

# **ETWS Primary Notification**

## **version 2**

Vodafone Group Plc  
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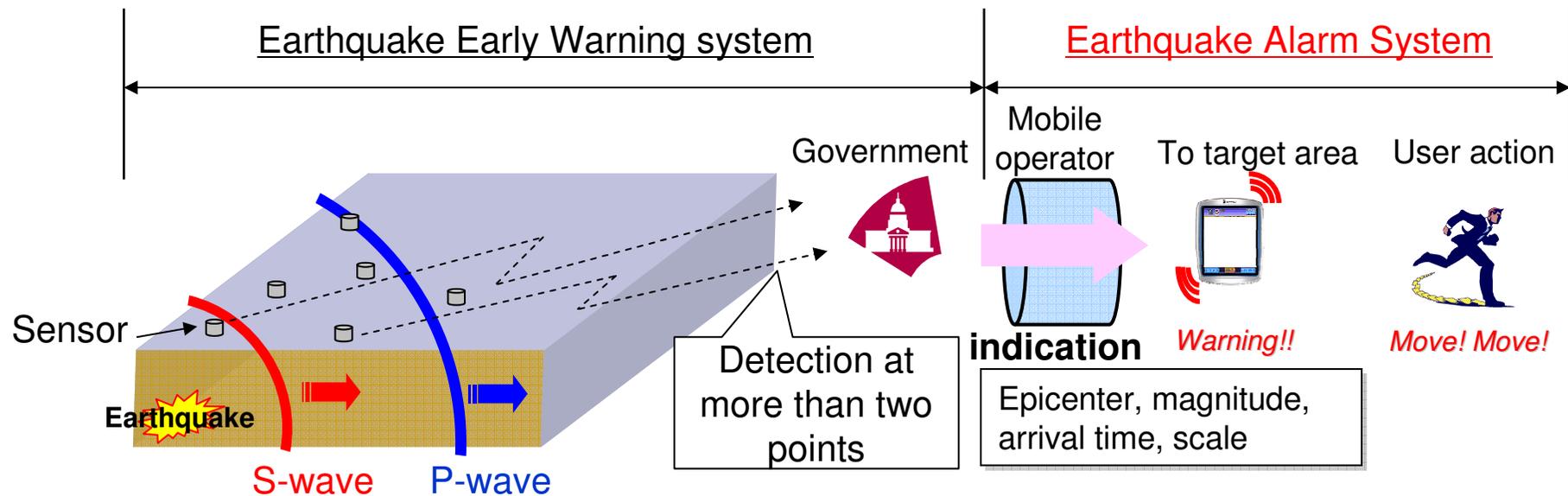
## Contribution Overview

- ETWS requirements were derived from the description in TS 22.968 Annex B
- This contribution gives a short summary of TS 22.968 Annex B
  - How the Primary Notification duration was derived
  - and the amount of information to convey in the Primary Notification
- CBS solution proposal for GERAN



# Earthquakes Overview

- Two types of waves are produced when an earthquake happens
  - Primary wave (P-wave)
  - Secondary wave (S-wave)
- Existing early warning system in Japan relies on the detection of the P-wave
- Once detected, the earthquake alarm system is triggered, notifying the impacted areas well before the S-wave arrives



## Derivation of the 4 seconds ETWS primary notification requirement

- P-Wave: little destructive force, travels at 7 km/sec
- S-Wave: major destructive force, travels at 4 km/sec
- Distance from epicentre to the area nearest to the epicentre in disaster areas can range from 10-50 km
- => arrival time interval at the area between Primary wave and Secondary wave is about 3-17 seconds
- It takes 5 seconds for the earthquake detection system to send Earthquake Early Warning information to a mobile operator
- It takes 2-3 seconds for users to take safety measures

Therefore, it is ideal to shorten the PWS delivery time to the order of seconds, not minutes



## Derivation of the 4 seconds requirement (cont..)

- Based on example scenario in Japan
- 2004 Chuetsu earthquake because it is the most recent inland earthquake
- Depth of epicentre is 13km
- Calculate a propagation distance of S-wave between the epicentre and a sensor:  $D$

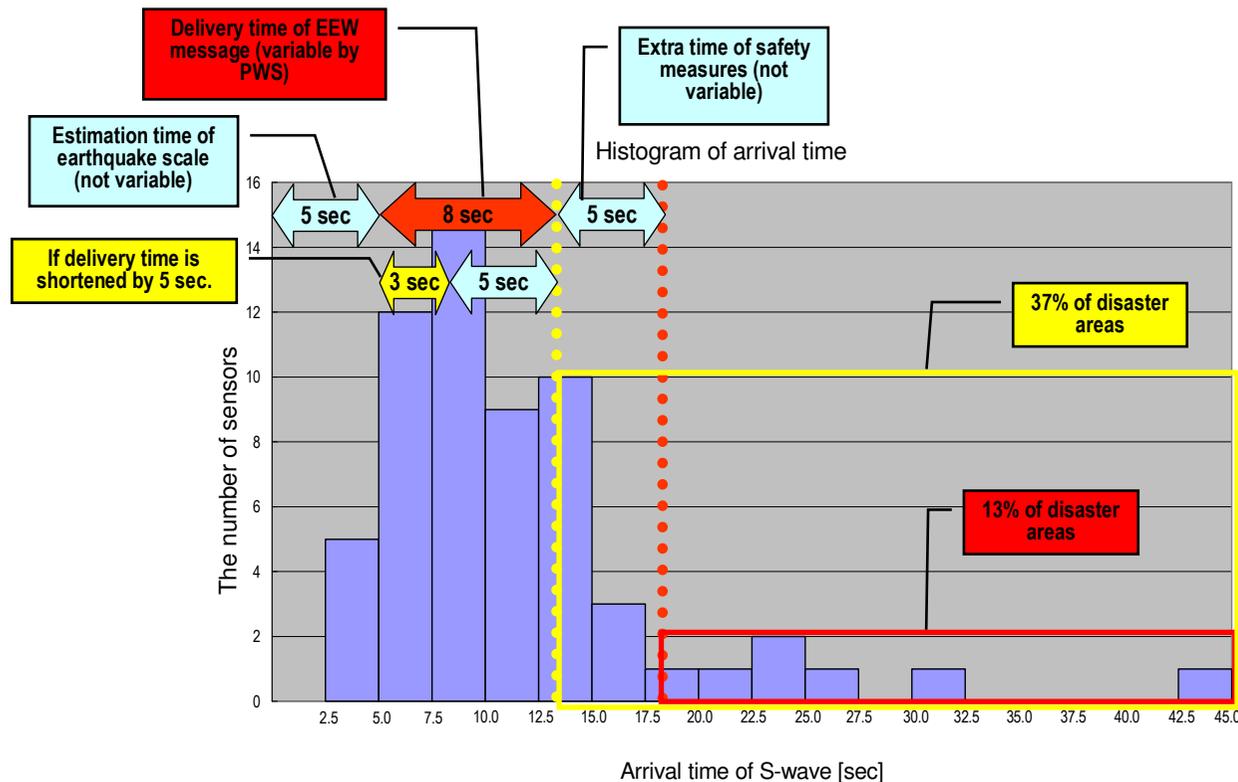
$$D = \sqrt{(\text{distance between sensor and epicentre})^2 + (\text{depth of epicentre})^2}$$

- Propagation speed of S-wave:  $V = 3.5$  km/s [1]
- Calculate arrival time of S-wave:  $T$

$$T = D / V$$

- Draw a histogram, and then compare arrival time S-wave with delivery time of EEW message (see next slide)





- Figure shows arrival time of S-wave measured at each earthquake sensor in the 2004 Chuetsu earthquake
- If the EEW is delivered within, say, 8 secs (red arrow), the figure indicates that
  - the EEW message is only delivered to ~37% of disaster areas before the S-wave arrives
  - including time to take safety measures, then a 8 secs EEW delivery time will be useful to only ~13% of the disaster area
- If the delivery time is shortened by 5 secs to 3 secs, notification can be delivered to 74% of the disaster areas, but only effective to ~37% of disaster areas when including time to take safety measures

*Note: statistics of past earthquakes indicate that the average time for the EEW system to detect the earthquake scale and issue a warning was 5 seconds*



## Justification for the amount of information needed for earthquake notification

- It is sufficient to transfer a few bits of data to have handsets ringing, buzz, or display a short text prepared in a handset
  - e.g. "Earthquake Warning! Do safety measures!"
- There is very little time to read the text for users to quickly execute safety measures (e.g. extinguishing gas stoves, opening doors, hiding under the table, moving to a safer place), before the arrival of the destructive Secondary wave
- After an earthquake happens, it would be effective to deliver more data such as map for navigation to safe area or emergency facility where users can get important information, food, or essentials for life



## Our Summary of TS 22.968 Annex B

- On the 4 seconds requirement to deliver the Primary Notification
  - How this requirement was derived shows that the notification cannot fundamentally guarantee to reach 100% of the disaster area
  - Therefore, the service is based on “best effort”
  - It is more important to deliver the primary notification in the shortest time possible (in the order of seconds)
- On the amount of information needed to deliver warning message to users
  - Some countries do not have regular earthquake drills like Japan
  - Telecom infrastructure may be damaged as a result of a earthquake so delivering the secondary notification may not be possible

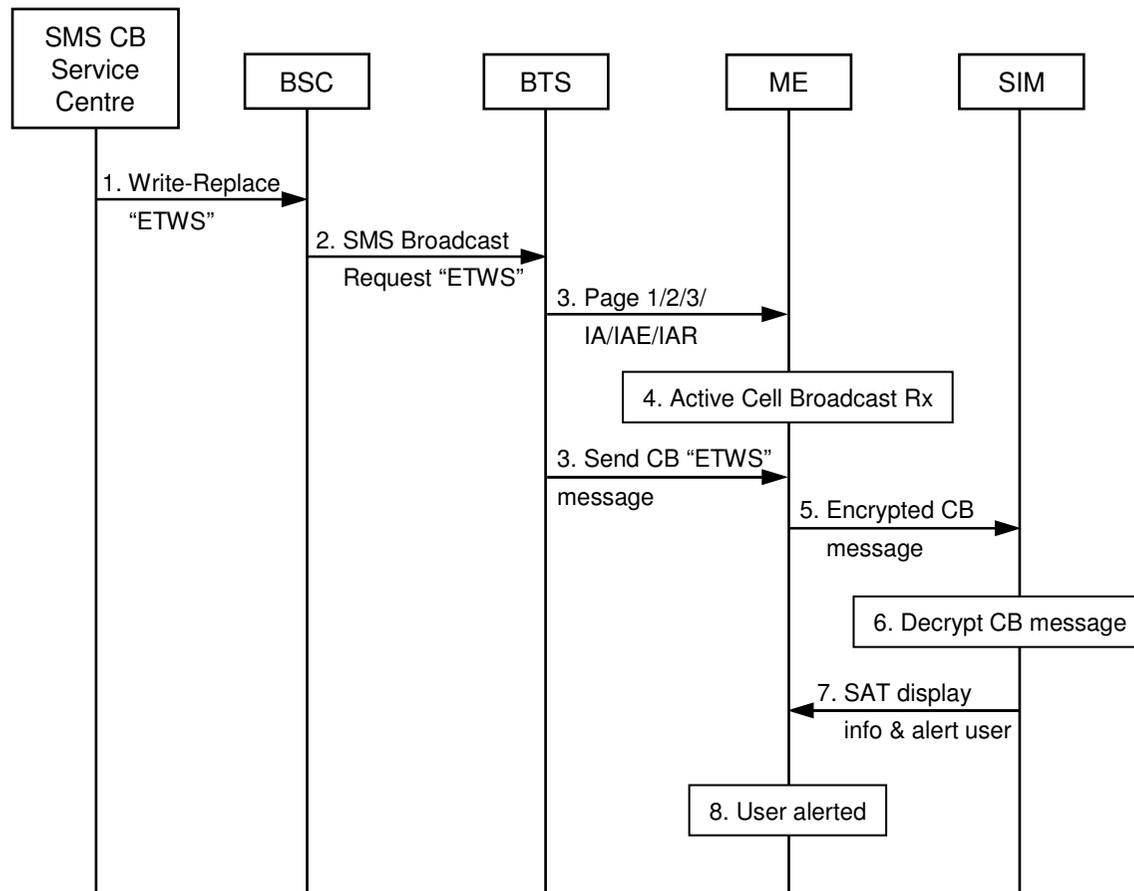


## CBS as the primary notification for GERAN

- There are no other existing methods to notify mobiles fulfilling some of the following requirements:
  - Common to GERAN, UTRAN and LTE
  - Securing warning message, this requires at least 50 bytes of data
  - Delivery of notification in the order of seconds
- The solution proposed in GP-080142 can guarantee to notify nearly all subscribers of an earthquake within 4 seconds
- In the worst case, CBS as the primary notification cannot meet this requirement but a majority of subscribers will be notified
- The SA1 requirement for 4 seconds clearly shows no guarantee of notifying 100% of population in the disaster area
- A similar statistical analysis in TS 22.968 Annex B could be done for CBS as the primary notification. The analysis could show its effectiveness to inform the population in the disaster area in the 1<sup>st</sup> second, 2<sup>nd</sup> second, 3<sup>rd</sup> second, etc. in terms of percentage of population informed.
- A new method to send notification is likely to require significant change to network and mobile equipment



## CBS Solution for GERAN: Idle Mode



At step 3:

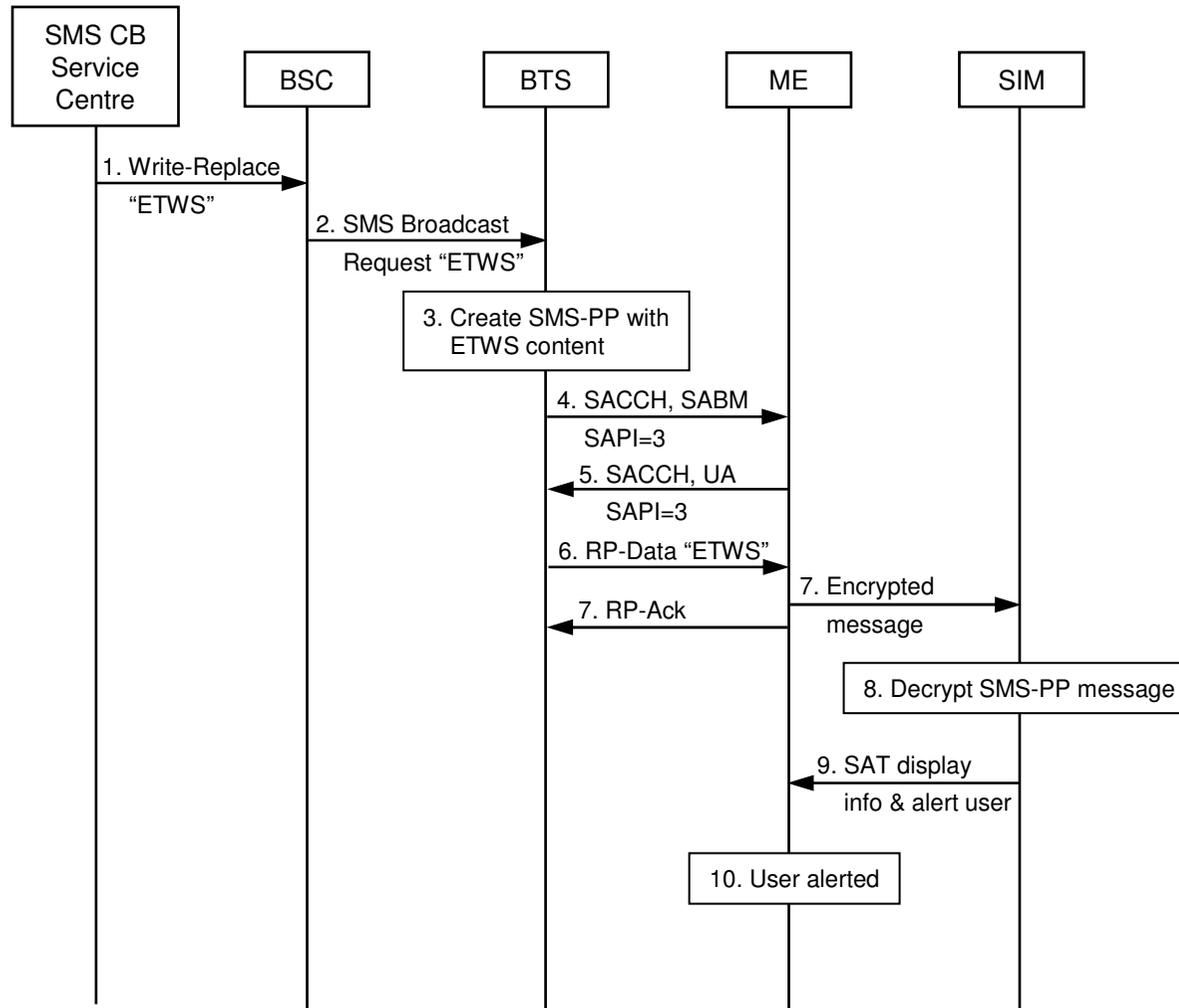
The BTS uses the ETWS tag to alert all idle mode mobiles that they should enable CB reception (to save battery power, many mobiles may have it switched off). The BTS (or BSC) does this by setting the "page mode" to "same as before" in all paging request type 1, type 2, type 3, Immediate assignment, immediate assignment extended and Immediate assignment reject messages that it sends (for a time period that at least exceeds multiple DRX periods. The equivalent messages on any/every PBCCH that is in use also have their "page mode" set to "same as before". Note: paging all mobiles may not be necessary if the mobile can be triggered to read the CBCH with an indication in SI4 but this would need mobiles to enable CB reception.

In parallel, the BTS starts, at the earliest opportunity sending the actual ETWS CB message. This message is continually repeated for the duration indicated by the SMS CB Service centre.

*Note:* alternative CB 'switch on' mechanisms might include a pre-defined TMSI that is sent with the 'identity type' set to "no identity". However this mechanism would interrupt on-going cellular operations (e.g. page request type 3 and Immediate Assignment messages can not be sent).



# CBS Solution for GERAN: Dedicated Mode



At step 3:  
The BTS copies the CB message content into a point to point short message structure (SMS-PP), with the SMS indicating that the mobile shall deliver it to the SIM. Note: a way to copy the ETWS encrypted CB message to a SMS-PP message by the BTS needs to be defined. The SIM will also need to be able to interpret the new internal SMS-PP header field to correctly identify the content of the message.



## Summary

- The paging cycle can range between 470.8ms (for BA\_PA\_MFRMS of 2 per 51-multiframe) to 2.1s (for BA\_PA\_MFRMS of 9 per 51-multiframe)
- It should be accepted that not all mobiles will respond to the first paging cycle given that it is statistically impossible to notify *everyone* in the disaster area within the 4 seconds requirement even with today's earthquake alarm system.
- Not everyone has a mobile in some earthquake-prone countries
- In idle mode, the duration for the mobile to receive the ETWS CB message after the mobile is paged is in the order of milliseconds but this could depend on the DRX cycle
- Dynamically increasing or decreasing the DRX cycle in the mobile is one possible way to ensure that the CB message is received by the mobile
- Next steps:
  - SAT needs to handle encrypted ETWS warning message
  - Method to covert CB message to SMS-PP message



## Reference

- [1] H. Yamanaka, et al., "Estimation of local site effects in the Ojiya city using aftershock records of the 2004 Chuetsu earthquake and micro tremors", (<http://www.eri.u-tokyo.ac.jp/hirata/chuetsu/kakenHoukoku/5.2yamanaka.doc>)
- [2] TS 22.968 Annex B: Japan - Public Warning System (PWS) Use Cases Earthquake and Tsunami warning

