SCIENTIFIC EVALUATION AND PILOT REPORT

Measurements, KPIs, coverage, reliability and user testing results

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PILOT REPORT STRUCTURE

1. Technological testing
2. International Experience related to 5G Broadcast and Public Warning Field
3. End-User Feedback: Research Methodology
4. Public-Warning Scenario Tests I
5. Public-Warning Scenario Tests II, III and final event
6. Project Timeline and Implementation
7. Coverage Measurements Analysis 2025-2026
8. Integration into the National Warning System
9. Technology Assessment and Recommentations
10. Compliance with Contractual and Technical Requirements

+ *Executive summary, conclusions, references and three annexes*

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Three complemetnary evaluation dimensions

From technial signal detection to meaningful public warning

Radio measurements

Outdoor drive tests and indoor measurements

Functional testing

Alert delivery, geofencing and device behaviour

User evaluation

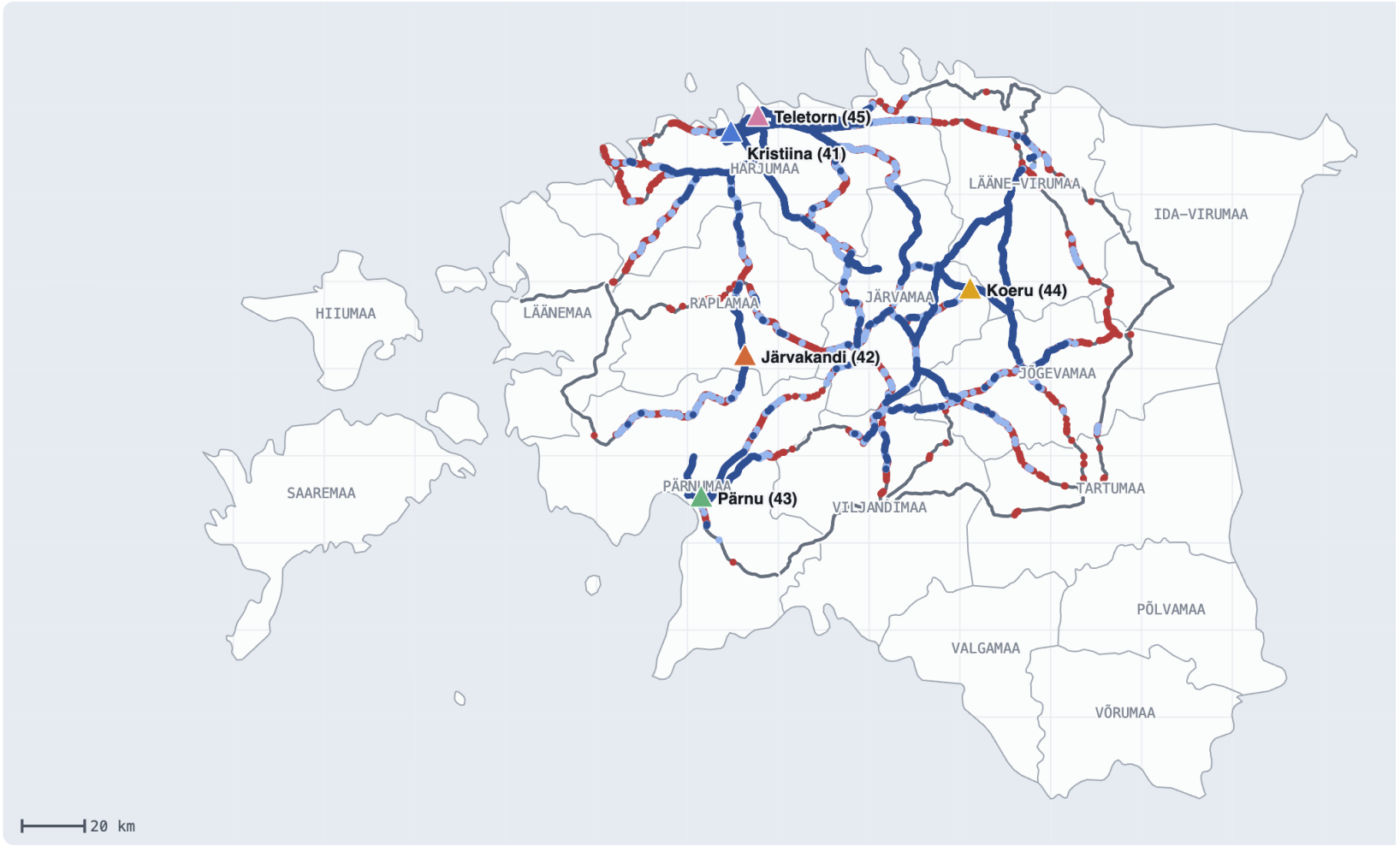
Message comprehension, noticeability and response readiness

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Field measurements in 2025

+2025

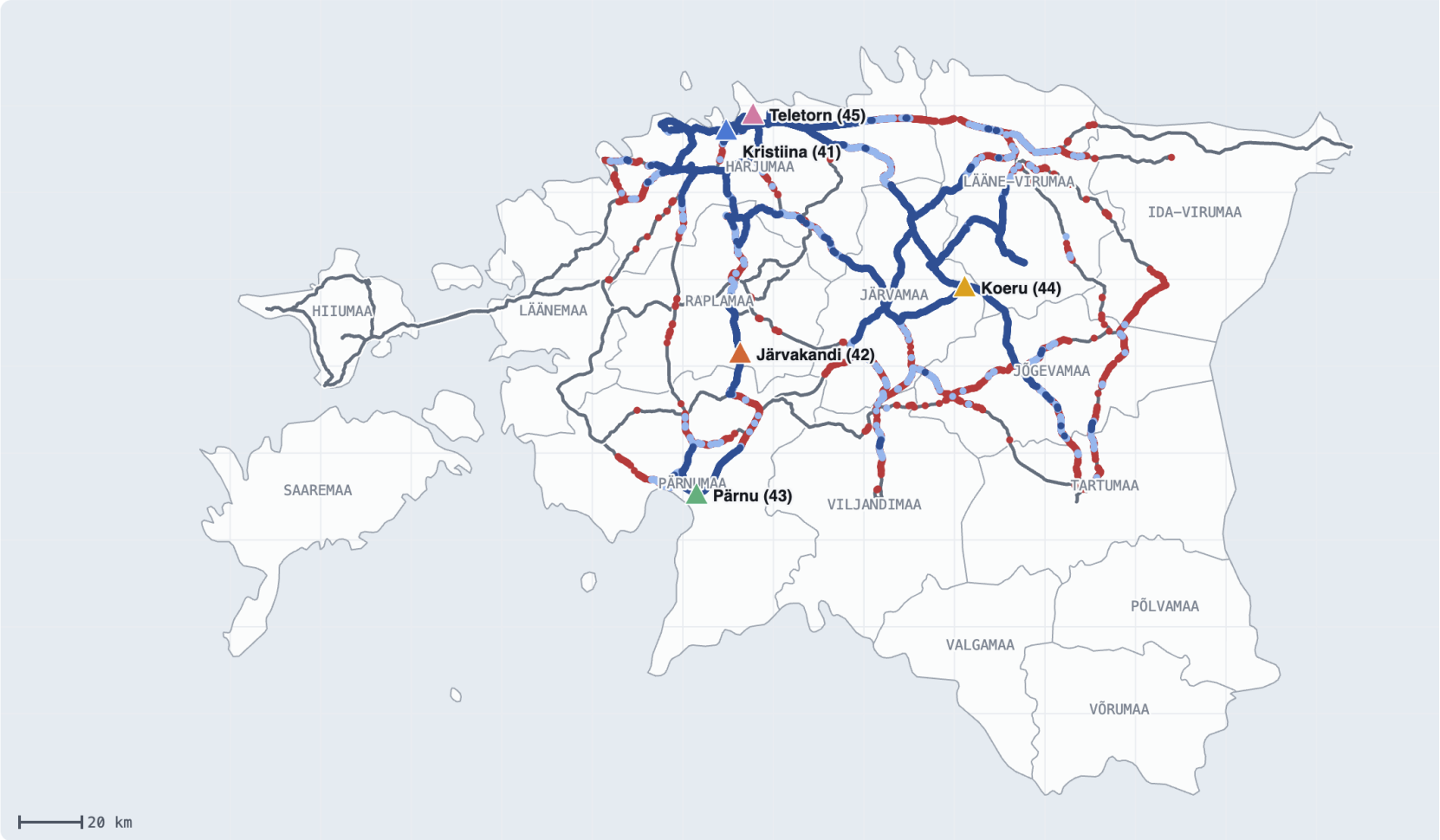
+ 39,588 logged observations
+ 9 measurement days
+ 39 logs/routes



Field measurements in 2026

+2026

+ 62,206 logged observations
+ 13 measurement days
+ 18 logs/routes

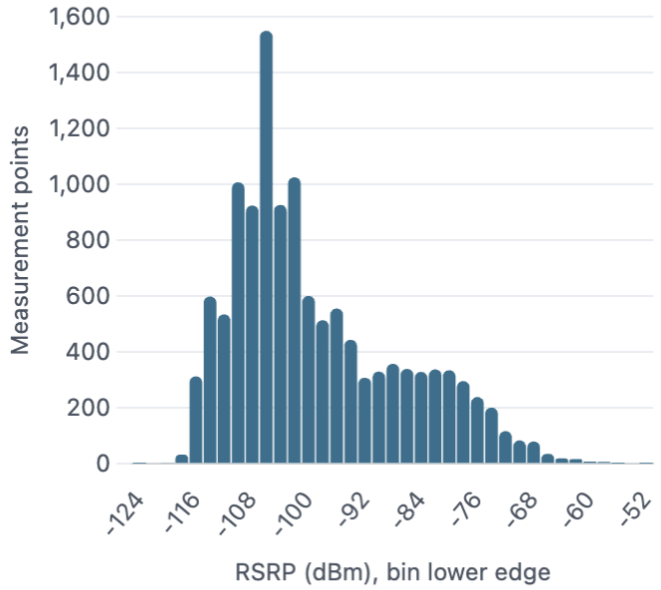


Changes in measured signal strength

2025

RSRP distribution · all towers

Reference signal received power (dBm) in 2 dB bins.



Coverage summary

Coverage probability P(SINR ≥ threshold) per serving tower. Distance is computed from each measurement point to the tower whose PCI it reports.

12,479
Measurement points

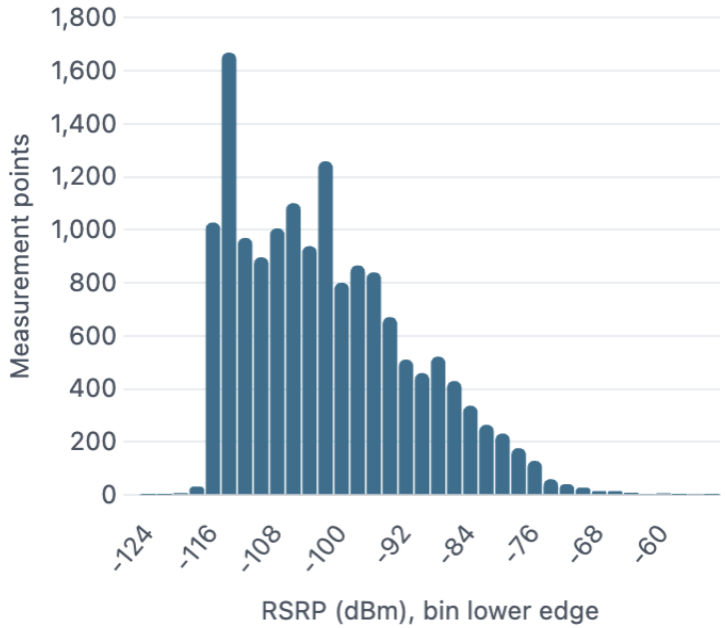
67.7 %
QPSK coverage (SINR ≥ 4.6 dB)

47.3 %
16-QAM coverage (SINR ≥ 8.4 dB)

2026

RSRP distribution · all towers

Reference signal received power (dBm) in 2 dB bins.



Coverage summary

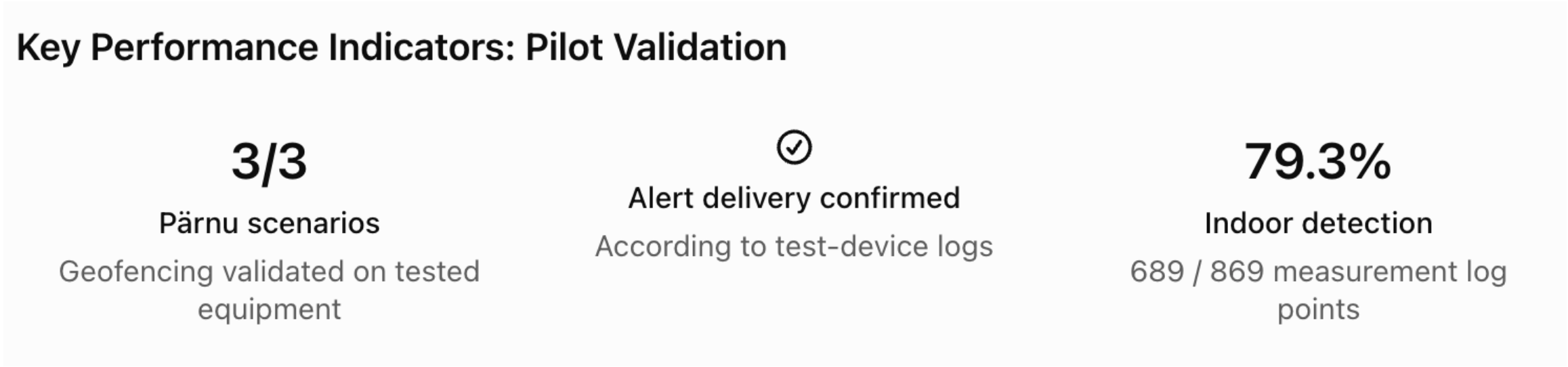
Coverage probability P(SINR ≥ threshold) per serving tower. Distance is computed from each measurement point to the tower whose PCI it reports.

15,337
Measurement points

66.2 %
QPSK coverage (SINR ≥ 4.6 dB)

45.1 %
16-QAM coverage (SINR ≥ 8.4 dB)

Key Performance Indicators – Did the warning system work?



Key Takeaway: *The pilot demonstrated end to end functionality under tested conditions, while indoor coverage and device compatability remian important constraints*

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Device Compatibility and Reliability Constraints

+ **Device support** 5G Broadcast reception requires manufacturer-enabled FeMBMS support.
+ **Geofencing** Device-based geofencing (category 4400) is not enabled on commercial Android devices in Europe.
+ **iOS restrictions** Emergency-alert reception could not be validated without Apple's required entitlement.
+ **Duplicate alerts** Repeated notifications may occur when moving between transmitters.

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User Testing: Study Design and Participants

Method used: *scenario-based testing, questionnaires and qualitative feedback. Non-random convenience samples.*

Questionnaire dimensions

- **Technical performance**
  Alert arrival, device behaviour, sound and noticeability
- **User perception and response**
  Perceived severity, anxiety and readiness to act
- **Awareness and training needs**
  Need for further information and guidance
- **Message comprehension**
  Clarity, language and information structure
- **System evaluation and trust**
  Usefulness, reliability and future acceptance
- **Qualitative feedback**
  Open-ended comments and suggestions

Background variables: age, gender, education and native language

Response scales: primarily 5-point Likert (1 = strongly disagree; 5 = strongly agree); selected technical ratings on a 10-point scale

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User Testing and Feedback

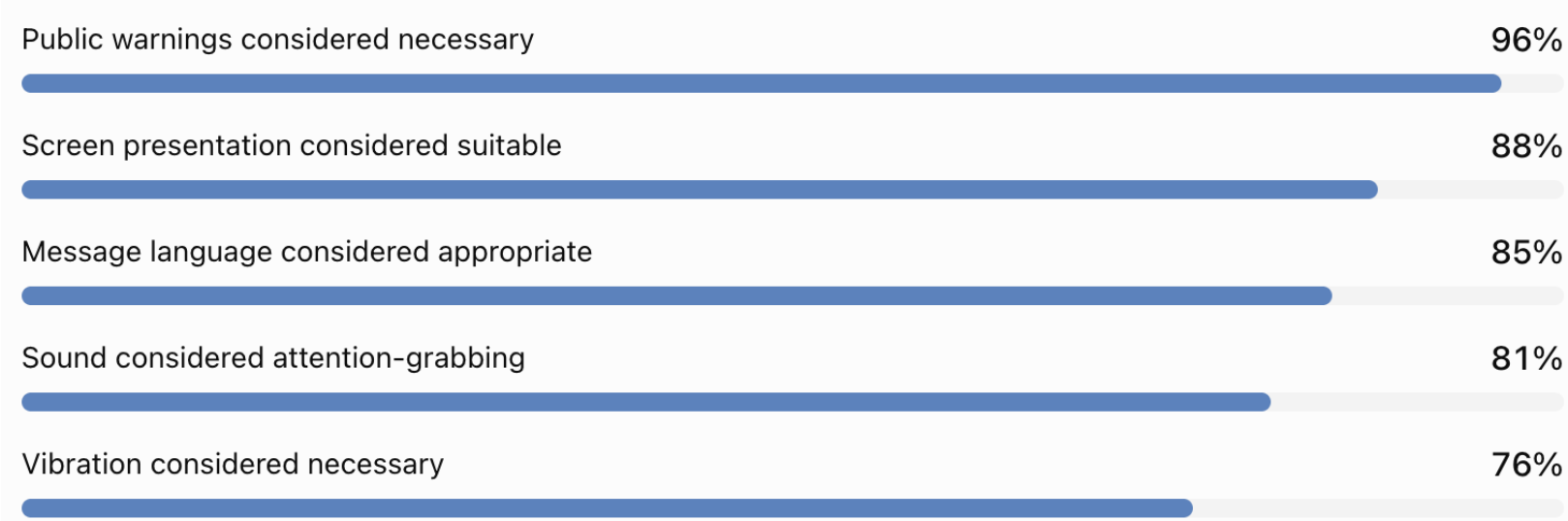
96%

Considered public warning necessary,

July 2025 survey,

72 respondents

3 separate locations



Share selecting “Agree” or “Strongly agree” for the respective survey statements.

Factors associated with readiness to act:

- Perceived risk
- Message clarity
- Alert noticeability

Exploratory findings from non-random convenience samples; not representative of Estonia's population.

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User Testing and Feedback

~130

Respondents in Pärnu tests,

March 2026,

3 scenarios

Scenario-Based Responses: Readiness to Act

Pärnu scenario tests · 31 March 2026 · Approximately 130 respondents

Missing child

Strong emotional response, attention and message comprehension.

Forest fire

Higher perceived threat and stronger reported readiness to act.

Flooding

More moderate immediate response; clearer action instructions were needed.

Key finding: Perceived risk, alert clarity and noticeability were associated with users' reported readiness to act.

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Scientific Conclusions and Recommendations

- **Technical feasibility demonstrated**

End-to-end public-warning delivery was validated under pilot test conditions.

- **Coverage requires further optimisation**

Indoor reception varied, and measured signal levels declined at several transmitters between 2025 and 2026.

- **Device compatability is critical**

Native smartphone support, geofencing and duplicate-alert handling remain key deployment requirements..

- **Further validation is recommended**

Repeat measurements across seasons

5G Broadcast is a promising complementary public-warning channel – not a replacement for existing warning systems.

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THANK YOU!

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