and (iii) existing EU initiatives and services, in addressing wildfires through innovative means or mitigation strategies.

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What Role Can 5G Play in the Prevention and Suppression of Climate-Related Natural Disasters?

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Climate change leads to an increased risk of natural disasters, calling for better-prepared public protection and disaster relief (PPDR) agencies to prevent and suppress life-threatening incidents. Superior network technology will play a key role in enhancing the capacity of first responder organisations to anticipate and efficiently deal with such threats. The 5G-EPICENTRE project is developing an ecosystem comprising experimental evidence, tools and innovative systems, which aim at communicating the benefits of 5G-connected solutions to PPDR organisations.

Climate change has significantly increased the risk and frequency of natural disasters (e.g. wildfires and floods), which claim thousands of lives on an annual basis. Such incidents require the immediate, unhindered and coordinated response of PPDR agencies, who must ensure that natural catastrophes' effects take a minimum toll on human lives, property and the region's biota. In their striving against the adverse effects of climate change, PPDR agencies are gradually opting in on the digital transformation that key technological enablers can offer them. As these technologies continue to grow faster, more precise and "smarter" (and adversely, more resource-demanding), the much-anticipated commercial roll-out of 5G cellular networks opens up new avenues for boosting PPDR agencies' capabilities to both prevent and, if necessary, suppress disastrous incidents, including those related to climate change. This can be done by leveraging the concept of the Internet of Things (IoT), alongside artificial intelligence (AI), whereby massive amounts of data can be collected, analysed and communicated to PPDR operations centres through both mobile and stationary devices, enhancing agencies' detection, localisation and awareness-building capabilities.

5G networks (and 4G networks before them) herald the promise of the required low latency and high bandwidth for facilitating the transmission of large volumes of mission critical (MC) data faster, aiming at guaranteeing the required service levels to support PPDR functions. This is particularly important considering the size of the data to be transmitted (including not only voice, but also rich multimedia and multimodal content), whereas the network itself might be unavailable, or highly disrupted, especially during incident-suppression operations. For example, when a high-definition (HD) video stream is contributed from the field of operations to a command and control centre, it is important for that stream to be transmitted over the network with highest priority, in a very short time, and with no drop off in quality, even if the network is congested with traffic from other tenants.

Thus, several multi-national initiatives and projects have been assembled over the years to explore 5G technology as a potential home for both existing and novel, highly interesting PPDR networked systems. Although both 4G and 5G technologies have been demonstrated to work well to complement or even as successors of current PPDR networks, the actual transition has been slow and riddled with challenges [1]. If PPDR agencies are to reap the benefits of 5G architectural features (such as 5G network slicing and 5G quality of packet communication management, see Figure 1) and vertical-specific deployments, to both prevent and combat natural, accidental and man-made disasters, it is important to deliver a reliable and conclusive evaluation of what 5G can offer to critical operations.

Steadily on the path to such outputs, the 5G-EPICENTRE [L1] project represents a coordinated effort among 17 partners across the EU, toward trialling and experimentally validating 5G capabilities to support PPDR users. The project is dedicated to demonstrating how different PPDR-targeting applications can exploit novel delivery models of 5G services (known as "network applications" [2]) to gain access to more refined capabilities that such networks can offer, for instance, explicitly requesting to prioritise PPDR application traffic flows and thereby, guarantee their quality of service (QoS). The concept has been operationalised into eight network-intensive use cases: (1) a collaborative platform for operational situation information exchange with support for voice, video, messaging and localization services; (2) a standards-compliant MC-Everything (MCx, i.e., voice, video, data) solution; (3) a mobile remote control drone navigation and localization app with video streaming capabilities; (4) a wearable platform for first responders, equipped with audio, video, environmental, positioning and bio sensors for increasing remote command & control situational awareness; (5) wearable video solution for streaming video and audio from a disaster location; (6) a

Figure 1: Schematic representation of 5G-EPICENTRE experimental evidence of 5G features for PPDR networked solutions.

drone-based live object detection and annotation app; (7) live annotated video contribution from combined drone and smart glasses cameras; and (8) an immersive augmented reality application for outlining how to administer emergency surgical care to disaster victims. Evidence from trials in these use cases is starting to accumulate, confirming that novel, 5G-specific features are crucial for the delivery of such (and other) ambitious vertical systems for PPDR [3]. More specifically:

- Guaranteeing service levels for MC communications: Commercial broadband networks are hardly exclusive to PPDR operations, which require priority over other services, particularly during suppressive action at the onset of a disastrous event. Dynamic 5G QoS management mechanisms have successfully been implemented in the context of the project, to guarantee unhindered communication flow and top performance of PPDR networked solutions (i.e. in terms of offering the necessary high bandwidth, low latency and jitter), even when the network is stressed with lower-priority traffic. Project partners successfully demonstrated this QoS management concept in cases (1), (2) and (4), whereupon MC communication streams were shown to be allocated the necessary bandwidth with higher priority over other traffic. Thereby, first responders can benefit from ultra-fast and ultra-reliable multimedia (i.e., voice, video, data, positioning, biosensor, etc.) communications in high-definition resolution, thus greatly enhancing both their organisational planning and situational awareness when disaster strikes.
- Multimodal IoT platforms for prevention and suppression: Internet-connected sensors (e.g. cameras, environmental sensors and biosensors) can be strapped to tree trunks, unmanned aerial vehicles (drones), or even people (first responders on the scene of a disastrous event), to calculate and analyse risk-related factors and alert both operations centres and field operatives to the presence of potential environmental threats. Such solutions can play a vital role e.g. in wildfire detection, as well as in suppression and post-fire recovery actions. 5G-EPICENTRE partners are rigorously experimenting with such solutions, examining, among others, airborne vehicles' control, wearables' reliability, and bandwidth of the transmission between the sensors and the operations centres. Recently, partners successfully demonstrated the application of 5G slicing toward the preservation of network resources for PPDR actors – without the slicing feature, such solutions cease to work reliably, especially in congested network conditions (typical in emergency situations).

In conclusion, analysing the aforementioned outcomes of the project, transitioning to 5G networks might hold the key for regional and civil protection organisations to build resiliency in the face of looming environmental threats. In the context of the 5G-EPICENTRE experimentation activities, project partners are constantly coming up with evidence through experimentation with the project use cases on how 5G can strengthen the capacity of first responder organisations to both deliver preventive actions, as well as respond to events faster, more safely and more effectively, while turning such knowledge into enhanced ICT solutions for public safety organisations. These outcomes represent an important step towards accelerating the migration of PPDR services to 5G cellular networks.

The partners involved in the development and integration of the reported tests are Airbus, Nemergent Solutions, OneSource, University of Malaga, and Athonet.

Link:

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