

Mobile-based warning systems to enhance volcanic warnings fast and far

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1. CONTEXT

Volcanoes produce multiple hazards affecting people across significant distances and differing temporalities, making rapid and targeted warnings challenging for scientists and emergency managers.

Following recent high profile volcanic incidents that have killed and/or affected local populations and tourists such as the 2014 Mt Ontake (Japan), 2019 Whakaari (New Zealand), and 2023 Mt. Merapi (Indonesia) eruptions, the challenge remains as to how to reach everyone at risk in a timely and cost-effective manner.

Following the UN *Early Warning For All Initiative*, Pillar 3 focuses on 'Warning Dissemination and Communication' and is led by the International Telecommunication Union (ITU). Whilst it is important to recognise the limitations of technology including technical or electrical failure, accessibility to (smart) phones, network coverage, and data access, technology could play a valuable role in the volcano warning system toolkit. This poster outlines how such technologies could be used in a volcanic context to enhance warnings.

2. ROLE OF MOBILE-BASED WARNINGS

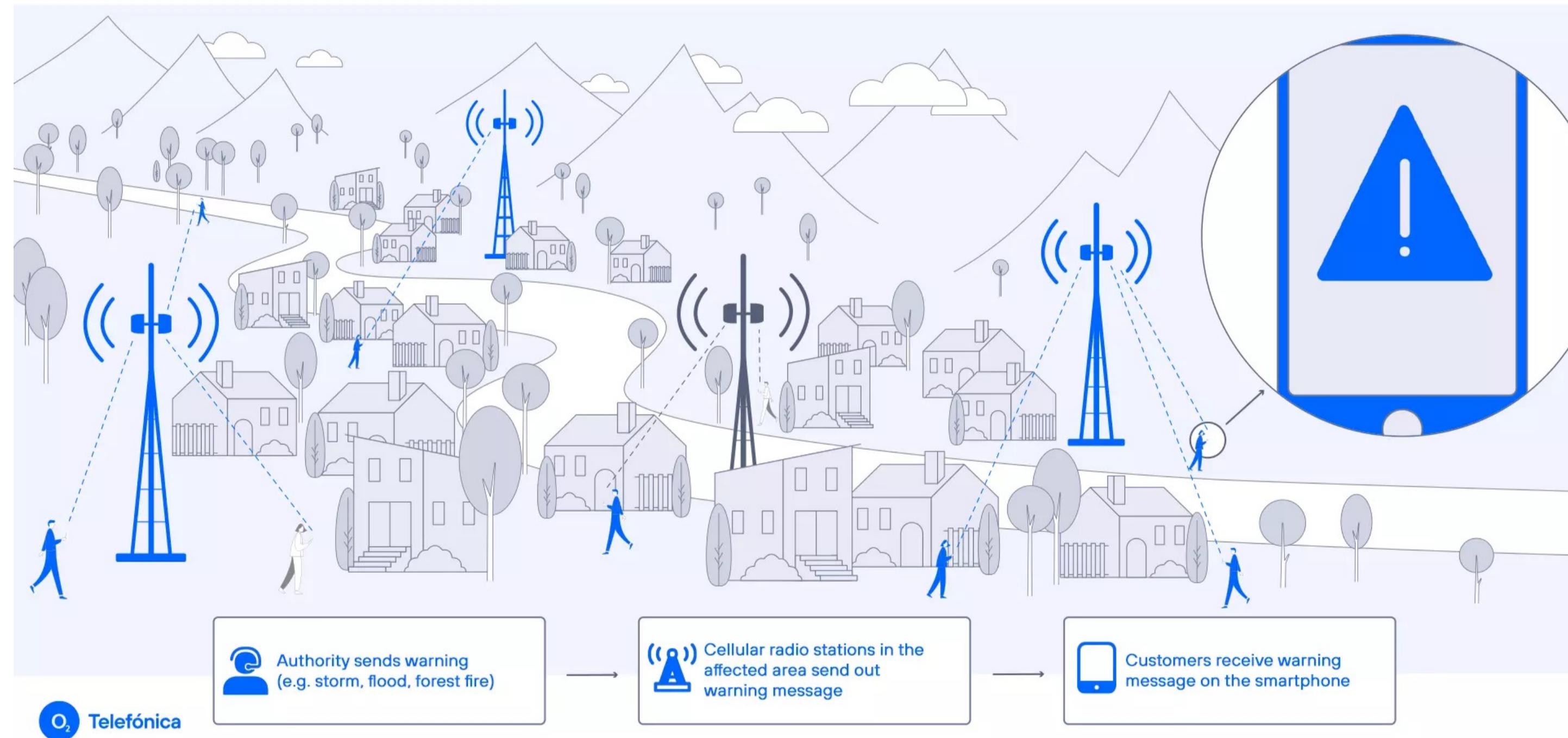
Mobile (cell)-based warning systems provide an essential tool to notify vulnerable populations rapidly of critical information.

In 2022, 95% of the world's population had access to mobile broadband networks, and three quarters of people owned a mobile phone. This makes mobile networks a powerful communication channel to alert populations about an imminent hazard.

Two complementary technologies have been developed:

- 1) **Location-based SMS** sends a message to all mobile phones detected in an area
- 2) **Cell-broadcast** uses a different network than SMS, enabling messages to be sent immediately to millions of people without network congestion in an at-risk area

Cell Broadcast - how it works



Public warnings using IT infrastructure via companies such as Everbridge enable a low risk, hassle-free implementation of warnings under global mandates and industry standards for:

- 1) **Multi Hazard Alerting:** for use when there are multiple events going on, both natural and human-made
- 2) **Multi-Agency Alerting:** multiple stakeholders can use the same solution, tailored for their jurisdictions. The solution can be scaled from national to regional or state level, with each agency having their own defined set of templates, roles, hierarchies and directories
- 3) **Multi-Channel Alerting:** e.g. Location-Based SMS, Cell Broadcast, Mobile Push, Notifications, SMS, Voice, Email, CAP (Common Alerting Protocol), Compliant for Sirens, TVs, Radio, Electronic Display Boards, Social Media

6. KEY TAKE AWAY POINTS

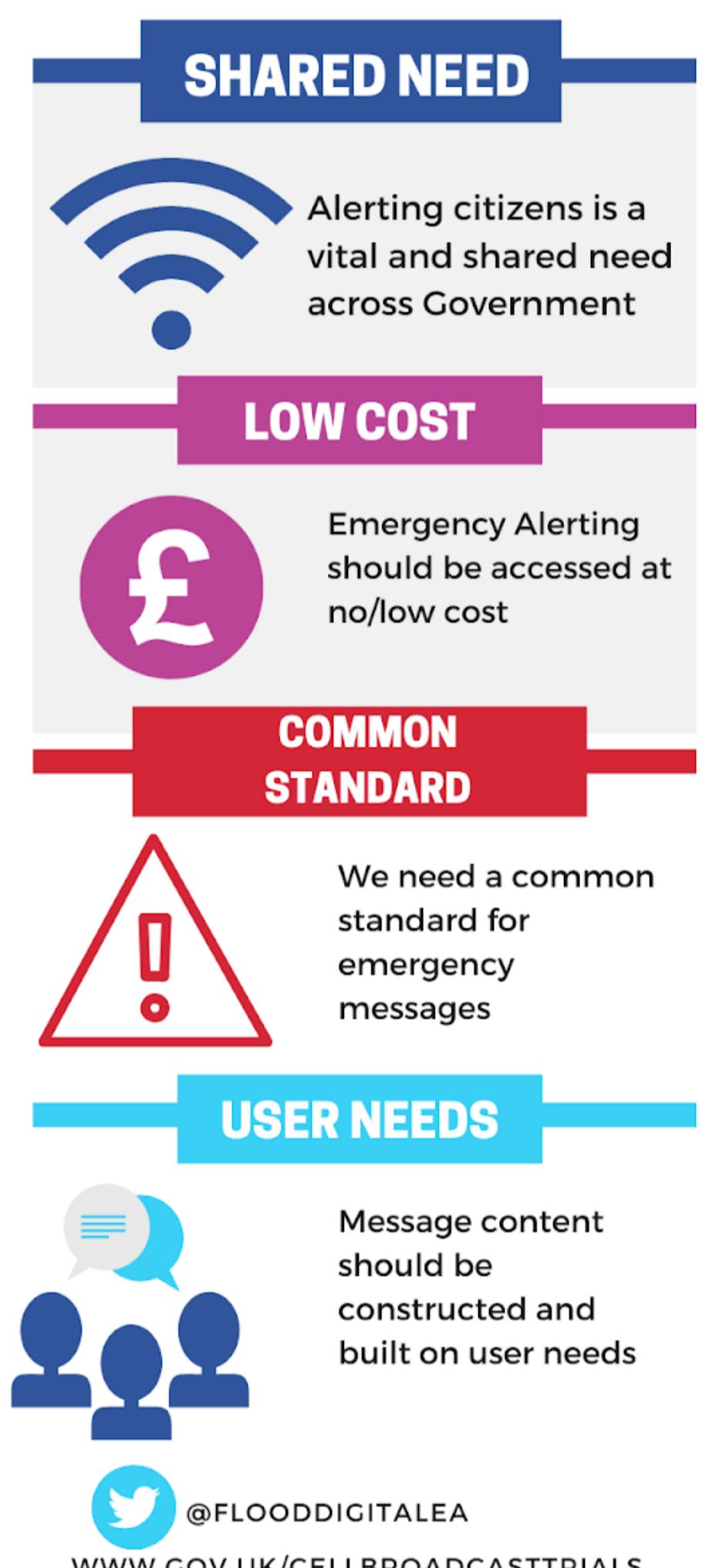
- Mobile warnings provide bespoke warnings to large numbers of people exposed to different hazards depending on their location
- Concurrent, complex, multi-hazard, Na-Tech events can be integrated to provide guidance in an evolving context
- Redundancy is key for technologically based warnings

3. GENERATING INCLUSIVE WARNINGS

As per the UN led *Early Warnings for All Initiative*, every person globally should be protected by warnings by 2027.

Mobile phone warnings are a significant asset as they are adaptable to specific requirements to be more inclusive e.g.:

- A user's language (set by the phone) so alerts are in the user's native language
- Disability requirements (e.g. visual or hearing impediments)
- Location and across all networks (e.g. works whether a tourist or migrant)
- Adhere to a range of standards and are low cost to issue and maintain the system



4. MOBILE WARNINGS FOR VOLCANIC HAZARDS

Volcanic observatories could benefit by integrating mobile warnings via key National Disaster Management Agencies:

- To alert people in specific areas to volcanic hazards, whether erupting or not, proximal or distal (useful for ash)
- Reach tourists or populations not signed up or familiar with local information services
- Assist the crisis management and response and recovery, using two-way communication
- Only governments can decide when emergency alerts should be issued, to whom, and with what message



5. TECHNOLOGY CAN AND OFTEN FAILS

Despite the many benefits of mobile technology in generating warnings things do go wrong (as seen in Hawaii):

Hawaii Ballistic Missile: On January 13, 2018, an alert was accidentally issued via cellular networks in Hawaii, instructing citizens to seek shelter due to an incoming ballistic missile.

Lahaina, Maui: Maui County officials failed to activate sirens to warn of the approaching wildfires. Power and cellular outages for residents further stymied communication efforts. Over 100 people were killed.

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