial networks usually depend on electricity from the local power grid. When the power goes, the networks go.

NEVER FORGET: LOSS OF DIGITAL COVERAGE HAMPERS YOUR EFFORTS

To drive the greatest value from new digital capabilities available to your firefighting agency, you need to provide a robust data connection that carries broadband internet to the frontline. Investing in drones and dash mounted cameras will not support situational awareness and help firefighters protect people and property without a critical comms PACE plan ensuring constant digital connectivity. Loss of coverage will mean losing tools directly dependent on data connectivity like drones, automated personnel accountability reporting (PAR) systems, access to GIS data, and incident command management tools. Your command-and-control tools may be designed to keep operating after communications fail, but they will no longer benefit from rich data sets hosted in the cloud or video transmissions from drones.

LTE NETWORKS CAN FAIL



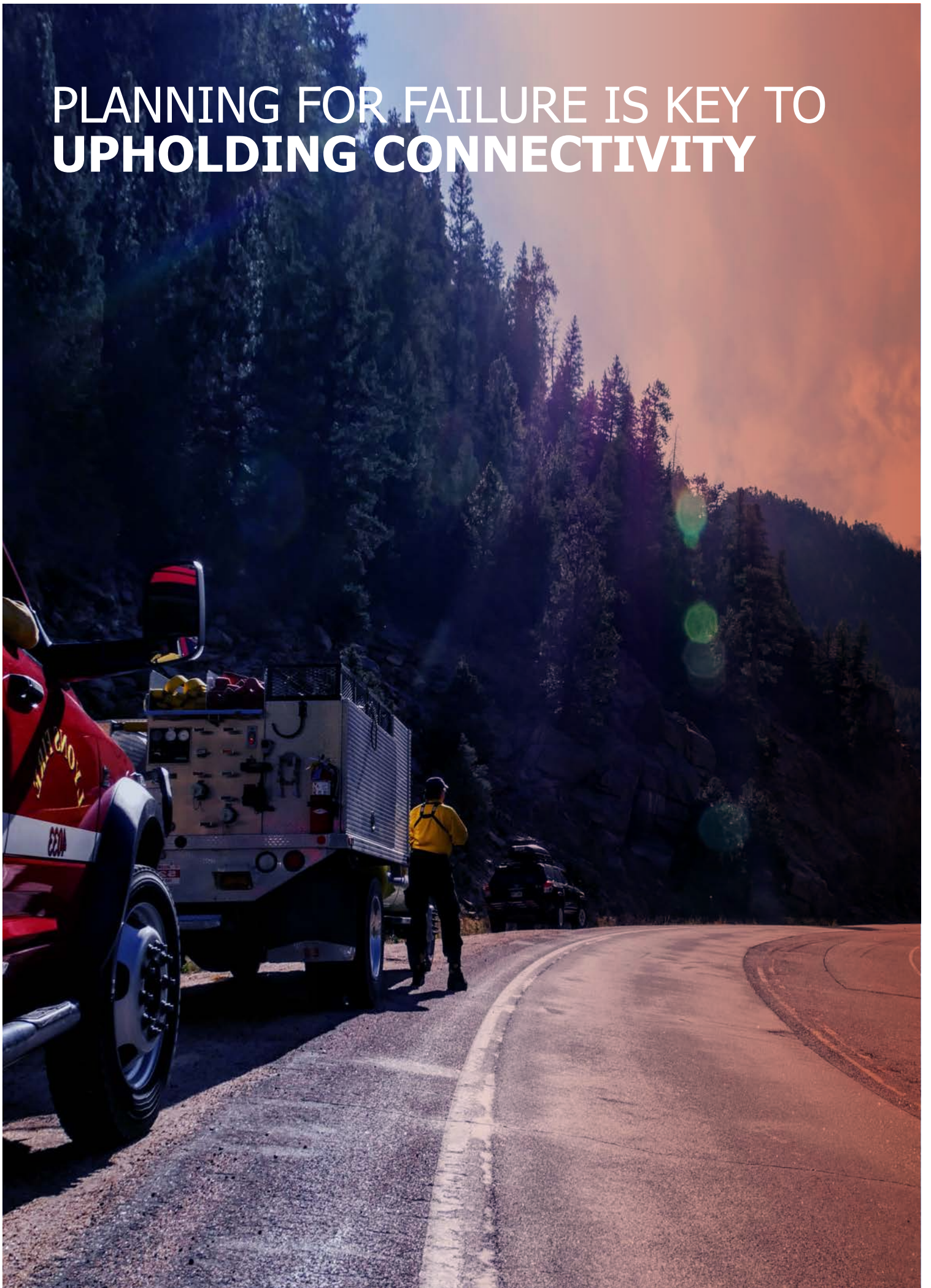
Data connectivity is the key to adding new digital tools to firefighting agencies. But while LTE networks are a good way to supply data connectivity, they are also vulnerable to outages. In one extreme example, a bomb caused massive disruption for first responder networks across a multi-state region of the US for almost a week¹. In Canada, a major service outage in July of 2022² left 12 million Canadians without use of their cable internet and cellular networks for a day. This included fire and rescue services responsible for keeping thousands of Canadian citizens safe. And on March 5, 2020, the American LTE-based first responder network FirstNet suffered a down-period in the southeast USA³. As a result, some voice and data services were unavailable to FirstNet clients for hours. These are good examples of why fire chiefs and other decision makers must always plan for the unexpected: Even a state-of-the-art emergency comms solution like FirstNet, which is being rolled out across the US, can suffer an unexpected outage. If your department relies on LTE as its single line of communication, all of their digital tools will be lost in case of an outage.

¹ https://www.cisa.gov/sites/default/files/video/22_0602_ecd_dependencies_2020-nashville-bombing_508C.pdf
PSCE-Whitepaper-Transboundary-Resilience-1.pdf P.11

² <https://www.bbc.com/news/world-us-canada-62174477>

³ <https://urgentcomm.com/2020/03/18/att-provides-some-details-about-march-5-firstnet-data-service-outage>

PLANNING FOR FAILURE IS KEY TO UPHOLDING CONNECTIVITY



In this paper, we've discussed how the establishment of shared situational awareness based on communication supports the success and safety of emergency response operations. Whether handled by a single fire department or by many collaborating emergency response agencies, the ability to support sustained situational awareness is important for mission success. As the number, ferocity, and unpredictability of mass emergencies grow, so does the need for critical communication solutions able to provide uninterrupted voice and data connectivity. Wireless digital voice and data connectivity enables inter-agency communication and the use of new, digital tools that further support situational awareness and firefighters' ability to protect people and property. But without coverage, communication is hampered, and situational awareness diminished.

In an emergency, coverage can be lost in any number of ways – from power outages to the destruction of infrastructure like radio towers and relay stations. Fire chiefs and the decision makers who support them need to make plans to ensure that firefighters and other front-line personnel are never cut

off from the big picture. In this paper, we have suggested adopting the PACE planning principle. PACE denotes always having a Primary, Alternate, Contingency and Emergency plan in place. Applied to critical communications systems, this requires them to be able to switch between four different communication approaches in case one or more is lost. We have also introduced four important parameters to judge a system by: It has to work out-of-the-box, provide automatic switching between alternate approaches, perform in all scenarios, and require no additional training of firefighters.

Fire chiefs and the decision makers who support them need to make plans to ensure that firefighters and other front-line personnel are never cut off from the big picture.



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