Warning and Situational-Awareness

Myanmar Controlled-Exercises REPORT

CAP on a Map Project

FOR

the Myanmar Department of Meteorology and Hydrology
Ministry of Transportation and Communication

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The Sahana Software Foundation is dedicated to the mission of saving lives by providing information management solutions that enable organizations and communities to better prepare for and respond to disasters. We develop free and open source software and provide services that help solve concrete problems and bring efficiencies to disaster response coordination between governments, aid organizations, civil society and the victims themselves.

The report contains findings from a study carried out to understand the readiness of Myanmar to operationalize the Sahana Alerting and Messaging Broker (SAMBRO) for their early warning and situational-awareness information needs. The report was prepared after analyzing the inputs obtained, through a set of controlled-exercises, conducted with various stakeholders belonging to Government and Nongovernmental Organizations (NGOs) managing emergency and crisis response in Myanmar. The report prescribes recommendations for consideration of the Government of Myanmar towards institutionalizing the SAMBRO warning and situational-awareness system in support of Disaster Risk Reduction and Management. The report targets Policy-makers of the National Warning Centers and Disaster Management Organizations. Mr. Nuwan Waidyanatha, Sahana Software Foundation Emergency Communication Expert and a Senior Research Fellow affiliated with LIRNEasia, lead the study and prepared the report. Mr. Biplov Bhandari a Sahana Developer and Asian Institute of Technology Researcher, has made contributions in assisting with staging the SAMBRO system, carrying out controlled-exercises, and consolidating the data in Myanmar. The controlled-exercises were executed under the supervision of Dr. Hrinnei Thiam, Director General - Myanmar Department of Meteorology and Hydrology.

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Evaluation Outcomes Report - Myanmar

1 EXECUTIVE SUMMARY

A challenge, in Myanmar, is notifying all Response Organization and the Public of an imminent threats, giving them ample time to prepare and respond to the hazard events. Sahana Alerting and Messaging Broker (SAMBRO), hosted at www.dmgwarning.gov.mm, was designed to **swiftly deliver warnings to National, Regional, and Townships, in minutes**. It creates a single link between the entities and individuals at the various administrative strata of a National Early Warning System (EWS). SAMBRO removes the need for costly and laborious hierarchical Phone and Fax trees with multiple Organisational nodes and links that can take hours to complete a dissemination cycle, as currently exercised in Myanmar. The SAMBRO technology, with SMS, Email, Web, and the Mobile App, has proven its capability to be effective in disseminating the single entry of a message to all targeted recipients through the multiple redundant communications channels in a manner of minutes.

Evidence from the evaluation surveys on the SAMBRO acceptance, with a score of ~3.6 of 5.0 (Figure 9) by Myanmar users to be inclined towards agreeing that the technology is easy-to-use and useful. All things considered, with a score of ~5.6 of 7.0, (Figure 10), the users had a positive perception of the technology with them indicating that it was beneficial, wise, and good to adopt. To evaluate the acceptance and the performance of the SAMBRO-enabled Myanmar Warning and Situational-Awareness Platform, a team of experts carried out a series of controlled-exercises in Naypyitaw, Kunyangong, and Nauyangdon. These involved members from invited Government Warning and Response Organizations participating in controlled-exercises. Findings to date are that the DMH staff were competent in issuing warnings, using SAMBRO, within the required “warning horizon” (Figure 6). However, some supplementary training and modifications in the implementation are required.

With SAMBRO “no one is forgotten” and all authorized personnel and the public receive the warnings and alerts. SAMBRO does depend on the reliability of the commercial telecommunications in Myanmar. The “common alerting picture” offers visualization of geographically targeted alerts on a map. SAMBRO features offer tools for filtering every National, Regional, and Township warning issues in the country. It **brings real-time awareness to all warning and response organizations**. That SAMBRO platform is able to integrate and serve every National, Regional, and Township warning center and response organization. A challenge faced by DMH is promoting the adoption of the versatile technology that brings coordination and cohesion to early warning in Myanmar. For DMH to offer the full benefits and potential of SAMBRO there must be National policies and plans to support their efforts to mobilize the National, Regional, and Township Response Organization to make full use of SAMBRO’s potential.

The SAMBRO EWS adopt an all-hazard all-media approach to integrating all National Warning Centers with available dissemination channels: Mobile Cellular Networks, Internet, and Broadcast media. The data exchange is fostered through the ITU-T X.1303 “Common Alerting Protocol[1] (CAP) warning standard[2]”. CAP-enabled SAMBRO allows for a distributed warning system that easily integrates with any CAP-enabled National or International warning system. For example, Google Public Alert (https://www.google.org/publicalerts) is now able to receive a CAP feed from DMH to re-cast the public warnings through all of Google’s products. CAP is recognized and advocated by the World Meteorological Organization (WMO), International Telecommunication Union (ITU), International Federation of Red Cross/Crescent (IFRC), and several other International Organizations.

There are difficulties that DMH must overcome to complete the interoperable CAP standard and the CAP-enabled SAMBRO platform for enhanced warning and situational-awareness in Myanmar. For example, integrating a much needed SMS gateway that brings efficiencies to the EWS, has been an enormous challenge for DMH. It has not been a practice for Myanmar to offer bulk SMS products for Government or Commercial use; whereby systems can directly interface with the Mobile Service Operators. Adopting such versatile technologies reduces costs and brings efficiency to early warning.

To support DMH with the expansion of the CAP and SAMBRO warning and situational-awareness platform, in Myanmar, we are recommending three key initiatives:

1. Promote the CAP-enabled and SAMBRO all-hazard all-media syst through evidence-based policy advocacy by sharing knowledge with National-level Policy-makers and Decision-makers to support the formulation of National policies, strategies and plans

2. Formulate a CAP working group, involving members of the Emergency Communication Committee (EmCC) and other relevant Stakeholders, to define the CAP implementation policies, strategies and plans as well as to oversee the CAP and SAMBRO expansion initiatives

3. Offer a CAP and Situational-Awareness training and certification program to support the Stakeholder Organizations with the adoption and implementation of CAP and CAP-enabled EWSs such as SAMBRO

By putting these recommendations into action, Myanmar will join the global consortium of Nations that have adopted the CAP standard to improve interoperability for sharing warnings across National and International EWSs for saving lives.

[1] CAP v1.2 standard specifications: http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html
[2] ITU-T X.1303 Recommendation: https://www.itu.int/rec/T-REC-X.1303-200709-I/en

2 INTRODUCTION

Figure 1 - 2015 flood after the CAP on a Map Kick-off workshop

Myanmar is vulnerable to a multitude of natural hazards. Floods (Figure 1) and Winds account for approximately 95% of the, recorded US$ 2 Million, 'average annual losses'. Effective early warnings are an important element of Disaster Risk Reduction (DRR) for saving lives and reducing economic losses in Myanmar.

To support Myanmar's DRR and Disaster Risk Management (DRM) efforts, with financial assistance from the United Nations Economic Commision for the Asia and Pacific (ESCAP), the Sahana Software Foundation partnered with the Asian Institute of Technology Geoinformatic Center in implementing the "CAP on a Map" project for "improving institutional responsiveness to coastal hazards through cross-agency situational awareness". It was an all-hazard all-media approach whereby the Common Alerting Protocol (CAP) warning standard and procedures, along with the Sahana Alerting and Messaging Broker (SAMBRO) software tool for managing DRR/DRM, were instrumental to achieving the project goal and objectives.

The SAMBRO software system was customized to serve Myanmar's warning needs. A set of Trainers, associated with the Myanmar Department of Meteorology and Hydrology (DMH), were given training. They intern trained a set of Trainers belonging to the Relief and Resettlement Department (RRD), Government Administration Department (GAD), Fire Services Department (FSD), Department of Irrigation (DOI), Department of Fisheries (DOF), Department of Agriculture (DOA), Department of Inland Water Transport (DOIWT), Department of Health (DOH), Myanmar Post and Telecommunication (MPT) and the Myanmar Red Cross Society. The National Trainers were responsible for building capacity within their respective Organizations for operationalizing and using SAMBRO for enabling the coordinated approach to early warning and dissemination.

DMH tested the system over several months (Figure 4) in preparation for putting it to full use during the Monsoon season. The testing involved that the warning classifications and predefined CAP message templates, and the message dissemination, through Email and the

Web, performed to the desired expectations. Throughout this period, SAMBRO was refined and operationalized based on the lessons learned during the test period.

A series of “controlled-exercises” were carried out, June 25th through the 30th, 2016, to evaluate the performance of the implemented system and the trained resource persons in operating and maintaining the SAMBRO warning and situational-awareness system. The report discusses the findings from controlled-exercises and recommends strategies to overcome the prevailing shortcomings. DMH might consider these recommendations in shaping National policies and strategies for integrating the Myanmar Warning and Situational-Awareness platform to serve in their early warning dissemination practices and visualization of a the common alerting picture.

3 METHODOLOGY

The methodology discuss in this section relates to the controlled-exercises. The key research question we ask was “**did the technology and the people perform as expected on the day of the controlled-exercise?**”. The goal of the “controlled-exercises” were to determine the readiness of Myanmar before going live with launching the system.
The evaluation process examined the three questions:

1. Have the Implementers operationalized the National cross-agency situational-awareness platform to meet the user expectations and ease-of-use?
2. Are the National Alerting Authorities competent in publishing effective CAP-enabled messages for a warming cycle?
3. Are the Subscribers, namely First-Responders, able to decipher the CAP-enabled messages that were received over the various channels (i.e. were they able to determine the necessary actions or inactions to exercise based on their SOPs)?

These questions were answered through a series of exploitation-evaluation activities following a format of Simulations and Tabletop Exercises (TTXs). The activities constituted three steps:

1. discussion of the operating procedures,
2. actual execution of those procedures, and
3. evaluating the outcomes

These activities were designed as verification exercises to determine the system’s:

1. Usability (UI/UX on system complexities, efficiencies, and quality),
2. Adaptability (capabilities and capacities to alter to the change and new system), and
3. Utility (state of being useful, beneficial, and cost-effective).

4 DESIGN

4.1 Training

Three members belonging to the DMH Meteorology, Hydrology, and Seismology were given training on the CAP warning standard and SAMBRO software system[3]. During the two weeks training, the three participants were exposed SAMBRO GIS techniques for developing predefined alert areas. The trainees completed a syllabus on the CAP standard and procedures. Thereafter, they were introduced the alerting features of SAMBRO in defining the event types, warning classifications (or warning priorities), and hazard specific CAP message templates. Following these activities the three trainees underwent a series of scenario driven alerting exercises to realize the behaviour of SAMBRO in serving their warning information needs and operational workflows.

The three trainees served as National Trainers to train the relevant Stakeholders; namely, other National Warning Centers, Disaster Management Organizations, and In-line Agencies[4]. The National Trainers exposed the users to the same CAP and SAMBRO training syllabus. A subsequent action and objective, of the National training segment, was for the National trainees to build capacity within their own organizations.

4.2 Controlled-Exercises

The basis of the controlled-exercises were such that all Alerting Authorities, responsible for issuing warnings, and Response Organization, responsible for receiving and relaying warnings, should have been trained and gone through a series of silent-testing to ready themselves for the controlled-exercises. The controlled-exercises should not be a surprise to the participants engaging in the Simulations and TTX.

The controlled-exercises comprised three evaluation stages, as shown in Figure 2:

1. Alerting Authorities: DMH staff in Naypyitaw issuing alerts
2. Response Organizations: RRD, GAD, DOI, DOA, DOF, DOH, DOIWT and MRCS staff subscribing to alerts and relaying alerts to their First-Responders
3. First-Responders: RRD, GAD, DOI, DOA, DOF, DOH, and MRCS staff in Kunyangong and Nauyangdon receive the alerts to execute their response plans

[3] Training of Trainers workshop: http://eden.sahanafoundation.org/wiki/Event/2015/SAMBRO_Workshop_TH_AIT
[4] Myanmar National Training Workshop: http://eden.sahanafoundation.org/wiki/Event/2016/CAP_MM_DMH_Training

Figure 2 - warning message originate and relay workflow

4.2.1 Alerting Authorities

DMH staff comprised members from Seismology, Meteorology, and Hydrology Divisions. They were separated into three groups: DMH-Earthquake, DMH-Meteorology, and DMH-Hydrology. Each group created a hypothetical scenario. Thereafter, they established their goal, intent, and actions. These steps, of formulating the “gulf of execution”, allowed them to realize their responsibilities and objectives in the exercise. Each group member executed a three stage alerting cycle: 1) created an alert, 2) then updated the alert, and 3) finally issued an “All-Clear” alert. They then examined the alerts posted on the web and received through email to determine the completeness.

A set of Observers were assigned to each group member to observe their behaviour in using SAMBRO for issuing the alerts. The Observers were given a questionnaire with score cards to assess the behavioural complexities of the user. Additionally, we used the Camstudio screen capture software to record the behaviour to then later examine the workflows. The screen capture videos provided insights on the sequence of actions and length of time the users exercised to accomplish their alerting activity.

4.2.2 Response Organizations

Response Organizations are those organizations that receive alerts from DMH and typically relay them to their own First-Responders. Participants from RRD, GAD, DOI, DOA, DOF, DOH, and MRCS attend the controlled-exercises. Each member installed the Mobile App and registered in SAMBRO to receive and relay alerts. Thereafter, the DMH staff issued an alert for the participants to experience receiving the alerts over Email, Mobile App, and viewing on the Web. The controlled-exercises took place at the premises of the RRD Emergency Operation Center.

4.2.3 First-Responders

The participating First-Responders belong to the Township’s Police, Fire, RRD, GAD, DOI, DOA, and DOH. During the exercises, the First-Responders installed the SAMBRO Mobile App and registered in the system to receive email alerts. The participants developed hypothetical scenarios that were relevant and based on previous experiences. A DMH staff member, then, issued an alert targeting those First-Responders. They used the received alerts to contextualise the tabletop exercises by sharing their opinion on the utility, usability, and adaptability of the CAP-enabled SAMBRO technology.

In this segment of the controlled-exercises we examine the aptitude and readiness of First-Responders to receive alerts generated and disseminated through the SAMBRO system. The project carried the exercises in Kunyangong and Nyaungdon Township in the Yangon Region (Figure 3).

Kungyangon is located in the south-western part of the Yangon city closer to the Andaman sea. The 2014 Myanmar Population and Housing Census indicates the population of Kungyangon to be around 111,000. The low lying area is rich in agriculture. Fisheries sector contributes to the economy as well. Cyclones and strong winds are the significant natural threats to the Township.

Nyaungdon Situated in the Ayeyarwady Region of south-west Myanmar,in the Maubin District. It is a Farming community bordering the Ayeyarwady river that wraps around their township. The 2014 Census estimates a population of 215,000. Heavy rains upstream can inundate their homes and crops and devastate their livestock, if they don't receive advance warnings to secure their lives and livelihoods.

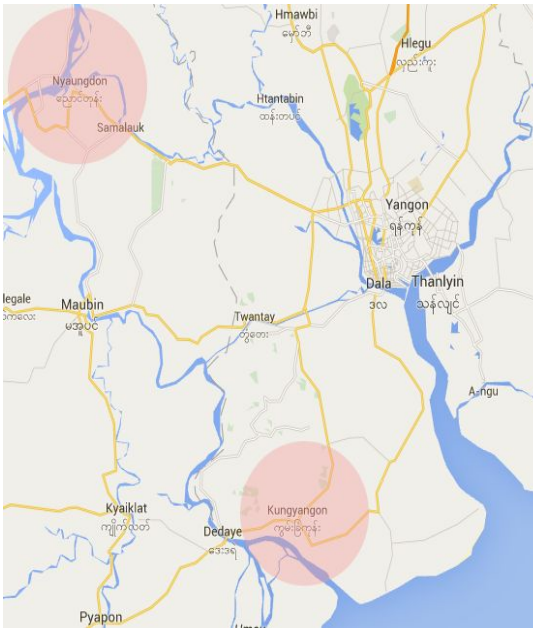

Figure 3 - Kungyangon and Nyaungdon

5 RESULTS

5.1 Silent-Tests

DMH carried out a series of silent-tests over a period of three (03) months prior to the controlled-exercises. These were intended to finetune their instance of SAMBRO. During this timeframe the DMH staff used SAMBRO to issue alerts under real circumstances to identifying the shortcomings in the implementation. Figure 4 shows the frequency of silent-tests carried out over the 3 months. Silent-tests were carried out, on average, every 2 - 3 days (mean = 2.69, standard deviation = 2.00). These were message predominantly on strong winds, cyclone emerging in the region, detected earthquake in the region, heavy rains, and floods.

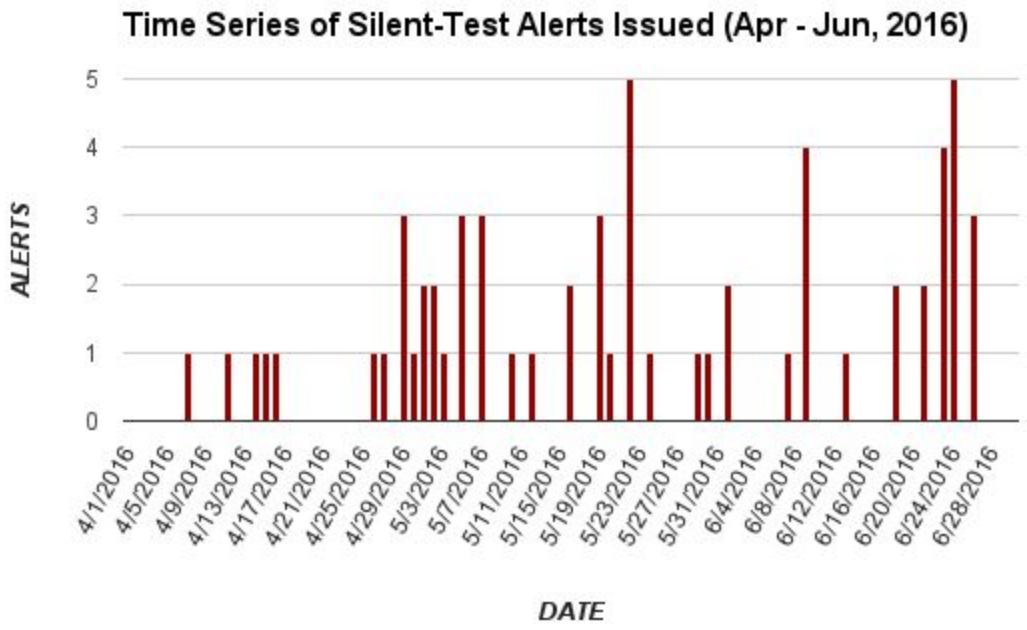

Figure 4 - Silent-test time series

5.2 Messaging Competencies

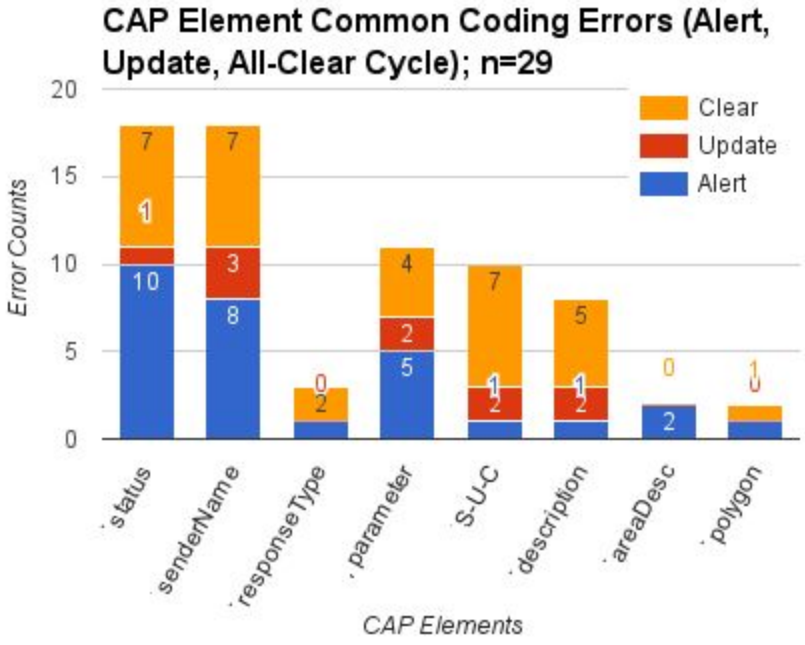

Figure 5 - Alert block coding errors

The message completeness (or consistency), shown in Figure 5, was heuristically measured. The CAP message files for each user and for each warning stage: alert, update, and All-Clear were examined by the evaluation team. The scoring method counted each CAP value that consisted of a coding error. They were were grouped by the hazard event and the warning stage. The sum for each hazard event, warning stage, and CAP element combination was calculated.

5.3 Messaging Efficiencies

5.3.1 Publishers

The alert Publishers, belonging to each of the groups: DMH-Seismology, DMH-Meteorology, and DMH-Hydrology went through a warning stage of issuing issuing an alert, then updating it and finally issuing an All-Clear alert. Figure 6 shows the respective times taken by each group to complete their task for their chosen hazard event and warning stage: earthquake/tsunami by DMH-Seismology, cyclone by DMH-Meteorology, and Flood by DMH-Hydrology.

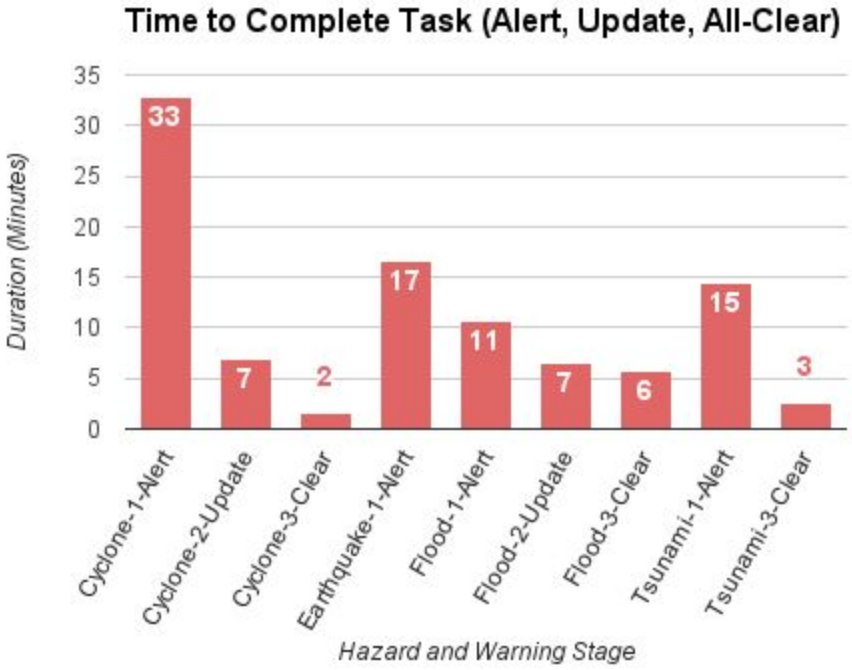

Figure 6 - Time to complete warning stage

5.3.2 Subscribers

The time taken for the alert Subscribers to receive the warnings is shown in Table 1. The time was recorded when the Publisher (i.e. DMH Staff member) began creating and issuing the alert message. The time was recorded by the Subscribers (or First-Responders) when the message was received by them in the Townships. The receive time was not the time indicated in the Mobile App or Email details but rather the time the recipients viewed the message on their devices. Given that the Web link is communicated through the Email and Mobile App, it would naturally be delayed relative to reading the summary in an Email or Mobile App.

Table 1 - Time to receive the warning on the Subscriber device

	Email	*Mob App*	*Web*
Kunyangong	0:30:51	0:30:30	0:32:00
Nauyongdon	0:09:15	0:13:48	0:11:30

5.4 Messaging Complexities

The complexity is based on a sample of 7 observed inputs. The Observers noted the number of attempts it took each Publisher to complete their tasks sequence with performing the independent actions: login, select template (or alert message for update and All-Clear), complete the alert block, info block, and the area block, of the CAP message. Figure 7 shows that, For most cases, it took each user 1 attempt but no more than 2 attempts in some of the cases.

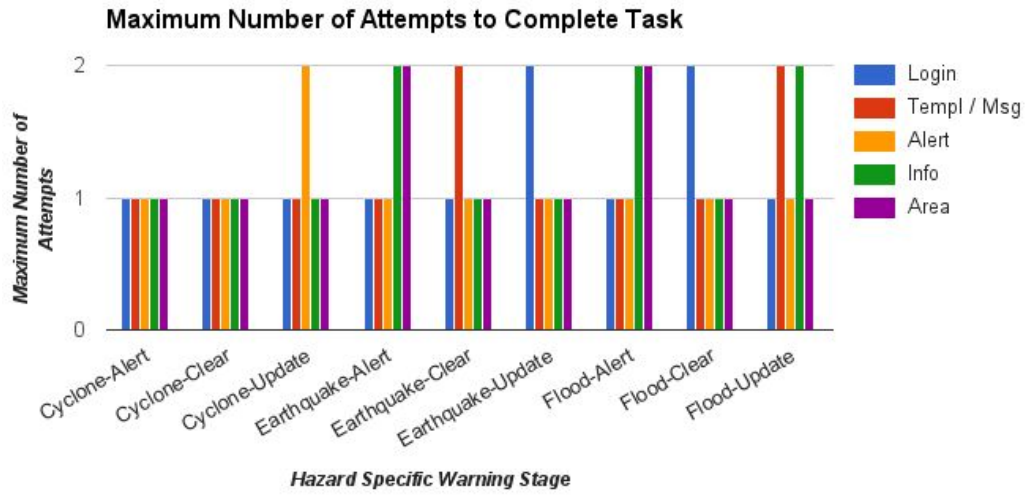

Figure 7 - Maximum number of user attempts

The Observers noted their personal perception of the Publisher's complexity to complete the tasks sequence actions: login, select template (or alert message), complete the alert block, info block, and the area block. Scoring was 1 = extremely difficult, 2 = difficult, 3 = moderate, 4 = easy, and 5 = extremely easy. With an overall average of 3.86 and a standard deviation of 0.60, we may infer that it was closer to being “easy” for all users to complete their tasks, minus a few exceptional cases, shown in Figure 8.

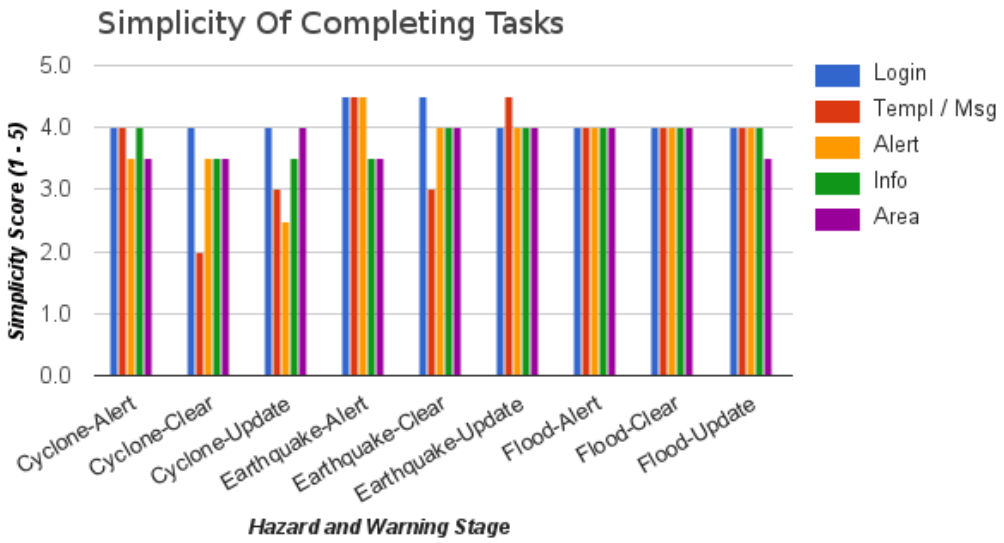

Figure 8 - Median simplicity (1 - complexity) of completing the tasks

The controlled-exercises had 3-4 users in each group issuing the same alert. To update or clear an alert the user must first find the alert message in the listing. Given the similarities of the 3-4 alerts, the users struggled to find their own alert to follow the next step of updating or issuing an “All-Clear” message. Some users were smart to use the search option to type in keywords such as their email address or sender data to quickly find their own alert message.

Some users had either forgotten to complete the description, instruction, or set the warning-classification to complete the info block; which required them to revisit the info block for a second attempt to complete. The consensus is that the tool for drawing the area on a map should be a more user friendly. Some users had difficulty zooming into the appropriate area on the map drawing the polygons to cover the area. These were apparent when drawing polygons for potential tsunami affecting or flood affecting areas.

5.5 Technology Acceptance

Technology Acceptance scores for the users’ perception of ease-of-use and usefulness of SAMBRO is shown in Figure 9 and the users’ attitude towards using SAMBRO in their work flows is shown in Figure 10. The ease-of-use and usefulness were given a score based on the likert scale 1 = strongly disagree, 2 = disagree, 3 = partial, 4= agree, and 5 = strongly agree. The attitude towards using was given a score based on the likert scale 1 = extremely, 2 = quite, 3 = somewhat bad / harmful / foolish / negative; 4 = neither nor; 5 = somewhat, 6 = quite, 7 = extremely good / beneficial / wise / positive.

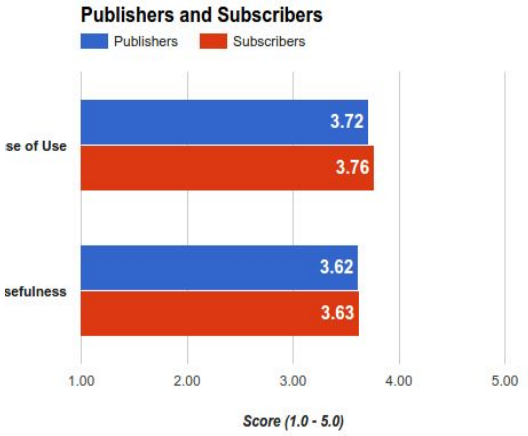

Figure 9 - user perception of SAMBRO usability

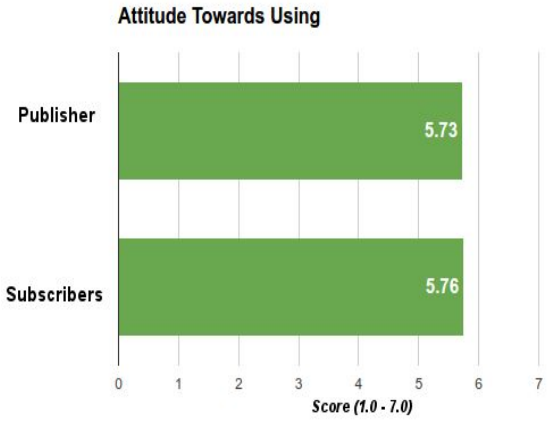

Figure 10 - User attitude towards using SAMBRO

The Technology Acceptance Model (TAM) results, in Figures 9 and 10, indicate that on average both the Publishers and the Subscribers are closer to agreeing that the SAMBRO warning dissemination technology is easy-to-use and agree that it is useful. All things considered, their attitude towards adopting SAMBRO, is closer to being “quite good, beneficial, wise, and positive”.

6 SYNTHESIS

The key question was “**did the technology, implementation, and the people perform as expected on the day of the controlled-exercise?**” Results from the controlled-exercise imply that the DMH, with some minor adjustments, is ready to begin publishing live alerts. However, the Government of Myanmar must integrate RRD, GAD, and other Stakeholders to complete the implementation. The identified shortcomings in the implementation and the aptitude of the users must be given emphasis. Key reasons for are technology and people to perform purely on the day of the exercise are that the:

1. Implementation was incomplete
2. Training was inadequate
3. Technology had some shortcomings

All the participants seem to have a general aptitude of using SAMBRO and the CAP concepts. However, frequent refresher courses would be beneficial. The implementation work could have received more planning and attention to improve the ease-of-use of SAMBRO; especially, with the CAP message Templates.

6.1 Incomplete Implementation

The implementation is two fold. It requires implementing SAMBRO for sending and receiving alert messages and implementing the CAP standard for interoperability. The section discusses the issues related to the:

1. SAMBRO implementation, and
2. CAP standard

6.1.1 SAMBRO Specific Issues

Results in Figures 5 indicate that CAP message templates, warning-classifications, and standard operating procedures were incomplete. Although it was expected that these prerequisites to have been in place, prior to the controlled-exercises, the participating users had to complete them on the day of the exercise. These shortcomings were the main cause for the resulting complexities discussed in Figures 7 and 8. In a typical implementation the event types, warning classifications, predefined CAP message templates, predefined CAP message area polygons, user accounts, subscriber lists, and subscriber groups should have been defined.

6.1.1.1 Clean Database

The observers also noticed a lot of unnecessary data such as a various renditions of the event types, warning priorities, and message templates that confused the users during the controlled-exercises. These redundant data should have been removed and the users should have been presented with a clean database to avoid confusions.

6.1.1.2 Optimizing the Message Templates

Some users did not realize that a single CAP message template could have been used for various stages of a hazard event. The users developed a template for each warning stage. One reason was because DMH has defined different descriptions for each stage of the warning cycle. In the case of a flood warning, the description for a rising flood is different from when the flood water has saturated to a peak and is different from when the flood waters were receding. The DMH Hydrology Division was clever in maintaining the three different descriptions in a separate text document, and in each Alert Editors personal computer, to copy and paste those descriptions for the given circumstance.

A single template with the five stage warning classification could have served a cyclone warning cycle from yellow, orange, red, brown, and green. The implementation had five different templates for each stage. This violates the CAP procedure for linking the chain of alerts because each time a user selects a new template and starts a new message SAMBRO treats it as a new event. It is important that the chain of alerts belonging to the same event, linked through the CAP “reference” element, comply for alerting hubs and rendering agents to realize the relationship between the alert messages during the alert, update, and All-Clear cycle.

6.1.1.3 Glossary of Commonly Used Terms

There were inconsistencies with the spelling. Users should be mindful of using the correct English spelling. These were mostly observed in the ‘description’, ‘instruction’, and ‘areaDesc’ CAP elements. It might be helpful for DMH to define a glossary of terms, based on the risk profile, that the users can simply copy and paste into the SAMBRO textboxes. For example, if it is known that Chin State is a flood risk area, then the a glossary with names of places prone to foods can be provided in a reference document.

6.1.1.4 Predefined Alert Areas

Predefined alert areas removes the challenge of an Alert Editor to define the potential impacting and alerting area polygon. Warning-classification and hazard specific predefined alert areas can be stored in SAMBRO to be reused. Some of the complexities illustrated in Figures 7 and 8 could have been mitigated with the introduction of predefined alert areas.

6.1.1.5 Translation to Myanma Bhasa

Some users had forgotten to complete or add the Info block for Burmese language. It is important that every alert message carries the English equivalent in Burmese. A large portion of the population do not comprehend the English language.

SAMBRO offers automatic translation of English to Burmese. These would include CAP index values, such as the scope, msgType, status, category, urgency, severity, certainty, so on and so forth. Others are common terms used in the CAP headline, event type, event, warning priority, and areaDesc (area descriptions) that can be translated before hand for SAMBRO to automatically translate the english strings to Burmese.

6.1.2 CAP specific issues

In general the participants did not seem to have received a comprehensive training in the CAP standard and the specifications. All SAMBRO users should have received an introductory training to the CAP specifications. This would give them a better understanding of the utility and the purpose of SAMBRO.

6.1.2.1 Unambiguous messaging

Often the participants used acronyms. It is important the CAP messages remove any kind of ambiguity. Moreover, these messages are not intended only for DMH and only for Myanmar. CAP messages with a public scope are for a wider audience including the International community. Alerting Authorities, in Myanmar, should avoid using any acronyms that are unclear to external audiences.

Figure 5 illustrates the errors found in the CAP messages. In SAMBRO, the CAP address element is populated by selecting the group name from a drop down list. The implementers had named the groups with an acronym. These values should be human readable values and not

acronyms. Therefore, implementers should take precaution to avoid using acronyms and encourage the use of complete names.

A predominant portion of the errors were on setting the “senderName”, “restriction” and the “audience”. The senderName, restriction, and audience that would typically carry a name such as the Department of Meteorology and Hydrology should be written in full and not as DMH. If acronyms are to be used then they should be defined in the CAP Instructions or the CAP message should provide a glossary of terms as a Resource.

6.1.2.2 Status of Test vs Exercise

Figure 5 shows that the status was inappropriately set to “Test”. For the purpose of the controlled-exercises the value should have been set to “Exercise”. Most users forgot to set the CAP message “status” to “exercise” and they set it to “test”, instead. The value “Test” is used for silent-tests and the value “exercise” is used for activities such these controlled-exercises.

6.1.2.3 Sender and SenderName

The “sender” value did not comply with the CAP specifications of being a unique globally assigned value such as an email address or internet domain name. In one instance the msgType was set as Cancel for an All-Clear stage message.

The senderName should be a human readable and comprehensible value that clearly indicates the name of the individual or the entity responsible for issuing the messages. Often participants were using their email addresses or other values.

6.1.2.4 Onset and other date and times

The ‘onset’ CAP element is an optional field. However, it may be appropriate to mention the onset of the Earthquake that may be a specific field important to third-party systems that may use that value in tsunami modeling. It is equally important to set an appropriate “expire” date and time indicating when the message would expire.

6.1.2.5 Parameter Naming Convention

There were attempts to use the CAP ‘parameter’ element. Figure 5 shows that in most cases the users show a level of incompleteness in using the parameter element. There were inconsis and the values were incomplete. For example, the rainfall value which should have been a number was written in words or provided some other description.

Some parameters had unnecessary hanging characters like brackets and in other cases the parameter valueName was filled with the parameter value. A few cases the users had indicated the rainfall (parameter value) in event code.

Other cases the parameter value is indicated in the parameter valueName instead. DMH might consider a naming convention for the parameter values. A suggestion might be “hazardname:measurename:unit”. For example, for a parameter valueName of

“flood:height:meters” would carry the numerical parameter value (e.g. 15) of the flood height and the parameter valueName “earthquake-magnitude-richters” would carry the numeric parameter value (e.g. 8.2) measured in Richters.

6.1.2.6 Headline to be more descriptive

DMH might consider a more descriptive value for the “headline” element of a CAP message. It might contain the event, possible effecting area, and the magnitude. The headline should provide more information than simply the event. For example, “Earthquake in the Gulf of Martaban, Myanmar”, “Heavy Rains, 77mm past 24 hours in Chin State, Myanmar”, or “Cyclone 200 miles of the coast, heading to Myanmar”.

6.1.2.7 All-Clear (threat no longer exists)

In CAP there is a clear distinction between canceling a message versus clearing an event (or indicating there is no longer any threat). When a user indicates the msgType = “Cancel” this implies that they are canceling the previous message with the identifier indicated in the CAP reference element and is not an indication of canceling the event. To provide an “All-Clear” or to stand down on the threat, the msgType is set to “Update” and the responseType should be set to “All-Clear”.

Additionally, with an All-Clear message the description should indicate that the threat no longer exists. The description should no longer provide past event information such “according to the (15:30) hr M.S.T observation today, the water level of Ayeyarwaddy River at Hinthada has exceeded by about (0.5) foot it may fall below its danger level but it remain above its danger level during the next (1) day”. This message still implies that the threat is still active and has not subsided yet.

6.1.2.8 Urgency, Severity, and Certainty

Whenever, the warning classification was undefined and the users attempted to set the severity, certainty, and urgency there is evidence of confusion. Especially, the values for the All-Clear message did not agree and was indicating severity, certainty, and urgency values from the previous update message.

The severity, certainty, and urgency values, for an All-Clear message, should be set appropriately. Certainty should not be set to “Likely” as observed in most of the alert messages issued by the users. Instead it should be set to “Unlikely” - not expected to occur p ~ 0; indicating that the event is no longer a threat. The Urgency should be set to “Past” - responsive action is no longer required “Unknown” - Urgency not known and “Minor” – Minimal to no known threat to life or property.

The warning-classification allows for defining the CAP severity, certainty, and urgency values to define the priority of the message. The implementers might consider mapping the severity, certainty, and urgency to a warning-classification value for the ease-of-use. Some discrepancies were around the severity and certainty values. For a tsunamigenic earthquake, the users may

want to indicate a possibly severity level other than “unknown”. If it is unknown as to whether the tsunami is likely then the severity should be set to “minor”.

The certainty can be set to ‘likely’ implying that there is a less than 50% chance of a tsunami or it is “possible” at the current point. The instructions can follow with a message to the recipients implying that they should prepare and be vigilant of the situation and be ready to receive the next update indicating whether a tsunami is imminent or not. When an event is cleared the severity and certainty can be set to a value other than “unknown”.

6.1.2.9 Description must be comprehensive

Some descriptions were incomplete. The CAP message templates provide partial text for the description element. The intent is for the users to complete the event specific information at the time of issuing the the alert. There were instances where users had forgotten to fill in the blanks with the event specific data. In other cases, the users had not provided a complete description leaving out important information such as the name of the agency providing the alert data, relevant dates, and locations.

6.1.2.10 Area to be meaningful

The alert block, of a CAP message, has very few attributes to complete and they are mostly selecting values from an option. The info and area blocks must be carefully completed and Figure 5 shows some of those complexities.

The area block had very little errors. The process is quite easy. Simply provide the areaDesc and draw a polygon or a circle on the map to indicate the area. A couple of users had forgotten to draw the area on the map. There were accidental use of the geocode element to indicate an earthquake magnitude. Some areaDesc values were ambiguous and did not describe the actual locations such as writing “coastal areas”, which should, at least, indicate “Myanmar Coastal Areas”.

6.2 Inadequate Training

6.2.1 DMH Users

The TAM questionnaire was answered by 9 participants. The first six questions were designed to determine the technology ease-of-use. The average score was 3.44 with a variance of 0.4, implies that all the users were consistent in expressing their perception of being between ‘impartial’ (likert score of 3) and ‘agreeing’ (likert score of 4); i.e. SAMBRO was easy to use. They had a similar perception on the usefulness of the technology, with an average score of 3.68 and variance of 0.78 (slightly inconsistent), but more inclined towards ‘agreeing’ that SAMBRO was useful.

These results imply that the users had not continued to use SAMBRO following the training to realize the true utility of the technology. Moreover, Figures 5 provide further evidence on the users’ weaknesses to follow the operating procedures. “Practice makes perfect” is something DMH might consider. The users must realize that SAMBRO is an enterprise solution designed

for a specialized mission critical activity. Therefore, training and continues training should not be taken lightly.

6.2.2 Response Organizations

Response Organizations, such RRD, GAD, MRCS, DOI, DOA, DOH, and DOF had received training. However, they had not realized the objective of the training, which was to bring awareness within their departments and train their own users. Thereafter, they were to collaborate with DMH with operationalizing the system. The trained staff were junior staff members who had been nominated simply for the sake of sending participants to the workshop. They were not in any authoritative position to bring awareness to their respective organizations and conduct any training to ready their internal users. Moreover, the trained participants capable of influencing their Department Heads. This is not a weakness on the part of DMH but rather a policy issue that should drive the commitment.

The controlled-exercises with the Response Organizations were merely another awareness exercise. The participants from RRD, GAD, DOI, DOH, and MRCS were demonstrated the utility of SAMBRO. DMH has no jurisdiction over any of the Response Organizations. The First-Responders are affiliated with the Response Organizations. Therefore, any kind of capacity building would have to be carried out by the staff belonging to the Response Organizations.

To that end, First-Responders in Kunyangong and Nauyangdon had not been exposed to SAMBRO and the accompanying new warning procedures. The First-Responders had not been registered as Subscribers and the mobile app was not installed and configured to receive alerts. Prior to the controlled-exercises these implementation specific activities had to be carried out, first. The mobile app and email was self-intuitive for the First-Responders to participate in the controlled-exercises with receiving early warnings.

6.3 Technology gaps

On the day of the controlled-exercise, all basic functionality of the SAMBRO technology worked except for the SMS delivery channel. DMH was struggling to obtain an SMS gateway and were consistent in pursuing with MPT to facilitate it. Bulk SMS and SMS gateways are not services that are currently offered in Myanmar. At present the Mobile Service Operators do not offer commercial bulk SMS products. Online commercial SMS gateways with bulk SMS products, such as Clickatell or TextMagic, do not service Myanmar either.

Table 1 shows a significant delay in Kunyangong receiving the alert messages. The significant delay in Kunyangong was because the SAMBRO Server, at the DMH head office data center, was dysfunctional. The data center lost power which disconnected the server from the Internet for the Publisher to create and disseminate the warning. The SAMBRO server has an Uninterrupted Power Service (UPS) capable of sustaining the power for SAMBRO for 20 - 30 minutes. However, the dependent Internet is not secured to work with a backup power. An

alternative solution is for MPT to host the server in their data center which is equipped to handle power failures.

The time of receiving and accessing the alert messages through the three technologies are somewhat consistent. To access the information on the Web, the Subscriber would typically click on the URL embedded in the Email body or click on the ‘view on the web’ button on the mobile app. If that had SMS, then the SMS text would carry the URL as well. The additional one to two minutes, indicated in the column labeled ‘Web’, in Table 1, is because it took some time for the user to login and for the browser to load the descriptive content with the map. Both the email and mobile app data is communicated through the Internet. The Subscribers, in Kunyangong and Nauyongdon, they used their own mobile GSM data connections.

7 RECOMMENDATIONS

The recommendations are intended to assist DMH with completing the implementation and expanding the objectives outlined by the project. For such the Government of Myanmar might consider:

1. Expanding CAP and SAMBRO
2. Formulating a CAP Working Group
3. Training and Certification
4. Operationalizing a SMS Gateway

7.1 Expanding CAP and SAMBRO

DMH might consider several plans and strategies for expanding CAP and SAMBRO in Myanmar. These strategies may require policies to support them. An important and foremost policy would be for the Nation to realize the potential of CAP and adopt CAP as the all-hazard all-media National warning information exchange standard. For such DMH might consider several steps involving the EmCC, that falls under the administration of the National Disaster Preparedness Working Group and the Vice President's Office:

1. Organize a DRR/DRM decision and policy -maker Stakeholder meeting, including members from EmCC, to showcase SAMBRO’s potential and share the knowledge from the DMH implementation and operationalization experience (to be held in September with the support of the CAP on a Map project)
2. Develop a plan, in consultation with the relevant Stakeholder Organizations, to build CAP and SAMBRO capacity within those Organizations to operationalize SAMBRO for early warning dissemination
3. Collaborate with the Stakeholder Organizations, to iteratively, design, implement, and test, SAMBRO to serve the Stakeholders’ needs

4. Conduct a set of controlled-exercises, with the Stakeholder Organizations, to evaluate their readiness to integrate SAMBRO into their warning practices
5. Use the evidence gathered from the implementation, testing, and controlled-exercises to support the policy development and advocacy

The CAP and SAMBRO expansion process would require the support of a CAP working group and an institutionalized training and certification program. These two components are discussed in the subsequent sections. The aforementioned five steps would serve as a platform for advocating the formulation of a CAP working group as well as the formulation of the training regime.

7.2 Formulate a CAP Working Group

7.2.1 Real Need

The CAP and SAMBRO expansion would require the formulation of a CAP working group. The goal of the CAP working group is to ensure that the policies and procedures around implementing CAP are harmonized across all adopters of CAP in Myanmar. These typically involve, agreeing on policy and operating procedures and terminology and structure of the content.

Stakeholders such as RRD, GAD, DOI, and DOH would relay DMH warnings to their respective First-Responders. Such messages may need to carry information that is relevant to all Stakeholders. It would be the CAP working group that ensure that the warning messages are constructed appropriately to carry the necessary and sufficient information to serve all Stakeholders.

7.2.2 Multiple incidents

There were discussion around the procedure for including information on swell waves in a cyclone warning. While the cyclone passing over land may affect a certain geographic area, the heavy winds would cause swell waves in an extended geographic area but confined to the coast line. To differentiate the alerting areas and the impacting areas, a CAP message may carry multiple Info (or information) blocks, one with the cyclone event information and the other for the swell waves event information. The extent of heavy rains, extending to a greater area, may also differ from the cyclone impacting area.

Decisions as to how one might model CAP to carry the necessary warning content is a challenge for the CAP working group to take on. There are two options, among others, that the group might consider in the Myanmar implementation:

1) Each incident: strong winds and swell waves, associated with the Cyclone event, would carry a single alert block and two Info blocks. The individual info blocks would carry its own alert area block for the strong winds affecting area and swell waves affecting area.

2) Another way of modeling it is by providing all the event data in the information block and define the two alert area for the strong wind and swell waves, respectively.

It is recommended that you do not consider issuing two separate alerts because it is important that CAP can associate the two incidents to be with the same cyclone event, which is typically identified in the CAP “reference” element.

7.2.3 Warning Classifications

Warning-classifications are available for Cyclone warnings. The cyclone warning-classification is color coded and is mapped to a definition describing the state of the cyclone event; i.e. the telemetries indicating the the cyclone’s life-cycle (start to end), the distance from the coast and the intensity. However, warning-classifications are not available for Flood, Earthquake, Landslide, Dam Safety, Fire, and the other events. Such warnings cuts across all Stakeholders. The CAP working group might take the lead in defining the missing warning-classifications. These classifications are important for defining the operating procedures and content (i.e. description and instructions) as well.

7.2.4 Descriptions and Instructions

Instructions and response actions are specific to the individual Stakeholder Organizations. DOI instructions for a flood event may require inspecting the river banks and strengthening them. DOA might require informing the farmers and supporting them with securing their harvest and livestock. Regardless of the specifics, the CAP working group may want to harmonize on a set of response types and instructions that are intuitive to all Organizations; whereby, they would use the preliminary set of instructions and response type to augment the message with their own specific instructions prior to relaying the message to their First-Responders.

7.2.5 Alert Area Polygons

Predefined alert area polygons are instrumental to accurately defining the affecting areas and increasing alerting efficiencies. The controlled-exercises observed difficulties with users defining tsunami and flood affecting areas. Such polygons are defined in a risk assessment.While the risk assessment maps may indicate the vulnerable areas, the working group might agree that a wider alerting area should be defined in the alert message. Such predefined alert areas should be mutually developed for stakeholder inclusion. For example, RRD might require that all personnel in the entire district are issued an alert even though the flood or tsunami inundation area is smaller.

7.3 Training and Certification

DMH might consider leading the process of formulating a training and certification program. The program can be the responsibility of the CAP working group. DMH Trainers can be the resources persons carrying out the training on behalf of the CAP working group. The training would comprise:

1. Advance course in CAP warning standard and operating procedures

2. Situational-awareness implementation and operationalization, using SAMBRO

The Advance course in CAP would introduce the importance of CAP and the implementation practices. It would provide insights as to how an Organization may adopt CAP for their warning information needs. While an Organization has the liberty to decide in developing their own CAP-enabled messaging platform or adopt an existing tool, they may chose to use SAMBRO. The Situational-Awareness implementation provides a wider scope and functionality beyond simply implementing CAP. A trained person may chose to implement SAMBRO for relaying (or re-originating) warning messages and operationalizing a Common Alerting Picture. Those personnel who have been trained would take the lead in training their own Organization in operationalizing CAP and SAMBRO, as seen appropriate.

7.4 Operationalizing the SMS Gateway

The SMS gateway is instrumental to bring about efficiency to the SAMBRO workflows. Therefore, DMH might consider integrating an SMS gateway with SAMBRO. There are three key functions that evolve around the SMS technology:

1. Alert recipients and to serve as a wakeup function
2. Alert decision-makers to approve or reject warning messages, prior to dissemination
3. Alert recipients, mainly first-responders, to acknowledge the receipt of the warning

Primarily SMS serves as a wakeup function (or an initial attention getter). Thereafter, the recipients of the message can follow the instructions in the SMS message to access a more detailed description of the imminent threat. The SMS technology, in its current form, may not be effective in warning an intended recipient in the middle of the night when they are sleeping. However, the SMS text with the embedded URL to the descriptive message and map visualization serves as a repository of reference to the message to access the warning information at anytime.

Secondly, SMS text is also used to alert the message Approvers. The message Approvers are decision-makers belonging to DMH and other Alerting Authorities. They must approve the warning message, to verify the content, before it can be delivered to the targeted recipients. These Approvers are not in the office 24 hours a day 365 days a year. An SMS text is sent to the designated Approver(s) with a URL to the message with the option to approve or reject. This removes the need for the decision-maker to be onsite to approve or reject the message.

A third utility of the SMS text is to serve as a feedback communication channel. Often early warning systems a designed as open ended systems. Such systems, in the absence of a feedback loop, does not guarantee that a warning message was received by the targeted recipient. SAMBRO introduces a feedback mechanism whereby recipients can use a SMS text to to acknowledge the receipt of the message.

Given the efficiencies and effectiveness the three SMS technology supported functions offer, DMH may want to strongly consider acquiring a SMS gateway. The project has provided the necessary specifications to Myanmar Post and Telecommunication to enable the service. There were concerns about sharing SAMBRO with other Stakeholders and how one might share the cost of the SMS. SAMBRO has the capability to assign separate SMS gateways for each Organization. Therefore, we can restrict the DMH financed SMS gateway for the use of DMH users only.

8 CONCLUSION

DMH had made a firm commitment to implementing and operationalizing the CAP-enabled SAMBRO platform for improving the National DRR capabilities. The system, in its current state, is operational with DMH issuing public warnings. Evidence points the need for some improvements in the warning content and warning procedures. Moreover, the Government of Myanmar should advocate policies and plans that help DMH with expanding the implementation to include all Stakeholders. Thereby, bringing an all-hazard all-media approach to the multi-hazard warning initiatives.

9 APPENDIX A - GLOSSARY OF TERMS

APP	Application
CAP	Common Alerting Protocol
DMH	Department of Meteorology and Hydrology
DoA	Department of Agriculture
DoF	Department of Fisheries
DoH	Department of Health
DoI	Department of Irrigation
DRM	Disaster Risk Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
Email	Electronic Mail
EmCC	Emergency Communications Committee
EOC	Emergency Operation Center
EWS	Early Warning System
GAD	General Administrative Division
GIS	Geographic Information System
GSM	Global System for Mobile
IFRC	International Federation of Red Cross/Crescent
ITU	International Telecommunication Union
MPT	Myanmar Post and Telecommunication
MRCS	Myanmar Red Cross Society
NGO	Non-Government Organization
RRD	Relief and Resettlement Department
SAMBRO	Sahana Alerting and Messaging Broker
SMS	Short Message Service
SOP	Standard Operating Procedures
TAM	Technology Acceptance Model
TTX	Tabletop Exercise
UI/UX	User Interface/User eXperience
UNESCAP	United Nations Economic Commision for the Asia and Pacific
URL	Universal Resource Locater
WMO	World Meteorological Organization