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DISASTER RISK REDUCTION WORKING GROUP

Solidarity
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Scaling Up Cell Broadcast for Last-mile Early Warning Delivery

Progress, barriers, and enabling mechanisms

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Table of Contents

List of Acronym

3GPP	The 3rd Generation Partnership Project
CAP	Common Alerting Protocol
CB	Cell Broadcast
CBC	Cell Broadcast Centre
CBE	Cell Broadcast Entity
COP28	The 28^{th} Conference of the Parties to the United Nations Framework Convention on Climate Change
CREWS	Climate Risk and Early Warning Systems
DMA	Disaster Management Agency
DRR	Disaster Risk Reduction
DRRWG	Disaster Risk Reduction Working Group
ECTEL	Eastern Caribbean Telecommunications Authority
ETSI	European Telecommunications Standards Institute
EWS	Early Warning System
EW4All	Early Warnings for All
EPC	Evolved Packet Core
EU	European Union
EAS	Emergency Alert System
GCF	Green Climate Fund
G20	Group of Twenty
GSMA	GSM Association
ITU	International Telecommunication Union
ICT	Information and Communication Technology
LDCs	Least Developed Countries
LLDCs	Landlocked Developing Countries
MHEWS	Multi-Hazard Early Warning Systems
MNO	Mobile Network Operator

MWEA	Wireless Emergency Alert System
NMHSs	National Meteorological and Hydrological Services
RAN	Radio Access Network
SAE	Emergency Alert System
SIDS	Small Island Developing States
SMS	Short Message Service
SOFF	Systematic Observations Financing Facility
SWIC	Statewide Interoperability Coordinator
SIM	Subscriber Identity Module
TV	Television
UN	United Nations
US	United States
USF	Universal Service Fund
VPN	Virtual Private Network
WMO	World Meteorological Organization
WEA	Wireless Emergency Alert

Executive Summary

As climate-driven hazards become more frequent and severe, timely and reliable early warnings are more critical than ever. Today, digital growth presents new opportunities to reach billions of people faster and more effectively, whether before, during, or after disasters. Strong growth in mobile networks and services offers unprecedented opportunities to alert populations about an imminent hazard. Cell broadcast (CB), in particular, has proven to be a powerful alerting technology as it can reach those at risk, quickly and effectively, over their mobile phone. The technology also benefits from ongoing innovations that make it even more effective and resilient, underscoring the importance of investing in cell broadcast technology as a strategic, future-proof measure. For this reason, CB has been recognized as a key component of effective warning dissemination communication and for the achievement of the UN's Early Warnings for All (EW4All) initiative, which has the ambitious objective of protecting every person on Earth with an early warning system by 2027.

This paper has been prepared as an input document to the G20 Disaster Risk Reduction Working Group (DRRWG) under South Africa's presidency. Its main objective is to analyze the state of CB implementation, to identify barriers to global scale-up, and to propose actionable pathways to accelerate its adoption.

The paper highlights that despite its recognized benefits and opportunities, CB adoption remains uneven, with only about 45 countries—primarily high-income economies—having implemented or currently deploying CB systems.

Key barriers to wider CB adoption - particularly in developing countries- are funding and limited awareness but the international community is mobilizing to address the challenges and accelerate the global implementation of CB. The paper identifies several enabling mechanisms that support this implementation. This includes supportive regulatory frameworks, cost-efficient deployment models, standardized alert protocols such as the common alerting protocol (CAP), and strategic international partnerships. These partnerships are notably enhanced through initiatives like EW4All, which foster collaboration across borders and stakeholder groups to strengthen CB systems worldwide.

With mobile networks now covering nearly 98 per cent of the global population and mobile phone ownership reaching 80 per cent[1], CB presents an important opportunity to bridge the "last mile" in warning dissemination. Advancing CB technology adoption is therefore essential not only for achieving the EW4All goal of universal coverage by 2027 but also for protecting vulnerable communities on the frontlines of climate and disaster risks.

By increasing awareness and championing scalable financing, harmonized policies, and technology transfer, the G20 can catalyze progress toward EW4All's 2027 target while safeguarding communities disproportionately impacted by disasters. This paper underscores

[1] ITU Facts and Figures 2024, available at https://www.itu.int/en/ITU-D/Statistics/pages/facts/default.aspx

that scaling up CB adoption is not merely a technical solution but a collective commitment to equity, resilience, and global solidarity.

1. Introduction

The World Meteorological Organization (WMO) has confirmed that 2024 was the warmest year on record. Climate change is fueling more frequent and intense hazardous weather, highlighting the urgent need for early warning systems (EWS). Ensuring that these systems are accessible to all—guided by principles of equality, solidarity, and sustainability—is essential.

In March 2022, the United Nations Secretary-General launched the Early Warnings for All (EW4All) Initiative, with the ambitious goal of ensuring that every person worldwide is covered by an early warning system (EWS) by 2027. At the time, it was estimated that one-third of the global population lacked access to this life-saving service. The urgency is heightened by climate change, which intensifies natural hazards and increases the necessity of protecting vulnerable populations.

Through the Early Warnings for All (EW4All) initiative, global efforts aim to strengthen EWS coverage, particularly for vulnerable communities on the front lines of disaster and climate risks, leaving no one behind.

In the initial phase of the EW4All initiative, over 30 countries have taken up action on closing the gap on EWS. Progress is evident as over 108 countries now report strengthened multi-hazard early warning system (MHEWS) capacities, when compared to 2015, and with the greatest increases experienced in least developed countries (LDCs), landlocked developing countries (LLDCS), and small island developing States (SIDS)[2]. Only 44 countries have EWS leveraging mobile channels using technologies like cell broadcast or location-based SMS, with another 13 countries in the process of development.

Early warning systems are increasingly recognized as essential tools for strengthening disaster risk reduction (DRR), not only by enabling adaptation to the escalating impacts of climate change but also by enhancing preparedness, response, and resilience to a wide range of hazards. As the number and intensity of hazardous weather events are on the rise, the need for effective warning dissemination systems has become critical. EWS are proven to save lives, protect infrastructure, and offer a high return on investment.[3]

Currently, most countries have major gaps in the dissemination of warning messages to populations at risk. By increasing awareness of new digital opportunities and bringing together key stakeholders from both the private and public sectors, including telecommunication regulatory authorities, Ministries of ICT, and mobile network operators, the gap can be addressed, and a multi-channel early warning system can be built to reach at-risk populations. The diversity of communities at risk necessitates the adoption of a multi-channel approach, with alerts being sent over different communication channels such as radio, television, social media, sirens, mobile networks, and satellite broadcast systems.

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[2] Global Status of Multi-Hazard Early Warning Systems 2024, see https://wmo.int/publication-series/global-status-of-multi-hazard-early-warning-systems-2024

[3] *Adapt Now: a global call for leadership on climate resilience*. Available at: https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/.

An inclusive, people-centered approach is required, utilizing existing community-based infrastructures and locally led feedback mechanisms to ensure that messages are understandable and actionable. In particular, effective EWS communication depends on the following elements:

- Warnings should reach every person at risk and all people should be covered by early warning information through local governments or national dissemination mechanisms.
- Risks should be understood, and messages should be clear, usable, and actionable.
- Countries should have updated registries of alerting authorities.
- Warnings should be disseminated in the common alerting protocol (CAP) format.

The proliferation of digital technologies offers unprecedented opportunities to strengthen the dissemination of EWS at scale. With 95 per cent of the global population covered by mobile networks and 8 out of 10 people owning mobile phones[4], these networks provide a powerful platform for disseminating alerts rapidly and effectively. While it is not sufficient in itself to provide actionable information to everyone, cell broadcast has emerged as an efficient and reliable solution for dissemination alerts through mobile networks.

Cell broadcast: Transformative technologies for saving lives

Cell broadcast (CB) is a proven technology capable of broadcasting text alerts to the large majority of devices in a specified geographic area. Compared to traditional or location-based SMS, CB is not affected by network congestion. It allows very high precision in geographic dissemination to target only those at-risk. It is important to note that the system benefits from numerous innovations to improve public warning systems. This includes, for example, enhancements in device-based geofencing, which improves the precision and effectiveness of the CB technology, which can achieve meter-level accuracy. These advancements improve public safety and optimize resource management. With new capabilities in mobile technologies and advanced handset functionalities, the technology will evolve. This ongoing innovation underscores the importance of investing in cell broadcast technology as a strategic, future-proof measure.

Key features of CB include:

- Geographic precision: CB sends alerts to mobile devices located within a specific geographic area, regardless of SIM activation. No advanced registration is necessary so visitors such as tourists can also receive cell broadcast warning messages, even without roaming service. The geographic precision also ensures that only those in the danger zone receive the alert, minimizing unnecessary panic among unaffected populations and strengthening trust in the system.

[4] See ITU Facts and Figures 2024: https://www.itu.int/itu-d/reports/statistics/facts-figures-2024/

- Real-time speed: Messages are delivered almost instantly, in a matter of seconds, regardless of network congestion. This is critical in emergencies where every second counts.
- Privacy-friendly: CB is a ‘blind’ technology that does not collect or store recipient data, making it a privacy-safe technology. This also means it cannot confirm how many people received the alert or track their responses, limiting situational awareness during disasters.
- Distinct alert tones and vibration cadence: CB uses a unique sound to grab attention as well as a distinct display, even if the phone is in silent mode, ensuring recipients immediately recognize the urgency of the message. This feature is particularly useful in noisy environments or when users may not be actively monitoring their phones. It is also important for people with visual or hearing impairment.
- Message display: Messages are displayed on the screen of the mobile phone without any user interaction and stay there until acknowledged by the user.
- Ease of use: Unlike app-based systems, CB does not require pre-installed software or user subscriptions, making them accessible to (almost) all mobile users with compatible handsets.
- Repeated broadcasting: CB messages can be set to broadcast repeatedly over a defined period, ensuring that handsets entering the target or at-risk area receive the message, even if they arrive after the initial alert is sent, and preventing handsets in the target area from receiving the alert multiple times.
- Authenticity: Unlike SMS, it is very difficult to fake a CB message, as only alerting authorities can send a message, increasing security, reliability, and trustworthiness.

Two main infrastructure components are required in the CB system: the cell broadcast centres (CBCs), which are typically located in the network of the mobile operator, and a cell broadcast entity (CBE), which is often based within the government domain or a trusted authority. The CBC is a standardized mobile network element mainly responsible for determining the set of cell sites from which the CB message should be broadcasted in a specific geographic area. The CBE is responsible for creating and formatting the CB messages before sending them to the CBC. The CBE can also receive alert messages from authorized alerting authorities and forward them to the CBC once the messages have been verified and validated.

Box 1: Cell broadcast integration to include other dissemination mechanisms in the public warning system

In a cell broadcast system, emergency alerts can be issued by multiple alerting authorities and the disaster management agencies (DMAs) through the cell broadcast entity (CBE) using the common alerting protocol (CAP) format. Alerts can then be disseminated in different languages and be received by end-users in their own language based on the device settings, increasing the accessibility and reach of the EWS. The cell broadcast centre (CBC) receives the emergency alerts from the CBE and based on the target area defined by the alerting authority in the alert message and the mobile network information related to the deployment of cell sites, sends the alert to the specific cell sites that provide coverage to the target area. Emergency alerts are then delivered to the screen of the mobile devices, alerting the end-user by a unique ringtone and vibration cadence. Since cell broadcast uses a different channel from commercial services (text, voice, and data) to send emergency alerts, messages are not affected by network congestion, reaching the end-user in near real-time.

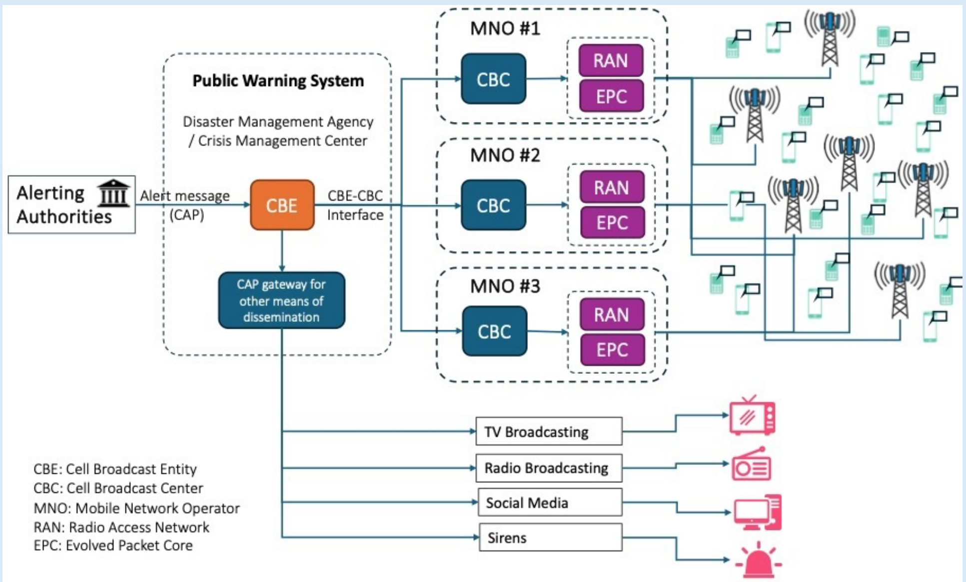

Figure: Illustrative diagram of CB integration in public warning system (Source: ITU)

In addition to emergency alerts disseminated through mobile networks using cell broadcast, a CAP gateway added to the CBE will allow other channels of dissemination to be added to the EWS, e.g., TV and radio broadcasting, social media, and sirens. This means that the CBE is converted to a public warning system with multiple channels of dissemination, not only mobile networks.

2. Global progress in implementing cell broadcast

By early 2025, approximately 45 countries, primarily developed and high-income economies, have implemented or are in the process of deploying CB. This means that despite the transformative potential of CB, the large majority of countries—particularly in the developing world—have yet to implement CB-based EWS. Expanding access to these technologies is a key priority for the EW4All initiative, particularly in developing countries where vulnerabilities are often greatest. While a number of countries use location-based SMS, CB is usually a preferred solution in particular as it does not risk network congestion challenges. In addition, SMS may not receive the needed attention of mobile phone owners as they are not delivered with a distinctive sound and vibration cadence linked to alerts and are often used for commercial purposes.

In terms of technical advancement, CB standards were established over 20 years ago, spearheaded by the 3rd Generation Partnership Project (3GPP) and building on earlier standards set by the European Telecommunications Standards Institute (ETSI)[5]. These standards define the functionality and implementation requirements. Since 2012, CB has been standardized in mainstream devices, with Apple iOS and Android (from Android 11 onwards) supporting CB functionality by default.

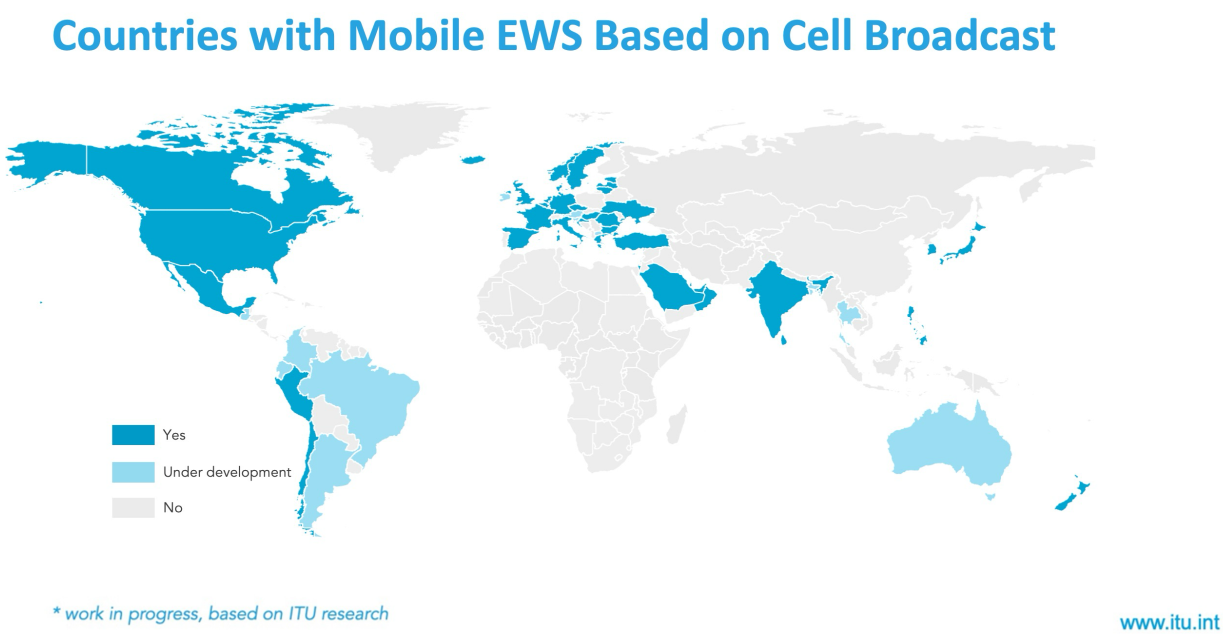

Figure 1: Countries with mobile EWS based on cell broadcast (Source: ITU research)[6]

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[5] ETSI TS 123 041 V18.6.0 (2024-10) Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Technical realization of Cell Broadcast Service (CBS) (3GPP TS 23.041 version 18.6.0 Release 18)

[6] *Note to Figure 1: The designations employed and presentation of material in this publication, including maps, do not imply the expression of any opinion whatsoever on the part of ITU concerning the legal status of any country, territory, city or area, or concerning the delimitations of its frontiers or boundaries.*

3. Barriers to adopting

Cell broadcast technology is not a novel innovation. Instead, it is a well-established and mature technology that has been in existence for over two decades. CB has been adopted in many countries, particularly in many high-income economies, where its potential to enhance efficiency and scalability is well recognized. However, the scaling up of CB implementation is hindered by a range of barriers, including the lack of governance and partnerships, financial constraints, and technical challenges.

While these barriers are global in nature, they tend to manifest differently depending on the context: low- and middle-income countries often face challenges related to financing, institutional capacity, and infrastructure gaps, whereas high-income countries may be held back by policy fragmentation, risk perception, or regulatory inertia.

3.1 Lack of awareness

A significant barrier to the widespread adoption and effective implementation of CB is the limited understanding among policymakers, emergency managers, and other key stakeholders regarding the unique capabilities and advantages of CB. This knowledge gap can hinder informed decision-making and result in insufficient funding allocation or missed opportunities to deploy CB as part of an integrated emergency communication strategy. Although CB technology has been available for decades in many countries, its adoption has been uneven. In some regions, stakeholders still equate CB with traditional communication methods, such as SMS, without recognizing its distinctive features and advantages.

Recommendations:

- Conduct targeted awareness campaigns, workshops, and training sessions to educate policymakers, emergency managers, meteorological offices, and other stakeholders about CB.
- Share examples of successful CB implementations, particularly in disaster-prone countries, to showcase their effectiveness in real-world scenarios.
- Include CB technology as part of broader training and capacity-building efforts for disaster risk reduction.

3.2 Governance

Strong and effective governance is essential for the successful implementation and operation of CB systems. A designated government authority, such as a disaster management authority or civil protection agency, must take the lead to ensure clear direction and accountability in the governance of the CBE and the CBC. However, governance issues often arise from fragmented responsibilities, competing priorities, and inadequate coordination among stakeholders. In many cases, overlapping mandates between agencies, unclear boundaries, or competing agendas result in inefficiencies and delays. Additionally, a lack of political commitment or insufficient alignment with national disaster risk reduction (DRR) priorities can further undermine CB implementation.

Recommendations:

- Strong governance frameworks should extend beyond technical coordination to institutionalize CB systems within national DRR strategies and multi-hazard early warning architectures, to provide a sustainable foundation for long-term operation.
- Conduct stakeholder mapping to clarify roles and responsibilities early in the planning process. Clearly defining responsibilities across government agencies, including meteorological agencies and regulators, but also mobile network operators (MNOs), and other stakeholders will help establish a common understanding and reduce potential conflicts.
- Promote inter-agency collaboration by establishing a joint task force and shared objectives.
- Secure high-level political support for CB systems. Advocacy efforts can help build the political will necessary for sustained prioritization and funding.
- Provide targeted training and resources to equip government officials, MNOs, and other stakeholders with the technical and operational knowledge required for effective CB governance and collaboration.

3.3 Working with mobile network operators

The successful implementation of CB systems depends on the cooperation of and with mobile network operators (MNOs). Many of the cell broadcast systems already in place demonstrate successful partnerships between MNOs and governments. However, the absence of clear-defined cooperation frameworks or financial incentives can pose challenges. Governments must create frameworks to encourage collaboration through financial support, legal mandates, and open dialogue.

Regulations play a crucial role in ensuring EWS are implemented effectively. While necessary, regulations should be accompanied by discussions with MNOs to address financial implications and operational concerns. Beyond saving lives and delivering humanitarian assistance, governments can explore other financial and non-financial incentives to foster cooperation, for example by providing or identifying funding to support the set up and operational costs of a CB system.

It is also essential to respect the confidentiality of MNOs' network information when working with them, such as the deployment of cell sites, to maintain competitive integrity.

Recommendations:

- Foster regular engagement between public authorities and MNOs to build trust and alignment, ensuring that public and private sector goals are mutually reinforced.

- Address data security and operational risks through transparent agreements that define roles, responsibilities, and protocols.

3.4 Cost and funding

Funding remains a critical challenge for implementing CB systems. The costs associated with a CB system include both the initial investment and ongoing operational and maintenance expenses.

The initial investment is influenced by various factors, such as the number of mobile operators and networks involved (e.g., 2G, 3G, 4G, 5G and future technologies), the type of system architecture (centralized or decentralized cell broadcast centre), the network size, existing infrastructure, and the specific system configuration. Operational costs encompass activities such as capacity building, public sensitization campaigns, and routine system maintenance. These factors result in considerable variation in costs across countries, depending on technical choices, the technical maturity of MNOs, and the local context.

Despite these costs, CB systems offer substantial returns on investment, particularly in disaster-prone regions. Research indicates that EWS, including CB systems, can generate returns up to ten times their cost by mitigating disaster impacts[7].

Recommendations:

- Explore available innovative financing options, especially for low- and middle-income countries, leverage international donor funding and support from development finance institutions.
- Utilize creative financing mechanisms, including Universal Service Funds, reduced licensing fees, and in-kind contributions, such as access to MNO infrastructure, to reduce costs.
- Ensure long-term sustainability by planning for ongoing costs, including system operation, maintenance, repair, and upgrades, to maintain functionality over time.

3.5 Mobile access and inclusivity

According to ITU statistics, by 2024, 97.9 per cent of the global population is covered by mobile networks, with 95 per cent having access to 3G or higher mobile technologies and 80 per cent of the world's population owns a mobile phone[8]. These figures highlight the extensive reach of mobile technology and its potential for disseminating emergency alerts using CB.

However, disparities persist, particularly in rural or underserved areas, which significantly reduces the effectiveness of CB systems. Additionally, systemic inequalities in digital access

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[7] *Adapt Now: a global call for leadership on climate resilience*. Available at: https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/.
[8] ITU Facts and Figures 2024: https://www.itu.int/itu-d/reports/statistics/facts-figures-2024/

and use exacerbate these challenges, leaving vulnerable populations at greater risk. In addition, non-technological barriers such as low literacy levels, language barriers, gender disparities, and the marginalization of people living in informal settlements or geographically isolated regions also affect whether alerts are received, understood, trusted, and acted upon. Bridging these gaps is crucial to improving the reach and effectiveness of CB systems.

At the same time, in addition to the traditional use of cell broadcast, new satellite services are in development, being tested and some already used, which allow satellites to communicate directly with mobile phones. Known as direct-to-device services (D2D), these technological breakthroughs mark an important milestone in bridging the digital gap and improving early warning systems with ubiquitous satellite services as they effectively complement mobile access beyond the limits of terrestrial networks. First, they extend their reach to underserved, remote, and rural areas, effectively ending the struggle to cover geographic areas traditionally not accessible. They also provide back-up services when terrestrial services are disrupted, due, for example, to natural hazards. The objective is that people at risk will eventually be able to use the service without extra equipment or change to their handsets, and that D2D will complement cell broadcast. An advantage of countries that have cell broadcast and then integrate D2D is that citizens will already be used to receiving alerts directly to their phone. While the technology behind the new service is new and based on innovative developments, their adoption will therefore not require any additional efforts.

It is also important to note that mobile coverage statistics alone do not guarantee universal access to emergency alerts. Factors such as device compatibility, user literacy, language barriers, and network reliability during disasters influence CB effectiveness. The design of CB systems must therefore account for the diverse realities of end users, including people with limited literacy, speakers of minority languages, persons with disabilities, and those living in informal settlements or remote regions.

To ensure inclusive communication, a multi-channel approach is critical, and CB systems must be used alongside other communication channels to address diverse population needs. Since CB systems rely on text-based alerts, it is important to supplement them with alternative formats such as voice messages. For example, Cambodia's EWS 1294 system uses mobile networks to deliver alerts through recorded voice calls. Complementary methods, such as community radio, loudspeakers, or sirens, can help fill gaps for those without mobile phones or reliable coverage, and reinforce the warning message. Furthermore, community-based feedback mechanisms should be established to ensure that warning messages are understood, culturally appropriate, and trusted by local populations. Local knowledge systems and existing social infrastructures must be recognized and leveraged to shape how warnings are received and acted upon.

Beyond technical access, an effective warning system must also ensure that recipients understand the alert and know how to respond appropriately. Public education, awareness campaigns, and community engagement are essential to ensure that alerts translate into protective actions. Strengthening preparedness and trust, especially through locally tailored communication, is critical to closing the gap between alert delivery and real-world impact.

Recommendation:

- Assess digital coverage and access and invest in expanding mobile network infrastructure, particularly in rural and remote regions, to close coverage gaps and extend CB reach.
- Invest in innovative technologies, such as satellite based early warning systems that complement terrestrial services and overcome important barriers.
- Integrate CB with complementary channels, such as community radio or sirens, to ensure that alerts reach everyone, including those without mobile phones. Systems should be tailored to the realities of people with limited literacy, speakers of minority languages, people living in informal settlements, and other marginalized groups.
- Implement programmes to make mobile phones and data plans more affordable, promote digital literacy, and support initiatives that target vulnerable groups.
- Establish community-based feedback mechanisms to validate the accessibility, clarity, and trustworthiness of alerts, leveraging local knowledge and strengthening social infrastructure for more resilient early warning systems.

3.6 Handset compatibility

Since 2012, CB functionality has been standardized in mainstream devices, with Apple iOS and Android (from Android 11 onwards) supporting CB by default. In markets with a high proportion of older devices, handset compatibility still poses a challenge. As mobile handsets are gradually replaced with modern, compatible devices, this issue will diminish over time.

Another challenge is that CB functionality is not always activated by default on compatible devices. In some cases, users may need to manually enable CB settings, but many are unaware of this requirement. Additionally, excessive, or inappropriate use of CB, such as for commercial purposes, can lead to user fatigue and opt-outs, limiting the system's effectiveness.

Recommendations:

- Analyse the mobile handset landscape in each country to assess compatibility challenges before implementation.
- Advocate for handset manufacturers to include CB functionality by default and ensure it is activated at purchase.
- Support public awareness campaigns to educate populations about the importance of opting in to CB alerts.
- Collaborate with handset manufacturers and governments to standardize CB settings and improve user accessibility.
- Commercial use of CB should be prohibited.

3.7 Security and trust

Ensuring the security and trustworthiness of the CB system is critical to maintaining public confidence in emergency alerting. Security measures for the CB system must be required by the government for the different stakeholders involved. For example, secure connections between the alerting authorities and the CBE, and between the CBE and the CBC, i.e., virtual private network (VPN) connections. Anyone with authorization to access the system (e.g., alerting authorities when creating and issuing emergency alerts) must have a valid username and password. In addition, both CBE and CBC should have end-to-end encryption and firewalls to prevent unauthorized access, malicious software and cyberattacks. All setup and failed or successful connection attempts to the CBE and the CBC must be logged.

Another key aspect of maintaining public trust in CB is preventing misinformation and unauthorized alerts. Strict protocols must govern how alerts are issued, with role-based access controls ensuring that only designated personnel can create and disseminate messages. Regular training for alerting authorities on cybersecurity best practices, along with public transparency about security measures, can further reinforce trust in the system.

Recommendations:

1. Establish mandatory secure connections (e.g., VPN) between alerting authorities, CBE, and CBC to protect data integrity.
2. Implement end-to-end encryption and firewalls to safeguard against cyber threats.
3. Conduct regular security audits and penetration testing to identify vulnerabilities.
4. Maintain comprehensive logging and real-time monitoring of all system access attempts.
5. Develop clear protocols for issuing alerts to prevent misinformation and unauthorized messages.

4. Enabling mechanisms in scaling cell broadcast

Scaling cell broadcast systems for mobile-based early warning services requires enabling mechanisms that address existing gaps and challenges in their implementation. These mechanisms are essential for overcoming regulatory, technical, and financial barriers while fostering collaboration between governments, MNOs, international organizations, and other stakeholders.

4.1 Regulatory approach

Regulation plays a pivotal role in enabling the implementation of CB. These systems require public alerting authorities to collaborate with MNOs to utilize existing mobile networks for disseminating alerts. Many examples from across the world highlight that a regulatory approach speeds up the process and facilitates negotiations between the public and private sector stakeholders. Clear regulation and the identification of specific use cases protect mobile network operators by clearly identifying which kinds of messages they are to send over their networks.

Regulatory measures have been credited with introducing EWS in countries previously lacking such systems, increasing their coverage and impact. Additionally, incorporating technical specifications into regulations ensures consistency, overcoming historical technical challenges associated with CB implementation.

However, in some instances, regulations may leave room for interpretation, leading to prolonged negotiations and delays in deployment. Clear, actionable policies are needed to prevent these obstacles and ensure swift and effective implementation.

Countries with established EWS regulations must foster active engagement among all stakeholders to implement systems that meet regulatory requirements and deliver timely and effective alerts. In cases where no such regulations exist, MNOs and governments should proactively collaborate to design systems tailored to their unique contexts and needs. Additionally, to address compatibility challenges, regulations should encourage handset manufacturers to prioritize CB capabilities, ensuring that all devices are equipped to support emergency warning systems effectively.

Box 2: Regulatory approaches in the European Union, United States of America, and Chile

The European Union established a specific date, 21 June 2022,[1] by which all Member States were to ensure that public warnings were transmitted by mobile network operators to all end-users concerned. While the regulation did not mention a specific technology (such as cell broadcast or location-based SMS), experience suggests that only CB and LB-SMS have the capacity to effectively reach a very large percentage of end-users across the EU. Currently, 11 EU countries have deployed cell broadcast, 7 have deployed location-based SMS, 4 have deployed both, and 5 are in the process of deploying either of those two technologies.[2] The EU-Alert system is designed to be interoperable across Member States.

Other countries outside the EU have also decided to implement alert dissemination mechanisms through mobile networks by implementing specific requirements in their regulations. For example, the United States implemented the Wireless Emergency Alert (WEA) system which is based on cell broadcast technology since alert messages are broadcast through mobile networks to the end-users' mobile devices. Although participation of mobile operators in the WEA system is voluntary, all major operators form part of the system and comply with specific technical requirements provide in the regulatory framework.

In Chile, after the devastating earthquake/tsunami that took place on February 2010, the government decided to use regulation to provide early warnings more effectively. Among those, it required mobile providers to deploy cell broadcast, mainly the cell broadcast centre and send emergency messages for free, while the government funded the cell broadcast entity (CBE). The system was launched in 2012 as part of the emergency alert system (SAE), including a unified central platform managed (CBE) by the disaster management authority to issue cell broadcast alert messages. In addition, all mobile phones sold in Chile are required to comply with the SAE system, i.e., capable of receiving alert messages through cell broadcast.

Regulatory provisions generally also include specific requirements to issue alerts. Among those is the responsible use of the alerting system, banning uses that do not comply with the aim of the EAS such as delivering political messages and for commercial use, which can annoy end-users that decide to opt-out to stop receiving commercial messages, and therefore emergency alerts as well. EWS based on mobile networks shall be used only to deliver emergency alert messages that comply with the specific requirements to deliver such messages.

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[1] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972

[2] EENA (2024) Public Warning Report Card.

4.2 Cost-saving options

Implementing CB systems can be financially demanding, but several cost-saving strategies can make deployment more accessible:

- Cloud-based systems: Hosting the cell broadcast entity (CBE) on cloud platforms can significantly reduce costs related to physical infrastructure, hardware, maintenance, and server space. Investment is required for cloud-hosting.
- Centralized system: In a centralized system, a single CBC connects to multiple MNO networks, unlike a decentralized system where each MNO maintains its own CBC within their network. This approach can lead to significant upfront cost savings, as only one CBC is required instead of three or four, depending on the number of MNOs. However, centralized systems can raise concerns among MNOs, as they necessitate opening their networks at a common access point, which to some MNOs is perceived as a security risk. Consequently, there are very few instances of MNOs opting for centralized systems despite their potential cost benefits.
- Regional and multi-country systems: Sharing an EWS across multiple countries in a region, rather than maintaining separate national systems, can reduce infrastructure costs and offer economies of scale. Regional systems also open the door to discounted rates with technology vendors and service providers. Importantly, governance decisions in such systems remain under the jurisdiction of individual countries, ensuring sovereignty over the dissemination of alerts.

An example of a cost-saving option is being explored by the Climate Risk and Early Warning Systems (CREWS) initiative, in collaboration with ITU and the World Bank, to create a regional cloud-based CB for Member States of the Eastern Caribbean Telecommunications Authority (ECTEL).

Beyond technical strategies, it is essential to emphasize the importance of avoiding redundancies and ensuring a coherent, complementary early warning landscape. In scaling up cell broadcast, countries are encouraged to leverage existing mobile network infrastructures, integrate cell broadcast within their existing multi-channel alert systems rather than creating parallel structures, explore partnerships with the private sector, and pursue regional and international collaboration. Together, these approaches can significantly reduce both implementation and operational costs while strengthening the overall resilience and effectiveness of early warning systems.

4.3 Common alerting protocol

The common alerting protocol (CAP) is the international standard format for emergency alerting and public warning.

CAP plays a critical role in ensuring the effectiveness and interoperability of CB for EWS. By adopting CAP as a standardized methodology, countries can enable seamless integration across multiple communication channels, ensuring timely and consistent public alerts. CAP enables the timely, clear, and actionable dissemination of warnings - critical for saving lives and reducing disaster impacts. CAP simplifies CB implementation by providing a uniform format that can be easily integrated into diverse alerting systems.

Currently, hydro-meteorological services have developed CAP capacity in 119 countries, though consistent use remains a challenge. Designating official alerting authorities is essential to maintaining a structured and reliable warning system, preventing misinformation and delays.

Moreover, the long-term sustainability of CAP use requires institutional commitment, capacity building, and technological support. Advances in digital infrastructure and cloud-based solutions can further enhance CAP implementation, enabling real-time dissemination, automation, and continuous improvement of early warning capabilities globally.

4.4 International initiatives and cooperation

International initiatives and donor-supported programmes play a crucial role in advancing cell broadcast and other mobile-based EWS.

Comprehensive approach to strengthening the early warning value chain

International initiatives such as Early Warnings for All (EW4All) are taking a comprehensive approach to strengthening the entire early warning value chain. The success and effectiveness of tools like cell broadcast, as well as the broader implementation of EW4All Pillar 3 — focused on warning, dissemination, and communication — are closely tied to the strength of the other three pillars: risk knowledge; hazard detection, observation, monitoring, analysis, and forecasting; and preparedness to respond. A coordinated and holistic effort across all four pillars is essential to ensure that early warning systems are truly effective in protecting communities at risk.

Awareness-raising campaigns

The Action Plan for the UN EW4All Initiative underscores the importance of integrating geo-located mobile-based early warning services, such as CB and location-based SMS, into global disaster risk reduction strategies. These technologies are identified as critical components of effective warning dissemination and communication systems, ensuring timely alerts reach those most at risk.

In collaboration with global partners, ITU actively promotes awareness and knowledge-sharing about the potential of mobile networks and services for early warnings. ITU emphasizes the value of leveraging mobile technology EWS, highlighting best practices from countries like those in the European Union (EU), where comprehensive regulatory frameworks have facilitated widespread adoption. Additionally, ITU advocates for national governments to establish regulatory obligations requiring MNOs to support EWS while also providing the necessary incentives to encourage their deployment.

Working with MNOs

During COP28, ITU, together with GSMA launched the call to action to support the EW4All Initiative and deploy mobile-enabled EWS, leveraging cell broadcast and location-based SMS technologies. As the mobile industry has played a leading role in the deployment of EWS, many MNOs, including VEON, KDDI, Globe, Safaricom, Telefonica, MTN, and Axiata Group immediately joined. Telecom Italia, Telenor, Telstra, and Vodafone recently joined, with more continuing to come on board. This demonstrates the commitment of the mobile industry and the power of digital connectivity to save lives.

Calling for financial investment for EWS

The EW4All initiative recognizes that financial investment is critical to scaling EWS infrastructure and ensuring its sustainability[9]. The initiative focuses on coordinating and scaling up existing mechanisms, such as the Green Climate Fund (GCF), the Climate Risk and Early Warning Systems (CREWS), and the Systematic Observations Financing Facility (SOFF). Additionally, international financial institutions, multilateral development banks, and the private sector presents opportunities for further investment, particularly in supporting nationally led MHEWS plans. Coordinated financial efforts are essential for ensuring the long-term viability of early warning systems worldwide.

5. Priority recommendations for scaling cell broadcast

To successfully implement cell broadcast, the following recommendations should be prioritized as foundational steps:

1. Mandate CB through national regulations:
    - Governments should enact laws requiring MNOs to implement CB systems, with clear technical standards and timelines.
    - Align regulations with CAP to ensure interoperability across channels (e.g., mobile, radio, TV, social media).
2. Establish multi-stakeholder governance frameworks:
    - Designate a lead agency (e.g., disaster management authority) to coordinate CB implementation, ensuring accountability across ministries, MNOs, and civil society.
    - Create public-private task forces to address technical, financial, and operational challenges collaboratively.
3. Unlock innovative financing mechanisms:
    - Mobilize climate adaptation funds (e.g., Green Climate Fund, CREWS) and repurpose universal service funds to subsidize CB infrastructure in low-income countries.
    - Pilot cost-sharing models between governments, MNOs, and international donors to reduce upfront deployment costs.

[9] See Global Observatory for Early Warning System Investments systematically tag and track investment in EWS, see https://earlywarningsforall.org/site/early-warnings-all/global-observatory-ews-investments

4. Launch global awareness and capacity-building campaigns:
    - Educate policymakers and communities on CB benefits through workshops, case studies, and partnerships with organizations such as ITU and GSMA.
    - Train emergency managers and MNO technicians on CB system operation, cybersecurity, and public communication protocols.
5. Strengthen regional and international collaboration:
    - Develop shared CB infrastructure (e.g., regional cloud-based systems) to reduce costs and streamline cross-border alerts.
    - Leverage key international summits and high-level meetings to align policies, share best practices, and elevate cell broadcast as a priority in climate resilience agendas.

Conclusion

The EW4All initiative has been instrumental in driving political momentum and forging partnerships to accelerate progress on MHEWS. To sustain this momentum, it is essential to continue scaling up the reach of the initiative by strengthening collaboration across sectors and reinforcing national leadership.

Effective MHEWS requires a comprehensive approach that considers the entire value chain—from risk knowledge, hazard detection, to warning dissemination and community action. Within this framework, CB technology emerges as a critical tool in strengthening MHEWS by ensuring that timely, clear, and actionable warnings reach those at risk. By safeguarding lives, livelihoods, and infrastructure, CB not only enhances resilience but also supports informed decision-making that promotes recovery and strengthens disaster risk management, helping communities build back better in the face of growing climate and disaster risks.

Despite its potential, barriers such as fragmented governance, funding gaps, technical disparities, and limited stakeholder awareness continue to slow CB adoption. However, these challenges can be overcome. With its ability to mobilize resources and align policies, the G20 is uniquely positioned to accelerate global CB deployment. By championing key enablers - including harmonized regulatory frameworks, innovative financing models, and technology transfer programmes - the G20 can drive progress, particularly in developing nations, where climate risks are most severe.

The roadmap outlined in this paper—focused on partnerships, standardized protocols like CAP, and multi-channel integration—provides a clear, actionable blueprint for achieving universal early warning coverage by 2027. As climate disasters intensify, the cost of inaction far outweighs the investment required. Through collective commitment, the G20 can scale up CB technology globally, ensuring that no community is left behind in the race against climate-driven threats.

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