QZSS Emergency Warning System Implementation in Australia: Field Testing and Analysis

Jack Barton, Runjie Guo, Akihiko Nishino, Manabu Shimada, Ryunosuke Ichikawa, Masato Nomiya, Fumihiro Saijo, Hidetoshi Kakiuchi, Naohiko Kohtake, Ismet Canbulat, Sisi Zlatanova

Executive Summary

This report details the implementation, testing, and evaluation of the Japanese Quasi-Zenith Satellite System (QZSS) Emergency Warning System (EWS) in Australia. The system, utilizing Japan's Michibiki satellites, was demonstrated and tested in two phases: March 2023 (Phase 1) and October 2024 (Phase 2). The demonstrations successfully verified the system's capability to transmit emergency alerts to areas with limited or no cellular coverage, providing critical communication during bushfire emergencies.

Key findings indicate that the QZSS-EWS offers significant advantages over traditional telecommunications-based warning systems, particularly in remote areas and during infrastructure disruptions. While technical challenges remain, participant feedback was largely positive, highlighting the system's potential for enhancing Australia's emergency response capabilities.

1. Introduction

Australia faces increasingly severe and unpredictable bushfires due to climate change. The 2019-2020 "Black Summer" bushfire season was the most devastating on record, affecting approximately 243,000 square kilometres, destroying over 3,000 buildings, and causing at least 34 human fatalities, with an estimated three billion terrestrial vertebrates impacted. These fires clearly revealed that new systems are required that would inform better the affected communities.

Emergency response authorities and spatial professionals need to re-think and re-design the emergency information communication by working together with the communities to understand what information is needed at all stages of the emergency cycle (Tomko et al, 2020)

Current telecommunications-based warning systems are vulnerable to disruptions during bushfires, including infrastructure damage and network overload. The QZSS-EWS presents an opportunity to complement existing systems by providing satellite-based alerts independent of ground infrastructure. QZSS-EWS have been investigated previously and they have shown a great potential (Choy et al, 2020).

This project was funded by NTT Data Inc. and the National Space Policy Secretariat (NSPS), Cabinet Office, Government of Japan, with support from the New South Wales Rural Fire Service, Fire and Rescue New South Wales, and volunteers from the Community Fire Units.

2. Background

The development of the EWS were led by specific characteristic of the Michibiki QZSS as well as requirements relevant for the territory and type of settlements in Australia, more specifically New South Wales. The sections below provide a brief overview of relevant background information.

2.1 Bushfire Management in Australia

Bushfire management responsibilities in New South Wales (NSW) are divided between:

- **Rural Fire Service (RFS NSW)** manages fires in rural and regional areas. RFS is largely dependent on volunteers. Currently RFS is the largest volunteer firefighting organisation in the world. RFS is the lead combat agency for bush fires in NSW, but it works closely with other agencies as well. RFS can also be involved in a range of incidents such as vehicle accidents, or other natural disasters as storms in the rural areas.
- **Fire and Rescue NSW (FRNSW)** is responsible for urban and suburban fire management and other incidents threatening safety and health of the NSW population such as vehicle incidents, hazardous material emergencies, building collapse or terrorism consequences management. FRNSW plays a critical role in prevention and community preparedness. FRNSW is responsible for hazard reduction (preventive) burning for reducing accumulated vegetation.

Additional supporting units are the **Community Fire Units (CFUs),** managed by FRNSW, which are volunteer teams trained to defend peri-urban properties, reducing pressure on primary firefighting resources. The teams as composed of local residents living in urban areas close to bushland, who have followed a dedicated program and are trained to prepare for bushfire season and take informed decisions whether to leave early or stay and defend properties.

The **State Emergency Operations Centre (SEOC)** in Sydney serves as a command hub, featuring representatives from all emergency-related organizations and multiple data feeds. SEOC has a dedicated Support Unit, which is responsible for 24/7 situational awareness of emergencies across NSW. The centre provides working desks and connections to specialised software to all emergency response units, which must be involved in a specific incident.

2.2 Australian Warning System

Australia's warning principles prioritize timely, clear, and actionable public alerts following ISO 22322:2022 guidelines. The Australian Warning System uses three levels (https://www.australianwarningsystem.com.au/):

- **Yellow (Advice)**: Awareness of incidents without immediate danger
- **Orange (Watch and Act)**: Increased threat requiring action depending on the changing situation.
- **Red (Emergency Warning)**: Immediate danger requiring urgent action. Failing to do so, life is put in risk.

These levels are accompanied with symbols (triangle) giving also indication about type of disaster such as bushfire, cyclone, storm and flood. Warnings are disseminated via multiple channels, The Australian National Emergency Alert is a national telephone-based service and is enhanced with location-based capabilities. It has been used widely since 2009. Nevertheless, telecommunications-based warning services are not very accurate and vulnerable to ground-based disruptions and network overload, which is typical occurrence in the often extreme and unexpected circumstances surrounding an emergency and/or disaster (Choy et al 2020).

Another option for dissemination are mobile apps such as Hazards Near Me app. However, such apps cover the territory of only one state, have different user interface and delineate burned areas in a different way (Tomko et al 2020). Moreover, all current systems do not provide real-time evacuation guidance.

2.3 Quasi-Zenith Satellite System (QZSS)

Global and Regional Navigation Satellite Systems (GNSS) in addition to providing position and timing, have the potential to deliver short warning messages. Figure 1 illustrates an example of a GNSS EWS system. A natural hazard, e.g. bushfire, heavy rain/flood, strong weather, tsunami etc., triggers an emergency procedure. Observations and data are collected by the relevant emergency service and management organisations such as type of emergency, location, intensity, affected areas etc. This can be accompanied by various other data and measurements. The Emergency Service Centre validates and identifies a distribution area for the broadcast and provides details of the event, compiles the message and transmits this to the Satellite Control Centre via internet. The Satellite Control Centre sends the message to the satellite, which transmit the warning messages to all mobile devices able to receive it in the dedicate area.

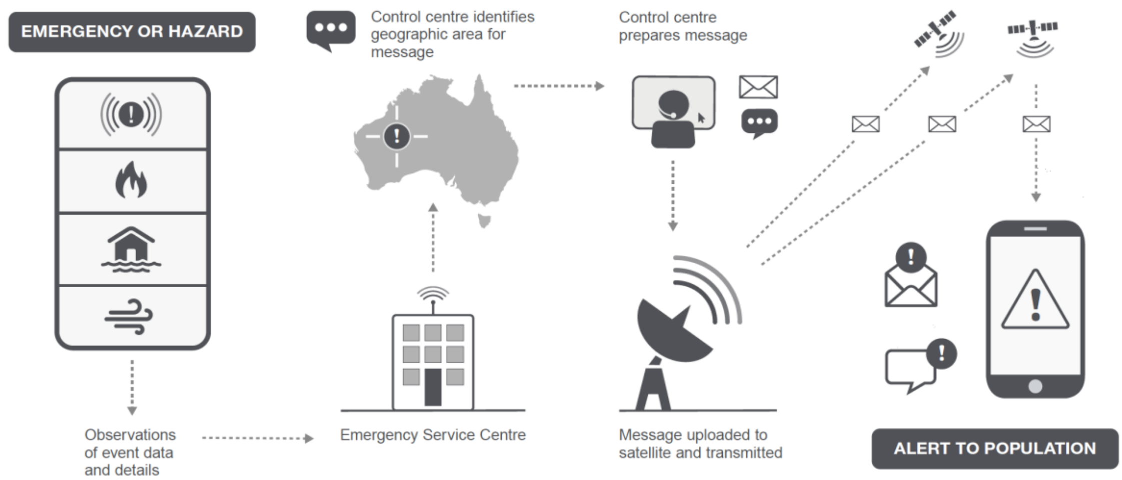


Figure 1: Generic Concept for GNSS EWS system

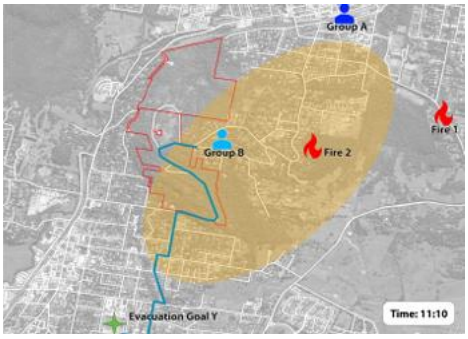
Japan's QZSS, also known as Michibiki is an example of such a GNSS that can provide short messages. Since September 2020 QZSS consists of four satellites. It is expected to expand to seven by 2026 and eleven by 2030. The System always provides continuous coverage with at least two satellites above Australia.

The messaging largely follows the above-described protocol. The Australian alert messages are to be composed by the corresponding Emergency Messaging Unit located in SEOC and sent to the Satellite Control Centre in Japan for distribution. The messages are received on dedicated smartphones and smartwatches, equipped with software for decoding the message.

Figure 2 illustrates the message standardised 21 items, such as message type, countryID, providerID, event category, event sub-category, severity, start time of disaster (event onset day, hour, minute), duration, guidance response type, event location (latitude, longitude) and area of effect (semi-major, semi-minor, azimuth).

This information is complemented with textual messages what action should be taken. The messages are designed according to the standardised messaging in Australia. The areas which need to be alerted are selected on a map (within ArcGIS) giving the Long, Lat and the two diameters of an ellipsoid (semi-major and semi-minor) rotated with the azimuth value.

Message	Binary Value	Description
Message Type	10	Test
Country ID	0111110111	Australia
Provider ID	0000	RFS
Event Category	111	Fire/Env/Infra
Event Sub-Category	000	Forest Fire
Severity	11	Minor
Event Onset Day	10000	16
Event Onset Hour	00001	1am UTC
Event Onset Minute	000000	0
Duration	0111	2-3 hours
Guidance Library	00	International
Response type	0000	Evacuate
Instructions	1000	Spare
Latitude	010010100100011	-37.775
Longitude	1110011100010110	144.975
Semi-major	0110	10000m
Semi-minor	0110	10000m
Azimuth	0000000	0
Specific Setting	000000000000000000000	To be left blank



a) b)

Figure 2: Emergency message structure (a) and example of an area to receive the alerts (b)

A number of smartwatches and smartphones were available for the tests within this project.

3. Phase 1 Demonstration (March 2023)

3.1 Overview

The first part of the project aimed to test the developments and signal reception in various areas with and without telecommunication coverage. Demonstration experiments were conducted at three locations in Australia:

- UNSW University (March 7, 2023)
- Nattai National Park (March 8, 2023)
- Royal Botanic Garden (March 9, 2023)

A large group of researchers was present at testing responsible for different aspects of the tests Cabinet Office was supervising the groups. NTT DATA, Keio University Graduate School and PASCO were monitoring the system and obtained results. UNSW representatives (including Professor Andrew Dempster, Professor Sisi Zlatanova, Emeritus Professor Chris Rizos, Dr. Jack Barton were providing access to different facilities, advising on specific emergency situations and discussing improvements to the system. NSW Telco Authority representatives

(Kusal Epa, Arul Kanagasingam) gave a presentation on the experienced bottlenecks and failures in using telecommunication message alerting to mobile phones.

3.2 Experiment Setup and Methodology

The experiments tested the strength of the signals from QZSS received via dedicated antennas and transmitted to smartphones. Three smartphones were equipped with satellite receivers, which were in separate units and allowed to be connected to the smartphone. Three different antennas were used:

1. Furuno's in-vehicle antenna
2. Sony's Spresense attached to the back of a smartphone (satellite orientation)
3. Sony's Spresense attached to the back of a smartphone (screen side up)

3.3 Evaluation Results

Reception performance varied significantly by location. The most elaborated test was performed at the Kensington campus UNSW to investigate what might disturb the reception:

- UNSW, Roof of the Electrical building: The reception was relatively poor despite open sky. It was concluded that it was because of the structure of the roof. The roof od Electrical engineering has metal gratings and a relatively high metal fence.
- UNSW, near glass window on the top floor of the School of Built environment: Despite the large windows, almost half wall, the reception was almost zero. The satellite was visible above the horizon, but no signal was detected. The possible explanation is that the signal cannot penetrate glass. Consequently, messages cannot be received indoors.
- The reception within the Outdoor UNSW lawn was very good. All messages were received.

At the other two locations the Botanical Garden and the national park all messages were successfully received.

Analysis of the performed tests revealed that:

- Furuno's vehicle-mounted antenna showed better reception sensitivity than Sony's Spresense
- All three devices received signals in open outdoor locations, even in a bushy areas.
- All messages were received within 20 sec.
- The Bluetooth transmission from Furuno's antenna to smartphones showed some delay

Despite the positive tests, several reception problems were identified:

- The reception showed some inconsistency even in locations with open sky. Analysis of poor reception identified ionospheric disturbances ("very disturbed state") as the most likely cause of unstable signal reception.
- Device temperature issues (operating range of 10°C to 40°C) were detected when outside temperatures approached 28.15°C

The tests were discussed within the UNSW group and some members of NSW RFS during a meeting organised at SEOC. Several important development recommendations were identified for the second phase were identified:

- A field test needs to be organised with NSW RFS
- Several smartphones and smartwatches have to be made available. It was decided that the smart devices are intended for response units or CFU. Citizens will not be involved.
- The messages should follow the standardised text messaging procedure of NSW RFS
- The area to be alerted should be selected on the map.
- Safe navigation routing should be provided to safe locations or shelters.

- The tools must be developed within ESRI software, because it is widely in use within SEOC.

4. Phase 2 Demonstration (October 2024)

4.1 Overview

Phase 2 demonstration was conducted October 13-19, 2024, in Sydney and Mittagong, Australia. The test intended to reflect as close as possible real-world situation. Therefore, a group was present at SEOC and another two groups around Mittagong. The key participants were:

- NSW Rural Fire Service (RFS)
- Fire and Rescue NSW Community Fire Unit (FRNSW CFU) in Mittagong
- UNSW representatives
- Japanese team (Cabinet Office, NTT DATA, Keio University, PASCO)

4.2 Demonstration Scenario

The demonstration was conducted within a simulated scenario of a bushfire emergency requiring evacuation in the Mittagong area. The testing scenario was set at Mt Gibraltar, between the towns of Bowral and Mittagong in the Southern Highlands, of NSW. Figure 3 shows the Mt Gibraltar precinct, which contains a 130 Ha nature reserve protecting the Mt Gibraltar Forest, a registered endangered ecological community. As the Reserve is on the western side of the mountain, it is exposed to western sun and dry westerly winds, creating potentially dangerous conditions for wildfire. On top of the mountain, adjoining the reserve to the east is periurban residential development, much of which is within Fire Prone Areas.

Figure 3: The test site.

The mountain has only two roads that can be used by cars when evacuating: one to the north into Mittagong and one to the south, to Bowral. The testing scenario assumed an initial simulated bush fire event, referred to as Fire 1 *Figure 4Figure 4, igniting to the east of the precinct under a westerly wind. Figure 4 shows the location of the Fire and Groups A and B. Detailed description of the scenario is given in Barton et al 2024. Below the major steps in the scenario are summarised:

1. Initial "Advice" alert notified all participants of a potential fire threat
2. Group A received a "Watch and Act" alert with instructions to evacuate to Wilfred Reserve
3. Group B received an "Emergency Warning" alert with instructions to evacuate to Loseby Park
4. Both groups followed smartphone navigation to their designated evacuation sites
5. Final "All Clear" message indicated the fire had been extinguished

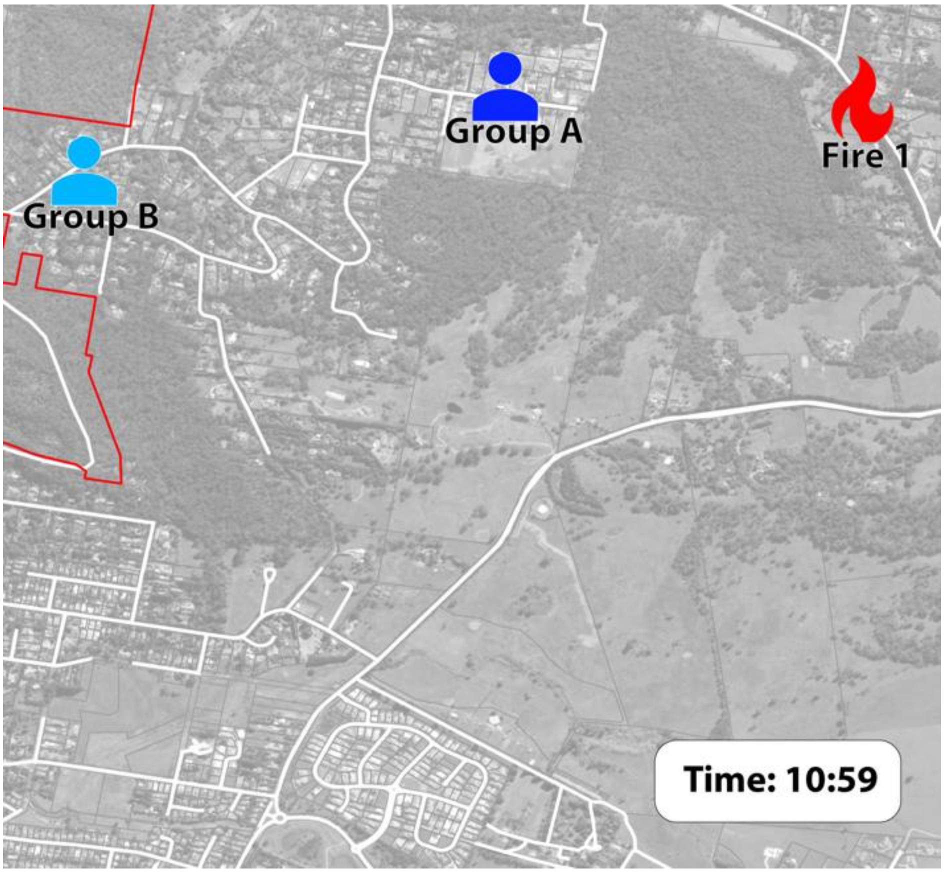


Figure 4: Location of the two groups A and B on the filed

4.3 Methodology

The field test aimed to test reception of message on the smartwatches/ smartphones as well as the developed application. The experiment consisted of the following steps:

- Sending alerts from SEOC in Sydney, using the dedicated map application for selecting area to be alerted
- Receiving alerts on smartwatches at Mittagong via QZSS. The messages were assembled with respect to the time frame of the scenario to the two groups A and B
- Displaying forest fire information and evacuation locations on smartphone screens
- Conducting evacuation drills to designated sites

To be able to test the accuracy of receiving and the routing service, the two groups A and B were carefully located in two different areas:

- Group A: Started at Nero St. and had to evacuated to Wilfred Reserve (approximately 3-minute drive)
- Group B: Started at Duke St. evacuated to Loseby Park (approximately 10-minute drive)

Following the recommendation from Phase 1, several new developments were provided:
- Smartwatches displayed a triangle icon according to the alert level (Figure 5)
- Information was transmitted from smartwatches to smartphones via Bluetooth to be able to see a map with navigation instructions
- Smartphones displayed detailed information including alert level, disaster type, location of the forest fire, evacuation instructions, and a map showing current location, fire location, and evacuation site

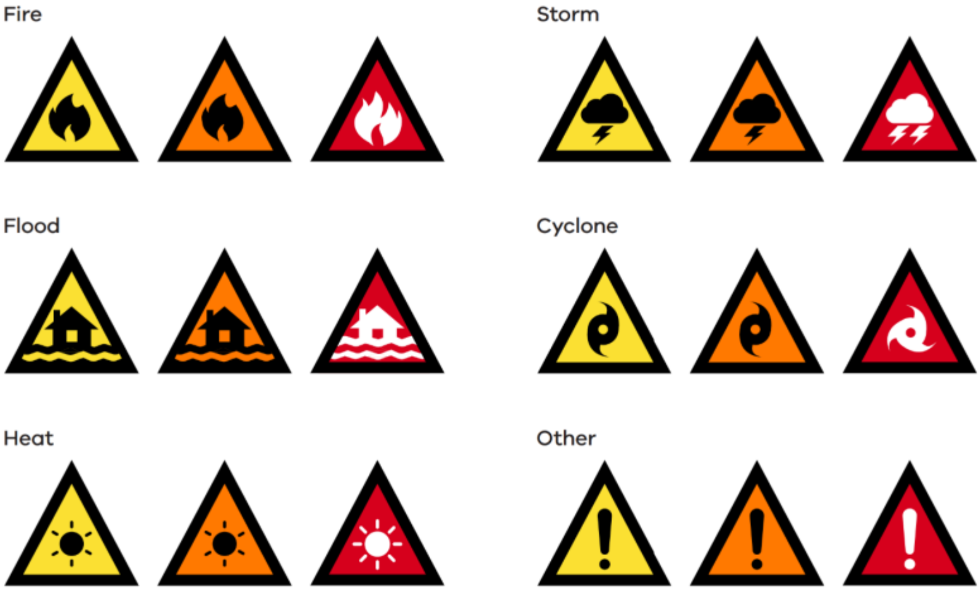


Figure 5: Alerting symbols

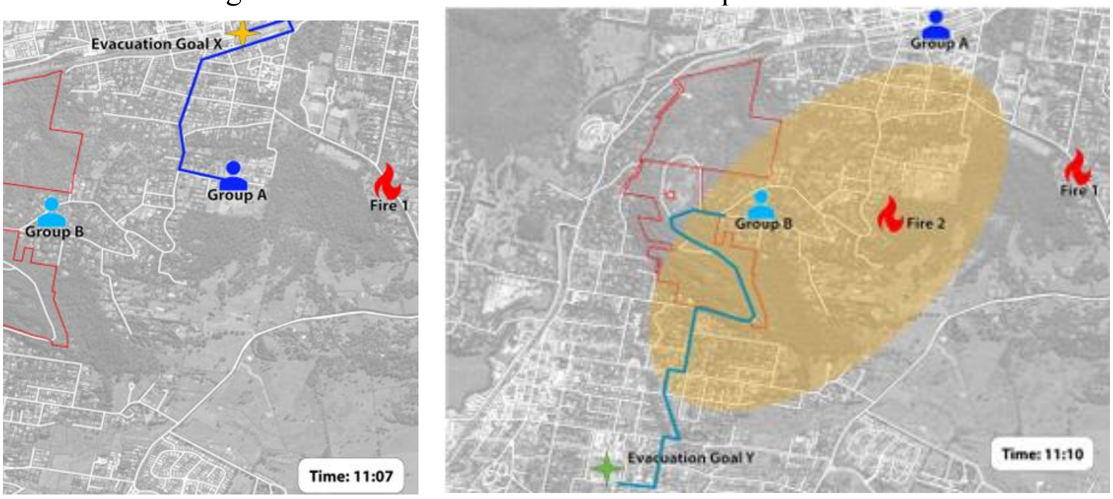
More details on the test can be found in Barton et al 2024.

4.5 Timeline and Technical Testing

The demonstration was carefully prepared in three days. Reception testing and site verification was completed on 14th of October at the site in Mittagong. Several rehearsals, which aimed to test and resolve transmission issues, and the watch-phone pairing were performed on 15th and 16th . The demonstration day on 17th was organised as follow:

1. The day was opened with a ceremony held at SEOC conference room at 10:00 AM
2. The developers explained the Michibiki Disaster Crisis Management and Reporting Service
3. Mr. Peter McKechnie, Deputy Commissioner of NSW RFS welcomed the field test and addressed the importance of such technology
4. The demonstration started by transmitting four different disaster messages by NSW RFS staff at SEOC and receiving them by groups A and B in Mittagong:
    - Message 1 "Advice" and a Yellow triangle icon was sent to both Groups A and B

- Message 2 "Watch and Act" with evacuation order was sent to Group A. Shortly after message to group A was send a second Fire 2 was detected as well as a change of the Fire spread.
- Message 3 "Emergency Warning" and a Red triangle icon with evacuation order was sent to Group B. The message was created after a change in the fire direction. Group B had to evacuate in southern direction as indicated on Figure 6b.
- Message 4 "All Clear" was sent to both Groups A and B



a) b)

Figure 6: Images form the system: a) The path of Group A for evacuation b) A polygon that indicates the target of the new alert message and the path for evacuation of group B.

Additional visit to SEOC took place on 18th of October. Following the main demonstration, the SEOC team conducted additional testing to determine the minimum possible transmission range. Testing at two points approximately 250 meters apart showed both locations received the alert, indicating current precision is greater than 250 meters.

4.6 Evaluation Results

The demonstration experiment was successful with minor issues:

- One smartwatch failed to display the alert icon after the first disaster report
- The "All Clear" signal displayed a yellow triangle icon ("Advice") due to smartwatch development limitations
- Some confusion regarding which groups should complete which sections of the evaluation forms

5. Participant Feedback

5.1 Positive Feedback

- Timely alerts can be sent to residents even in areas where cell phone networks are unavailable or during network outages
- Targeted citizens receive alerts using their smartphones and smartwatches, which is very beneficial
- Alerts can be sent pinpointed to the exact location of residents by specifying the area with an ellipse
- The system can be utilized for multiple types of emergencies and over broader areas

ID	Do you think this warning system is effective for bushfire response?
R1	Null
R2	Very effective system for bushfire response
R3	The voice message in the receiver's language is very good as there are multi-language communities the sat system can reach, more especially if mobile tower affected.
R4	Excellent technology for regional areas that fail on mobile network. Reaches audience in a timely manner + has potential to reach a more targeted audience
R5	Yes I hope on a broader scale this system will be affective
R6	Exceptional technology & accuracy. Would be a lot more reliable & direct compared to current mobile/cell phone warning systems.
R7	Null
R8	Yes, very useful for helping residents + firefighters especially when no mobile system/signal available the flexible addressing location of messages is very useful.

- Near real-time alarm transmission (~20 seconds) was highly valued

ID	Are there any functions you would like to add to this warning system?
R1	Null
R2	System covers all functions required
R3	To be able to say I am safe, with my details and 'next of kin', so others who call in to police/BFIL* can note. (*Bush Fire Information Line)
R4	Integration with other technology independent of the smart watches to provide ability to be more accessible. GPS navigation to evacuation point would be useful
R5	Ability to link to maps + navigate to evac point
R6	Integrate to Google Maps to navigate to evacuation point, or street-by-street directions if mobile reception is unavailable.
R7	Null
R8	Map -> offline instructions to evacuation point reliably between watch + phone, to receive all messages.

ID	Your Opinions, Impressions, and Others in General
R1	Null
R2	I very much like this tool. The researchers are very professional.
R3	Fantastic technology + demonstration. The team are very knowledgeable and were able to answer questions with a deep understanding of their program. This technology has HUGE potential 😉
R4	An exciting technology that will change the way emergency warnings can be sent & received.
R5	Null
R6	Very good system, will be useful for comms teams + residents
R7	Null
R8	Null

5.2 Challenges and Improvement Needs

- Receive alert information directly on smartphones only (without intermediate devices)
- Send messages to the elliptical area in finer divisions, approximately 100 meters (current precision is ~250 meters)
- Send and receive alerts with integration of surrounding facilities and demographic information
- Improve user interface for the ArcGIS Pro plug-in used for alert creation
- Develop more intuitive navigation functionality (evacuation routes displayed like GPS navigation)
- Ensure integration with existing RFS alarm systems that handle multiple simultaneous bushfires

6. Follow-up Activities

On October 18, the team visited the NSW RFS Operations Centre to understand better the work of the emergency responders. The team observed:

- Media booths for various TV stations to be able to provide timely information to citizens
- Individual terminals used by police, fire departments, and national parks to be able to connect to dedicated information systems of accessible by the response units.
- Large-screen central monitor displaying forest fire situations against topographic maps to better orientation and assess of the situation.
- Forest fire spread simulation capabilities. A dedicated software environment SPARK https://research.csiro.au/spark/) is used to simulate and evaluate the fire spread.
- Triple Zero (000) emergency call centre made available during the emergency to collect information from communities
- The centre uses many space technologies including the satellite constellation Starlink, which provides telecommunication services.

This visit provided valuable insights into Australia's advanced emergency management systems and potential integration points for the QZSS-EWS service.

7. Future Development Path

After the demonstration, results were reported to the Consulate-General of Japan in Sydney and the Embassy of Japan in Australia, with positive feedback for future collaboration. UNSW team is proactive about continuing the collaboration towards further extensions of the application allowing to provide more accurate ground information as well as integrating with the existing systems of NSW RFS.

Key issues identified for future development are listed below:

1. **Software Interface**: The alert message creation/transmission software interface needs to be automated or integrated into existing local systems
2. **Direct Smartphone Reception**: Development of direct reception via smartphones without intermediate devices. This aspect of the developments will require consideration of power consumption issues.
3. **Transmission Range Precision**: Improving targeting precision from current ~250m to desired ~100m

4. **Offline Navigation**: Developing efficient offline map data preparation for navigation in internet dead zones. The current implementation relies on the availability of internet to provide navigation paths.
5. **Integration with Existing Systems**: Adapting the system to complement NSW RFS's current warning systems.

8. Conclusions and Recommendations

8.1 Conclusions

The demonstration experiments successfully verified the functionality of the QZSS Disaster Risk Management and Reporting System. Several key advantages of the current developments were highlighted:

- Improved Warning Coverage: the ability to provide alerts in areas without cellular coverage
- System Resilience: the approach is entirely independent from ground-based telecommunications infrastructure
- Rapid Transmission: Near real-time delivery of emergency messages (~20 seconds)
- Geographic Targeting: Ability to send messages to specific geographic areas with accuracy of 250m.
- Multi-Hazard Application: The field test scenario was for fire, but the systems can be potentially used across various emergency types

8.2 Recommendations

Discussions with the teams and the emergency units have discussed a number of options to improving the NSW warning systems:

1. Expand the use of QZSS in bushfire management to complement existing emergency communication systems
2. Invest in satellite-compatible receivers for rural communities and emergency responders
3. Develop adaptive evacuation routing algorithms to enhance public safety
4. Integrate QZSS data with AI-driven fire prediction models for proactive decision-making. Specifically providing real-time environmental measurements to AI-driven models
5. Work with Geoscience Australia and The National Emergency Management Agency to expand the demonstration beyond NSW for national discussion
6. Continue development to address technical limitations and enhance user experience
7. Explore integration with bushfire simulation models like SPARK for improved predictive capabilities

By leveraging satellite technology through the QZSS-EWS, Australia can significantly enhance its bushfire response capabilities, improving safety outcomes for both residents and emergency personnel.

APPENDIX 1. Survey Responses

R1.

(Note: The time for Group A is calculated by the difference between the times of No. 8 and No. 12. For Group B by the difference of No. 11 and No. 12.)

Questionnaire			
No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☐ Yes ☐ No	(For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☐ Yes ☐ No	(For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

R2.

Questionnaire			
No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☑ Yes ☐ No	Very effective system for bushfire ~~se~~ response (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☐ Yes ☑ No	System covers all functions that are required (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

My opinion, is that it covers everything people need to be effectively warned and evacuate in time. Very impressed with this system, built very well and works extremely

Start Points, Evacuation Routes and Meeting Points of Evacuation Sites

R3.

Questionnaire			
No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	■ Yes ☐ No	THE VOICE MESSAGE IN THE RECEIVERS LANGUAGE IS VERY GOOD AS THERE ARE MULTILANGUAGE COMMUNITIES. THE SAT SYSTEM CAN REACH MORE ESPECIALLY IF MOBILE TOWER AFFECTED. (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	■ Yes ☐ No	1) TO BE ABLE TO SAY I AM SAFE, WITH MY DETAILS, NEXT OF KIN SO OTHERS WHO CALL IN TO POLICE/BFIL CAN NOTE. (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

I VERY MUCH LIKE THIS TOOL. THE RESEARCHERS ARE VERY PROFFESIONAL.

R4.

Questionnaire			
No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☑ Yes ☐ No	Excellent technology for regional areas that fail on mobile network. Reaches audience in a timely manner + has potential to reach a more targeted audience. (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☑ Yes ☐ No	Integration with other technology independant of the smart watches to provide ability to be more accessible. GPS navigation to evacuation point would be useful (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

Fantastic technology + demonstration. the team are very knowledgeable and were able to answer questions with a deep understanding of their program. this technology has HUGE potential! :)

Start Points, Evacuation Routes and Meeting Points of Evacuation Sites

R5.

No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☑ Yes ☐ No	Yes, I hope on a broader scale this system will be affective. (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☑ Yes ☐ No	Ability to link to maps + navigate to evac point. (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

R6.

No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☑ Yes ☐ No	exceptional technology & accuracy. would be alot more reliable & direct compared to current mobile/cell phone warning systems. (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☐ Yes ☐ No	integrate to google maps to navigate to evac point, or street by street directions if mobile reception is unavailable. (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

An exciting technology that will change the way emergency warnings can be sent & recieved.

Start Points, Evacuation Routes and Meeting Points of Evacuation Sites

R7.

No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☐ Yes ☐ No	(For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☐ Yes ☐ No	(For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

R8.

No.	Questions	Judgement	Reasons / Comments
1	Do you think this warning system is effective for bushfire response?	☑ Yes ☐ No	Yes, very useful for helping residents + firefighters especially when no mobile system/signal available. The flexible addressing location of messages is very useful. (For example, this warning system helps residents, visitors, firefighters, etc.)
2	Are there any functions you would like to add to this warning system?	☑ Yes ☐ No	map → offline route navigation instructions to evacuation point. reliability between watch + phone, to receive all messages. (For example, a function that sends more detail information of bushfires.)

Your Opinions, Impressions, and Others in General

Very good system, will be useful for comms teams + residents.

References:

Barton, J., A. Nishino, N. Kohtake, H. Westrin, M. Shimada, R. Guo, R. Ichikawa, J. Li, I. Canbulat, and S. Zlatanova, 2024, Near-realtime Location Specific Messaging During Extreme Bushfire Events, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLVIII-3/W3-2024, 9–14

Choy, S., Y. B. Bai, S. Zlatanova, A. Diakite, E. Rubinov, C. Marshall, P. Knight, A. Riddell, V. Rooke, M. Woolf, N. Kishi, and S. Kogure, 2020 Australia-Japan, QZSS emergency warning service trial project, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLIV-3/W1-2020, 21–28

Tomko, M., M. van der Vlucht, L. Shorth and S. Zlatanova, 2020, Bushfire communication: needs to consider space, time and user experience, Position magazine, February/March, pp.18- 20