G20 Disaster Risk Reduction Working Group
PRIORITY 2: Global Coverage of Early Warning Systems
DELIVERABLE 2

Scaling Up Cell Broadcast for last-mile Early Warnings Delivery: Progress, Barriers, and Enabling Mechanisms

G20 DRR input paper prepared by ITU

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List of Acronym

3GPP	The 3rd Generation Partnership Project
CAP	Common Alerting Protocol
CB	Cell Broadcast
CBC	Cell Broadcast Center
CBE	Cell Broadcast Entity
COP28	The 28th 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 offer 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. 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 protection 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 it to analyzes the state of CB implementation, to identifies barriers to global scale-up, and to proposes actionable pathways to accelerate its adoption.

The paper highlights that despite its recognized benefits, CB adoption remains uneven, with only about 43 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. While 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% of the global population and mobile phone ownership reaching 80%, 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 climate disasters. This paper underscores that scaling up CB adoption is not merely a technical solution but a collective commitment to equity, resilience, and global solidarity.

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 Systems (MHEWS) capacities, when compared to 2015, and with the greatest increases experienced in Least Developed Countries (LDCs), Landlocked Developing LLDCS), and Small Island Developing States (SIDS)[1] reach. Only 45 countries have EWS leveraging mobile channels using technologies like cell broadcast or SMS).

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 is 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.[2]

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

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

[2] *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/.

such as radio, television, social media, sirens, mobile networks, and satellite broadcast systems.

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 and usable.
- 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 percent of the global population covered by mobile networks and 8 out of 10 people owning mobile phones[3], 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 network.

Cell Broadcast: Transformative Technologies for Saving Lives

Cell Broadcast (CB) is a proven technology capable of broadcasting text alerts to all devices in a specified geographic area. Compared to traditional SMS, CB is not affected by network congestion while allowing very high precision in geographic dissemination.

Key features of CB include:

- Geographic Precision: CB sends alerts to all mobile devices located within a specific geographic area, regardless of SIM activation. No advance registration is necessary so visitors such as tourists will 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.
- 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.

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

- Privacy-Friendly: CB does not collect or store recipient data, making it a privacy-safe technology. However, 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 on "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 stays there until is acknowledged by the user.
- Ease of Use: Unlike app-based systems, CB do 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, ensuring reliability and trustworthiness.

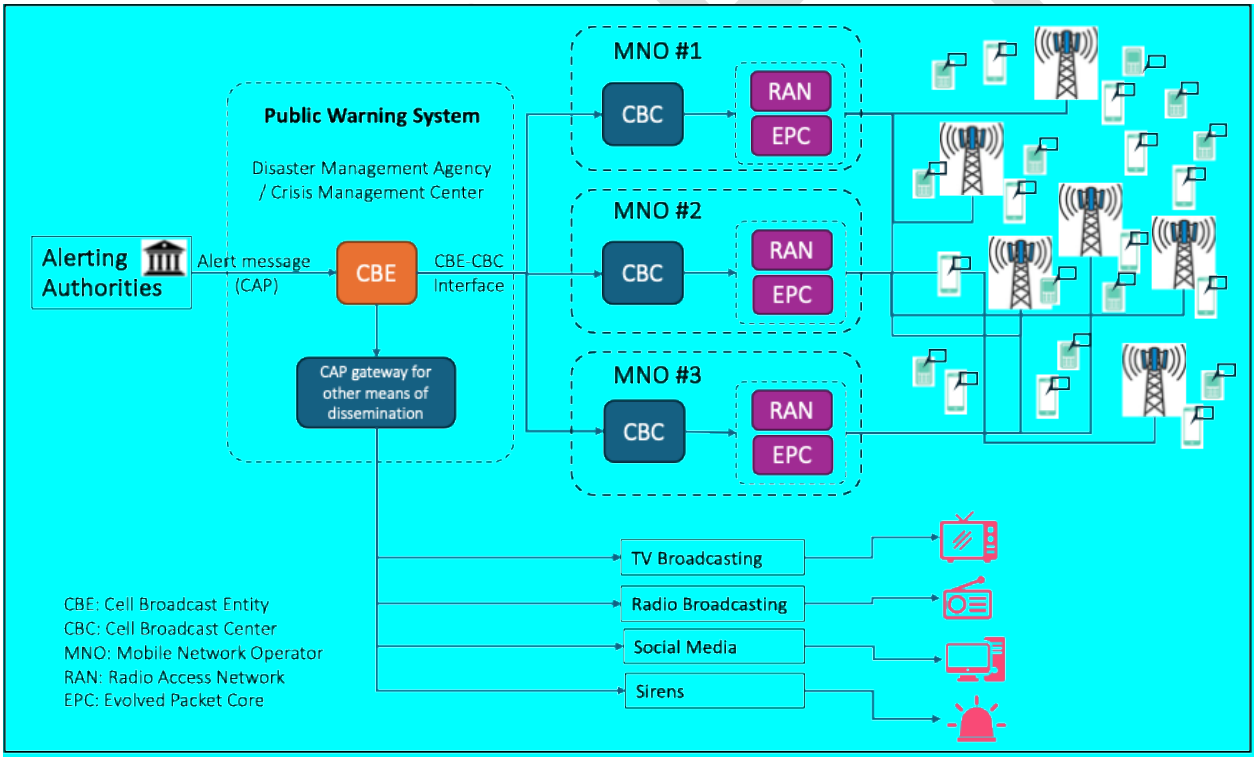
Two main infrastructure components are required in the CB system: the Cell Broadcast Centers (CBCs), which are typically located in the network of the mobile operator, and the Cell Broadcast Entity (CBE), which is often based within the government domain or a trusted authority. The CBC is a standardized mobile network element mainly responsible of determining the set of cell sites from which the CB message should be broadcasted in a specific geographic area, while 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.

Box 1: Cell Broadcast integration to include other dissemination mechanisms in the Public Warning System

In a Cell Broadcast system, emergency alerts are issued by multiple Alerting Authorities and the Disaster Management Agencies (DMA) through the Cell Broadcast Entity (CBE) using Common Alerting Protocol (CAP) format. Alerts can then be disseminated in different languages and be received by the end-user in their own language based on the device's

settings, increasing the accessibility and reach of the EWS. The Cell Broadcast Center (CBC) receives the emergency alerts form the CBE, and based on the target area defined by the Alerting Authority in the alert message and the mobile network's 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.

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.



Source: ITU

1. Global Progress in implementing Cell Broadcast

By early 2025, approximately 43 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)[4]. These standards define the technology's 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.

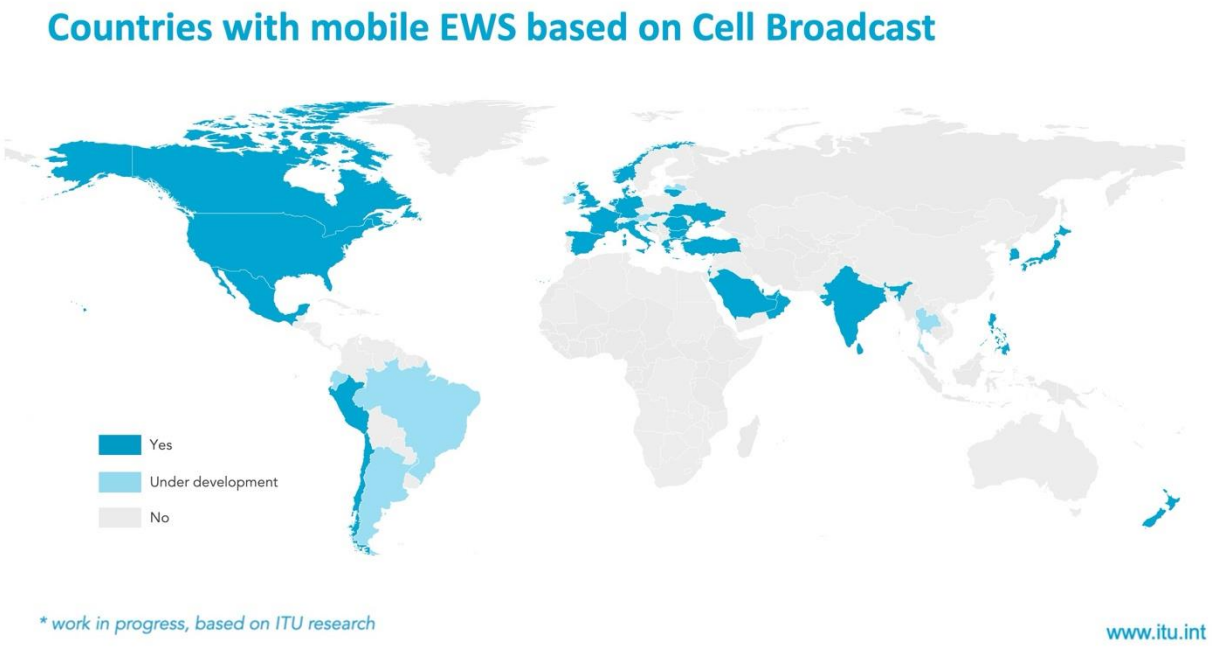


Figure 1: Countries with mobile EWS based on CellBroadcast Source: ITU research

[4] 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)

2. Barriers for 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 the high-income ones, 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 governance, partnerships, financial constraints, and technical challenges:

2.1 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 CB's unique capabilities and advantages. 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.

Recommendations:

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

2.2 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:

- Conduct stakeholder mapping to clarify roles and responsibilities early in the planning process. Clearly defining responsibilities across government agencies, regulators, MNOs, and other stakeholders will help establish a common understanding and reduce potential conflicts.
- Promote inter-agency collaboration by establishing joint task forces and shared objectives.
- Secure high-level political support for CB systems. Advocacy efforts can help build the political will necessary for sustained funding and prioritization.
- 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.

2.3 Working with Mobile Network Operators

The successful implementation of CB systems requires the cooperation of mobile network operators (MNOs). Many of cell broadcast systems already in place demonstrate successful partnerships between MNOs and governments. However, the absence of clear-defined cooperation framework 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 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 concerns about data security and operational risks through transparent agreements that define roles, responsibilities, and protocols.

2.4 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 networks involved (e.g., 2G, 3G, 4G, 5G and future technologies), the type of system architecture (centralized or decentralized Cell Broadcast Center), 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[5].

Recommendations:

- Explore diverse 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.

2.5 Mobile coverage and mobile ownership

According to ITU statistics, by 2024, 97.9% of the global population will be covered by mobile networks, with 95% having access to 3G or higher mobile technologies, and 80% owning a mobile phone[6]. 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 exacerbate these challenges, leaving vulnerable populations at greater risk. Bridging the digital gaps is important, in this case, to improve the reach of CB system.

[5] *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/.

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

At the same time, 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 also influence CB effectiveness.

To ensure inclusive communication, CB systems must be used alongside other communication channels to address diverse population needs. Complementary methods, such as community radio, loudspeakers, or sirens, can help fill gaps for those without mobile phones or reliable coverage.

Recommendation:

- Invest in expanding mobile network infrastructure, particularly in rural and remote regions, to close coverage gaps and extend CB's reach.
- Integrate CB with complementary channels, such as community radio or sirens, to ensure that alerts reach everyone, including those without mobile phones.
- Implement programs to make mobile phones and data plans more affordable, promote digital literacy, and support initiatives that target vulnerable groups.

2.6 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 outdated devices, handset compatibility still poses a challenge. Nevertheless, as mobile handsets are gradually replaced with modern, compatible devices, this issue should diminish over time.

Another challenge is that CB functionality is not always activated by default on compatible devices. 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:

- Analyze 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.

2.7 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 Cell Broadcast system must be required by the government to the different stakeholders involved.

For example, secure connections between the Alerting Authorities and the CBE, and between the CBE and the CBC, i.e., 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 from 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:

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

3. Enabling mechanisms in Scaling CB

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.

3.1 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.

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 EU, US, and Chile

The European Union established a specific date, 21 June 2022,[1] in which all Member States shall ensure that public warnings are transmitted by mobile network operators to the end-users concerned, whether Cell Broadcast or Location-Based SMS. Such provision was based on the mobile service coverage and capacity to effectively reach end-users across the EU above other mechanisms of dissemination. 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.[1]

Other countries 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 broadcasted 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 implement a number of regulations to provide early warnings more effectively. Among those, it required mobile providers to deploy Cell Broadcast, mainly the Cell Broadcast Center 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 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.

3.2 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. However, 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 raise concerns among MNOs, as they necessitate opening their networks at a common access point, which is perceived as a security risk. Consequently, there are very few instances of MNOs opting for centralized systems despite the 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 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 Eastern Caribbean Telecommunications Authority (ECTEL).

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 programs play a crucial role in advancing Cell Broadcast and other mobile-based EWS.

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.

The International Telecommunication Union (ITU), in collaboration with global partners, 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. Telcom 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 also recognizes that financial investment is critical to scaling EWS infrastructure and ensuring its sustainability[7]. 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, 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.

4. Priority Recommendations for Scaling Cell Broadcast

To successfully implement the 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 the 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.
4. Launch Global Awareness and Capacity-Building Campaigns
    - Educate policymakers and communities on CB's benefits through workshops, case studies, and partnerships with organizations like ITU and GSMA.

[7] 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

- 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

6. 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 programs—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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