

## ANNEX V

### PTWS MEDIUM TERM STRATEGY 2009–2013

#### I. Introduction

##### 1.1. Purpose of the document

The PTWS Medium Term Strategy (PTWS MTS) describes the basic directions towards continuously improving the Pacific Tsunami Warning & Mitigation System to meet stakeholder requirements during the period 2009-2013. It focuses on describing general, common but essential, strategic objectives to ensure an effective and efficient, tsunami warning and mitigation system that is interoperable wherever possible with the other ocean basins and seas. The PTWS working group structure derives from the PTWS MTS and is described in the PTWS Working group Structure. And details of the methods to accomplish these strategic objectives are defined in the PTWS Implementation Plan.

##### 1.2. Vision

The MTS envisions that the PTWS is:

*An interoperable tsunami warning and mitigation system based on coordinated Member State contributions that uses best practices and operational technologies to provide timely and effective advice to National Tsunami Warning Centres. As a result, PTWS communities at risk are aware of the tsunami threat, reduce risk, and are prepared to act to save lives.*

##### 1.3. Context

The Pacific Ocean basin is the largest, most diverse, and most tsunami-prone of any of the earth's ocean basins. Pacific Ocean nations face and must be prepared for distant, and local tsunami threats. In the past, Member States depended primarily on Pacific Tsunami Warning Center (PTWC) and Northwest Pacific Tsunami Advisory Centre (NWPTAC) advice to inform National Tsunami Warning Centre decisions. But a new awareness of local and regional threats demands that Member States commit to address these threats through improved and expanded National Tsunami Warning Centre capacities and through formal regional collaboration. The result is an interoperable network of National and Regional tsunami warning and advisory centres that complement the distant tsunami advice PTWS and NWPTAC provide. This MTS provides the framework for MS to take responsibility and ownership for their National systems and to engage in the international coordination and collaboration process through the ICG/PTWS.

##### 1.4. Framework for The Global Tsunami and Other Ocean-Related Hazards Early Warning System (GOHWMS)

The Pacific Tsunami Warning and Mitigation Systems operates as an important component within the global tsunami warning and other ocean-related hazards early warning systems. The governance of PTWS is provided through an Intergovernmental Coordination Group (ICG), under the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The PTWS reflects the key principles of the Framework for the Global Tsunami and other Ocean-related Hazards Early Warning System (GOHWMS):

- Identifying warning and mitigation system requirements unique to the Pacific Ocean basin

- Capitalizing, to the extent practicable, on existing international groups with relevant responsibilities such as GLOSS and JCOMM
- Harmonising structure, standards, and practices among ICGs
- Integrating with other international systems and organizations such as WMO and ISDR
- Collaborate on research and development across ICGs

### 1.5 Strategic Pillars

Considering the important role the GOHWMS plays and the unique requirements of the Pacific Ocean basin, the Pacific Tsunami Warning and Mitigation Systems Medium Term Strategy is comprised of three Pillars supported by three foundational elements. The three Pillars are:

- Risk Assessment and Reduction: *hazard and risk identification and risk reduction*
- Detection, Warning and Dissemination: *rapid detection and warning dissemination down to the last mile*
- Awareness and Response: *public education, emergency planning and response*

The supporting foundational elements are:

- Interoperability: free, open and functional exchange of tsunami information
- Research: *enhanced understanding and improved technologies and techniques*
- Capacity Building: *training and technology transfer*
- Funding and Sustainability: *resources to sustain an effective PTWS*

### 1.6 Document Structure

Section II provides an analysis of the current state of the PTWS. Section III describes the three pillars. Section IV reviews the Foundational Elements, and Section V discusses Implementation.

## II. Analysis of the Current State of the PTWS

The current state of the PTWS can be summarized as follows:

- 2.1 Whilst there has been significant progress, risk assessments and reduction still incomplete for many areas.
- 2.2 Whilst there has been a considerable expansion in the amount of seismic and sea level data to detect tsunami threat, the data is not always interoperable or made timely available to the warning centres. Exchanging observational data between neighboring Member States (sometimes even within a single Member State) and across the region remains a challenge.
- 2.3 Pacific-wide and Regional Warning/Advisory services provided by PTWC, WCATWC and NWPTAC have been robustly operated with high reliability. Although centers have been making ceaseless efforts to improve their services by introducing new technologies as well as to maintain the operational systems, the Pacific in some areas may potentially

soon lag behind the capabilities being developed in the other ocean basins for more threat based tsunami warnings.

- 2.4 Some 24/7 robust Local/National Warning systems have been developed and others are still under construction for determination of local, regional and ocean-wide tsunami threat. Establishing a 24/7 robust national systems remain great challenges.
- 2.5 A positive tendency is that Member States' awareness of the urgent necessity for preparing countermeasures against tsunami threats has been increasing, especially after the 2004 Indian Ocean Tsunami disaster. Still, there is a need for more risk assessment, capacity building, disaster prevention education and other activities to achieve further and sufficient tsunami preparedness and sustainability of operational systems.
- 2.6 Whilst there are now semi-regular, internationally coordinated exercises for the PTWS, there is minimal routine monitoring of system performance to underpin continuous improvement and ensure messages are delivered in a timely and accurate manner down to the "last mile".
- 2.7 Whilst awareness and preparedness is improving around the region, considerable effort is required to ensure all communities at risk are aware the threat and able to respond safely.
- 2.8 Member States are the main contributors to the PTWS. The budget for the ICG/PTWS provided by the governing body, UNESCO/IOC, and donated by Member States is not adequate to support all critical ICG/PTWS activities. Other PTWS activities highly depend on national regular budgets. For example, national and regional tsunami warning/advisory operational centers, which are not included in the PTWS budget, nor are extra budgetary contributions offered by concerned organizations such as ISDR, UNDP and aid or technical agencies such as AusAID, USAid, JICA, Cosude or DIPECHO.

### **III Strategic Pillars**

#### **3.1 Introduction**

To formulate the PTWS Medium Term Strategy MTS we should consider the present situation described in section II and develop realistic strategic objectives that are achievable in 5 years. The driving question is "What can be done even with the present limited resources to at least make the populations at risk safer?" The response to this question makes it possible to prioritize the activities for improving the various components of the entire PTWS. These priorities may also be considered by aid and technical cooperation agencies as guidance for their support to the PTWS.

The next sections describe the strategic objectives to be accomplished and the contents of each pillar as well as offering suggested priority actions. Needless to say the ICG/PTWS and Member States will support the activities addressing these strategic objectives as much as possible. It is important to encourage Member States initiative as the main stakeholders and actors in these activities.

##### **3.1.2 Pillar 1: Risk Assessment and Reduction**

Tsunami risk consists of several components such as hazard assessment (specifying tsunami sources and waves height along the coast), and risk assessment, estimating tsunami effects to the coasts or estimating damages. Its final aim is to know where the dangerous places are and how strongly a tsunami could affect those areas. To put it straight, risk and hazard assessment is to be conducted at and by each Member State who knows the natural and social conditions of its coastal area more than any other countries, utilizing the recent and historical data completed

by existing scenarios of Pacific-wide tsunamis and developing local scenarios as well. This assessment is an unavoidable starting point for efficient tsunami preparedness activities.

Risk assessment is fundamental to the other pillars. It is also required for disaster risk reduction—activities that reduce community exposure to tsunami and other ocean-related threats.

### **Strategic Objective**

Member States will specify and detail danger levels and dangerous areas at their own coast brought by tsunami phenomenon.

Member States should develop risk reduction strategies through appropriate agencies and organizations to reduce, where possible, community exposure to threats from tsunamis and other ocean-related hazards.

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Developing a tsunami hazard maps based on recent and historical data and/or numerical simulation is the ideal goal. Simple and rough estimation, like using altitude data of coastal topography as inundation criterion, can serve temporarily until more accurate mapping develops in the future including through paleo-tsunami research.

#### Suggested Mechanisms:

Steps for tsunami risk assessment in Member States include:

1<sup>st</sup> : Specify tsunami sources capable of generating tsunamis that affect its own coastal area. Local source or distant source? Which source is more likely to affect the coast?  
-> Specify them from the past tsunami records or consideration of tectonic circumstances. Data of past earthquakes and tsunamis are important, but past tsunami databases may lack the severest case(s). So it would be advisable to assume the largest scale of geophysically possible cases as well as referring to the past databases.  
-> Utilize maximum tsunami height distribution charts of wide areas by numerical simulation that can indicate tsunami energy direction.

2<sup>nd</sup> : Specify danger level at each coast or dangerous area  
-> by numerical simulation, recent and past records and other available means  
Post tsunami reconnaissance surveys after recent or new event provide unique detailed data valuable for risk and hazard assessment. Such survey must be organized and carried out quickly and thoroughly after each tsunami occurs,

Since the work for the above steps includes technical and research capabilities, capacities and skills, it needs support from or cooperation with research communities. To make it relevant and timely a compromise solution should be sought in terms of accuracy in the short term, because it would take long time and large budgets to pursue it due to its continuous improvement.

In the long term, it would be ideal to have Member States' own available experts who can deal with various technical matters. Such human resources development is essential for the sustainability of the system. It requires training courses, overseas or national opportunities for graduate or postgraduate education and scientific and technical networking.

3<sup>rd</sup> : Specify appropriate strategies and techniques for reducing Member State communities' exposure to tsunami and other ocean-related threats.

### 3.2 Pillar II: Detection, Warning and Dissemination

An effective tsunami warning system involves the rapid detection and quantification of the earthquake source, forecasting and verification of wave propagation and the likely threatened areas, development and dissemination to the “last mile” of information about the threat to enable communities to respond.

- **Detection** involves the implementation and development of seismic and sea level observing systems that enable rapid assessment and verification of the threat.
- **Warning** involves the rapid detection of local earthquakes capable of generating local tsunamis, forecasting of wave propagation and potential impacts for regional and ocean wide tsunamis, and conveying that information in interoperable message formats.
- **Dissemination** involves the timely and accurate distribution of threat and warning information from and between warning centres, and from National Tsunami Warning Centres to the community.

Since the Pacific is the world’s largest ocean and has tsunami sources in widespread regions, it is appropriate to consider it in several geographical scales when we deal with tsunami warning systems. Tsunami warning systems of the PTWS have the following 3 scales:

#### a. Local warning (or National warning)

#### b. Regional warning

#### c. Ocean-wide warning

The followings are descriptions of improvements needed for warning systems of each scale.

#### a. Local warning (or National warning)

Local warning systems or national warning systems are the most crucial part in the entire end-to-end system for both local and distant tsunamis, due to the inalienable national responsibility for informing communities at risk and urge or order immediate evacuation.

This system should be established or improved prior to the regional or ocean-wide system.

#### Strategic Objective

Develop National warning center or function by each MS.

Establish emergency response mechanism on a 24/7 basis among concerned organizations. Build optimized procedure for all steps; from issuing warnings to evacuation. Master the procedure by continuous practices including through full-scale evacuation exercises and drills down to the “last mile”.

Utilise new and available technologies and develop arrangements for the transmission and receipts of tsunami warnings alerts from international centres, and the dissemination of alerts and public safety actions within countries.

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Build (or improve) observational networks for seismic and sea level data and online communication system(s) to rapidly collect these data. Establish or reinforce capabilities to analyze those data, evaluate tsunami effects and issue tsunami warnings through improved communication networks for delivering warnings and information.

**Suggested Mechanisms:**

- > Improvement of seismic and sea level observation networks requires considerable funding and human resources, so that it may be difficult for many countries to achieve this strategic objective.
- > Address improvements by better focusing on hazard assessment and building on efficient use of existing support mechanisms and international networks (such as CTBTO, FDSN and IRIS for seismic monitoring and GLOSS for sea level monitoring).
- > While the precise production and definition of a tsunami warning requires specific capabilities, the delivery of warnings to the population is usually provided through other mechanisms by mandated agencies (Interior, Cabinet, Civil Defence, Hydrometeorological and Weather Services). Early involvement of these bodies in the national tasks of the PTWS may help save time and money.

**note:** For local tsunamis, which occur just near the coast of a particular country, there is usually a very short time until the tsunami hits the coast. Therefore, local or national warning system should develop community awareness beforehand and initiate emergency action on their own, without waiting for information from overseas organizations. For distant tsunamis, local and national systems securely receive information from international centers, evaluate the effect on domestic coast and decide to issue national warnings.

**b. Regional warning**

Regional systems are for protection from tsunamis that affect several Member States within the Pacific Ocean but do not have an impact over the whole ocean like the 1960 Chilean Tsunami. In other words regional systems are the systems whose area of responsibility (AoR)<sup>3</sup> is a part of the Pacific Ocean. There are already two established regional systems, which are operated by WCATWC and NWPTAC respectively. Meanwhile there are other regions where new regional systems may be required, particularly for the regions that are adjacent to tsunami generation source and have many nations within small area. In such regions cooperation among neighboring Member States of exchanging or integrating real-time seismic and sea level data is essential. In that regard some regional systems should be considered with high priority just like local system establishment. (e.g. system in the Southwest Pacific region where proper detection of earthquakes is difficult in a single country due to sparse distribution of small islands)

**Strategic Objective**

Existent two regional systems:

At least, maintain the present level of operational services provided by WCATWC and NWPTAC.

Achieve further improvement on Warning/Advisory services by these Centers, to include more specific information on the tsunami threat

Other new regional systems:

Develop regional warning systems to provide warning service for the region as required.

Utilise Regional Working Groups to coordinate and share information on user requirements and communication issues and develop capacity on a regional basis

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Existent two regional systems:

The USA and Japan continue their operational services in close cooperation for providing effective Warning/Advisory Services consistent with the PTWC's Warning/Advisory service.

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<sup>3</sup> AoR of regional systems depend on cases. Some are fairly wide so that the systems have characteristics of ocean-wide system, some others are smaller and the systems have characteristics of local systems to some extent. For example, WCATWC and NWPTAC are the former and Pacific side of Central America system would be the latter.

- WCATWC will target providing tsunami height estimations.
- Improve tsunami estimation accuracy.
- Improve earthquake determination (location, depth and M) accuracy.
- Other new regional systems:
  - Share real-time seismic and sea level data among Member States within the region.
  - Establish regional warning center if required and ensure steady operation.

**Suggested Mechanisms:**

Existent two regional systems:

The USA and Japan will continue their longstanding contributions to maintain stable operation and to improve their Tsunami Warning/Advisory services.

Other new regional systems:

Promote cooperation and coordination through regional Working Groups of the ICG/PTWS, receiving and using information and advice from technical Working Groups WGs

Funding is a challenge, but it should be on the countries' own expenses along with efforts to obtain support by international aid funds.

**note:** If all the Member States in the region have capabilities to individually analyze the shared observational data and evaluate the tsunami impact on their own coasts, establishing a regional center that provides tsunami warning for the whole area of the region may be unnecessary. In that case each MS delivers its domestic tsunami warning in the same manner as in local systems.

**c. Ocean-wide warning**

Ocean-wide system deals with tsunamis capable of expanding in a vast area of the Pacific Ocean, affecting a number of countries. This system uses global observational networks of seismic and sea level data, and also requires prompt and reliable communication means to deliver warnings to scattered countries around the Pacific Ocean. This warning information has the role of triggering the national warning procedure in each MS for ocean-wide tsunamis.

**Strategic Objective**

At least, maintain the present level of operational services provided by the PTWC.

Achieve further improvement on Warning/Advisory services by the PTWC.

Utilise Regional Working Groups to coordinate and share information on user requirements and communication issues and develop capacity on a regional basis.

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The USA continues its operational services in close cooperation with other regional centers for providing consistent and effective Warning/Advisory Services. Any further improvement of the PTWS will be constructed on the basis of this present ocean-wide system and service. PTWC will target providing tsunami height estimations.

Improve tsunami estimation accuracy.

Improve earthquake determination (location, depth and M) accuracy.

Keep the Tsunami Warning Focal Point (TWFP) list up to date and as complete and reliable as possible.

**Suggested Mechanisms:**

The USA will continue their longstanding contributions to maintain stable operation and to improve their Tsunami Warning/Advisory services.

The ICG/PTWS will reinforce its mechanisms for obtaining and updating the TWFP list.

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**note:** What is most important for tsunami warning systems of any scale described above (a., b. and c.) is to guarantee stability, reliability and sustainability in the end-to-end operation, from receiving/delivering warning at centers down to the population evacuation, and the system should always be ready (24/7) for the occurrence of this quite rare natural phenomenon. In other words, the primary aim for a warning system should be to maintain the system as a whole and keep the necessary reliability after its construction, or to develop such system as to be easy to maintain and to assure reliability.

From that standpoint state-of-the-art technologies should be carefully assessed before bringing these into operational systems. It is essential to evaluate the newest, promising technologies from the viewpoints of not only effectiveness or attractive prospects but also operational reliability and robustness, when considering introducing them into the warning system.

### ***Detection***

Detection involves the implementation and development of seismic and sea level observing systems that enable rapid assessment and verification of the threat to enhance the accuracy and timeliness of threat information.

#### **Strategic Objective**

Enhance seismic and sea level monitoring capability.

Development of cost efficient sea level observing technologies to maximize the return from resources and underpin sustainability of the system.

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Improve accuracy of earthquake location and size by making available all present and future seismic data collected by national and internationally coordinated networks (such as CTBTO, IRIS, FDSN).

Develop national capability with access to interoperable neighbouring seismic information for detecting local tsunami threat.

Coordinate and share information on the development of analysis techniques.

Timely access for tsunami warning centres to all currently available and suitable sea level station data in agreed standard format (CREX). Priority should be given to stations within 1-hour travel time from known sources.

### **Pillar 3: Awareness and Response**

It is essential that the communities that are vulnerable to the effects of tsunami are made aware of its effects and how to respond when it happens through simple cost-effective and cultural sensitive awareness programmes. Such programs would include developing and disseminating information through the media, workshops/seminars, awareness materials, Internet, signage and billboards. If not already in existence, tsunami related curriculum programs should be developed to build that inherent capability in the young adults and children.

Due to the nature of tsunamis, Member States must be able to respond however this will require putting in place systems and processes to enable cost effective response coordination. These systems and processes would include response management structures, evacuation plans and maps, communication systems to enable such amongst emergency services, emergency operation centers, shelters and other basic necessities to support evacuees/victims, medical, search and rescue infrastructures.

Member States should also plan and conduct exercises on regular basis to test early warning systems and emergency evacuation.



To ensure that Government officials, NGOs, private sector and community representatives are able to provide the required response, sustainable capacity building programs should be developed and delivered.

*Strategic Objectives:*

- Strengthen public awareness of tsunami and associated hazards and how to prepare to respond;
- Develop and conduct exercises to test early warning systems and evacuation mechanisms;
- Establish rapid and effective evacuation mechanism given the risk assessment guidance and data;
- Develop and deliver suitable and sustainable capacity building programs to facilitate effective and efficient response and coordination;
- Establish and or strengthen appropriate response structures to facilitate effective coordination;
- Develop tsunami related curriculum programs for all levels of education to build an inherent capability and raise the interest of young people in the disaster management field providing a source of career development and support to the Member States in the future to plan, respond to and recover from tsunamis; and
- Mainstream awareness and response programs into Member States development strategies and sector plans to facilitate acquiring of resources to enable implementation of required response infrastructures/mechanisms;

Suggested Mechanisms:

- i) Training and instruction to responsible officials of government and awareness raising programmes for the public. Make use of various training and educational programs offered by various organizations. First investigate what programs exist by questioning offering organizations and Member States actually using them, and then compile a list of them as reference information for all Member States
- ii) Translating existing good educational materials into local languages and delivering these materials to the people is one of the best ways for disaster prevention education;
  - ❖ Investigate what materials and supporting system exist by questioning the offering organizations and Member States that are actually using them
  - ❖ For both of the above, it is very important to collect past activities and evaluate their effectiveness for further improvement.
  - ❖ Regarding capacity building and improving public awareness, ITIC takes the main role of activities described above as its main task.
- iii) Full scale evacuation exercises and drills should be considered as reliable preparedness tools to test both warning systems and evacuation plans. It also helps to strengthen awareness of both local governments and population.

## **IV. Foundational Elements**

### **4.1 Interoperability**

Taken together, the GOHWMS and PTWS MTS require three kinds of interoperability:

First, National Tsunami Warning and Mitigation Systems must be interoperable among PTWS Member States and with the PTWC and NWPTAC to ensure full and open access to tsunami-relevant observational data, analysis, advisory and warning information, operational techniques and technologies, and best practices. More effective National Tsunami Warning and Mitigation Systems will result.

Second, the PTWS must be interoperable with other ocean-related hazards warning and mitigation systems to use and share data, analyses, and awareness and preparedness, and other common elements of such systems. Synergies will result that will increase the effectiveness of National Tsunami Warning and Mitigation Systems, regional warning centre operations, and drive down the costs of operating and maintaining ocean-related hazard and mitigation systems.

Third, the PTWS must be interoperable with other ICGs in the context of the GOHWMS framework. Again, improvements in effectiveness and efficiency will result—for Member States both individually and collectively.

For enhancing such interoperability, IOC created the TOWS-WG to coordinate activities of the ICGs and of relevant organizations dealing with other ocean-related hazards. From recognizing that the ICG/PTWS (and its predecessor ICG/ITSU) has been continuously operated and successfully contributed to tsunami disaster mitigation in the Pacific for these forty years, the ICG/PTWS should share its experiences and knowledge within TOWS-WG and learn from new developments in other regions.

### **4.2 Research**

Each of the three pillars requires on-going research and development to advance all elements of the PTWS. Investigations of the tsunami phenomena, including tsunami caused by landslides, volcanoes, and other sources and new developments, whether in tsunami detection, tsunameter technology or innovative GPS applications, new threat-based forecast systems, developments in operations and communications technologies, or innovative approaches to community preparedness need to be monitored, evaluated, and publicized to Member States. Such advances are critical supports to the three central pillars of the PTWS MTS.

There are many new research programs and technologies being conducted and developed. Since these are leading edge activities, many of them provide interesting and relevant results in theory, but they need to be validated in experimental stage in order to be put into practical use. Therefore we have to pre-assess new research results or technologies from various viewpoints such as relevance, effectiveness, efficiency, robustness, ease of maintenance easiness and sustainability before officially introducing them into operational systems.

PTWS needs to promote closer cooperation with relevant research communities. PTWS also should take the role of requesting research communities to conduct or develop research or technology necessary for improving tsunami warning and mitigation system and contribute to solving problems discovered or highlighted through our actual system operations or various other activities.

### **4.3 Capacity Building**

An effective tsunami warning and mitigation system requires ongoing capacity building and training to support all three strategic pillars. Capacity building activities must be carried out continuously and forever in the three strategic pillars. Each country must be able to understand its risk and know ways in which they can mitigate the hazard, provide warning guidance to its populations in a timely manner, and be able to carry out awareness and preparedness activities to sustain knowledge and ability-to-respond across generations.

The building of national human resource capacities that can develop, guide and lead these activities in each country is essential. Substantial experience, knowledge, and best practices have been accumulated over the years by Member States prone to tsunamis. This should be shared widely through trainings and workshops. Training courses and national, cross-sector and inter-regional workshops are excellent ways in which to build these skill sets and at the same time, to improve the networking between countries during a real event.

As these skills are developed over time, trainings should be regularly conducted, and also be continually refreshed as new methods, technologies, and practices are identified. An example of regular training already available within the PTWS is the ITSU Training Programme organized by the ITIC for PTWS Member States since the 1970s; such a programme--and others--can be expanded and/or customized to encompass and meet the needs of all countries.

### **4.4 Funding and System Sustainability**

Like any system, a robust, effective PTWS requires substantial investment to be viable and evolve to meet new needs and incorporate new technologies. There is a need for renewed Member State commitment to invest in National Tsunami Warning and Mitigation Systems and to contribute—in whatever way possible—to the operation of the PTWS. In addition, there is a need engage donor agencies and organizations to support all elements of the end-to-end tsunami warning and mitigation system in the Pacific Ocean.

Implementing this Medium Term Strategy will require additional investments from within and outside the PTWS Member States. A separate supporting funding and sustainability strategy is needed to realize these investments.

## **V. Implementation**

The PTWS Steering Committee will coordinate and monitor MTS implementation.