Common Alerting Protocol Message Broker for Last-Mile Hazard Warning System in Sri Lanka: An Essential Component

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LIRNEasia
Learning Initiatives on Reforms for Network Economies

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INTERNATIONAL DISASTER REDUCTION IDRC

HARBIN ENGINEERING UNIVERSITY

Outline

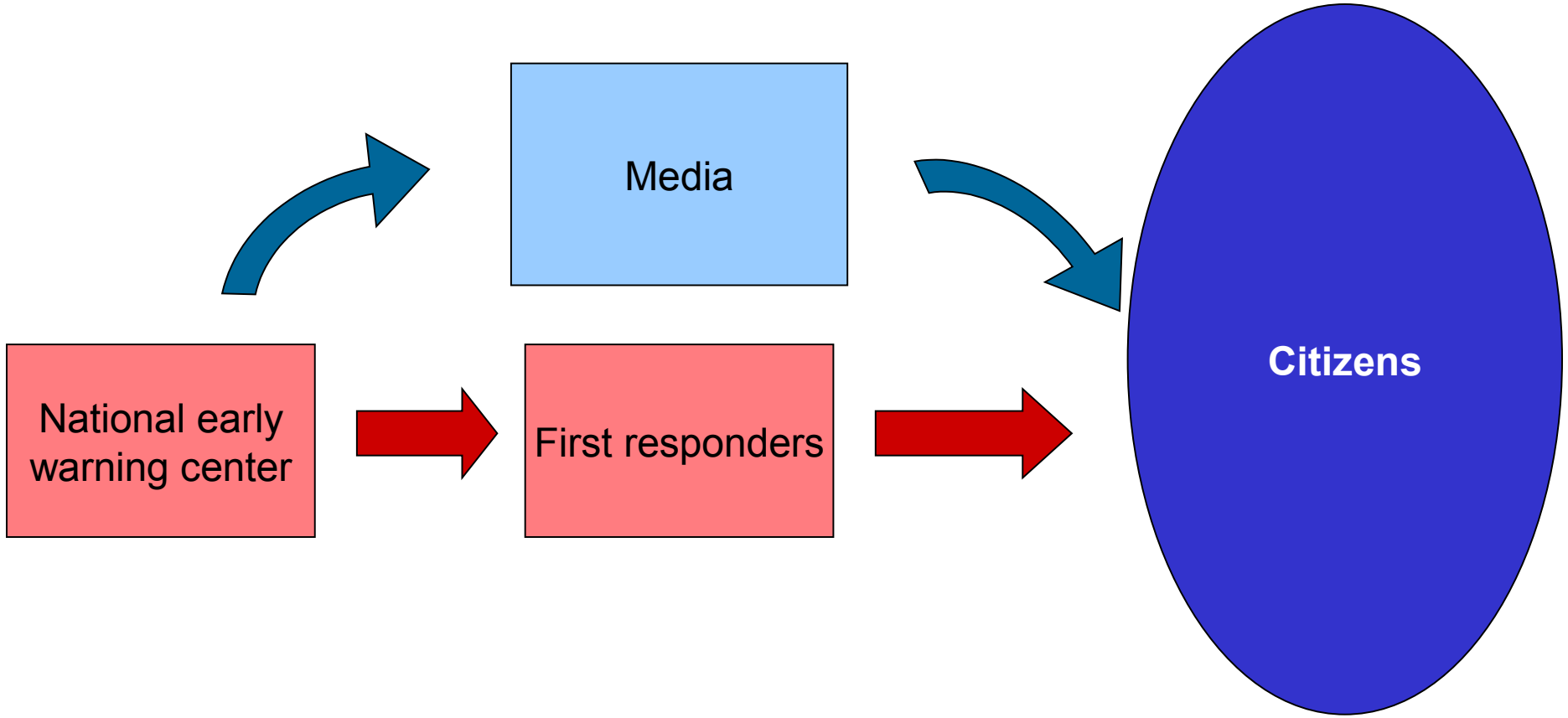
- **Overview of HazInfo Project:**
  Research Design, Information Communication Technologies

- **Methodology for Evaluating the Last-Mile Hazard Warning System:**
  CAP content standard to evaluate the communicability of Alerts,
  Reliability of the ICTs and First-Responders (processes),
  Concept of operations

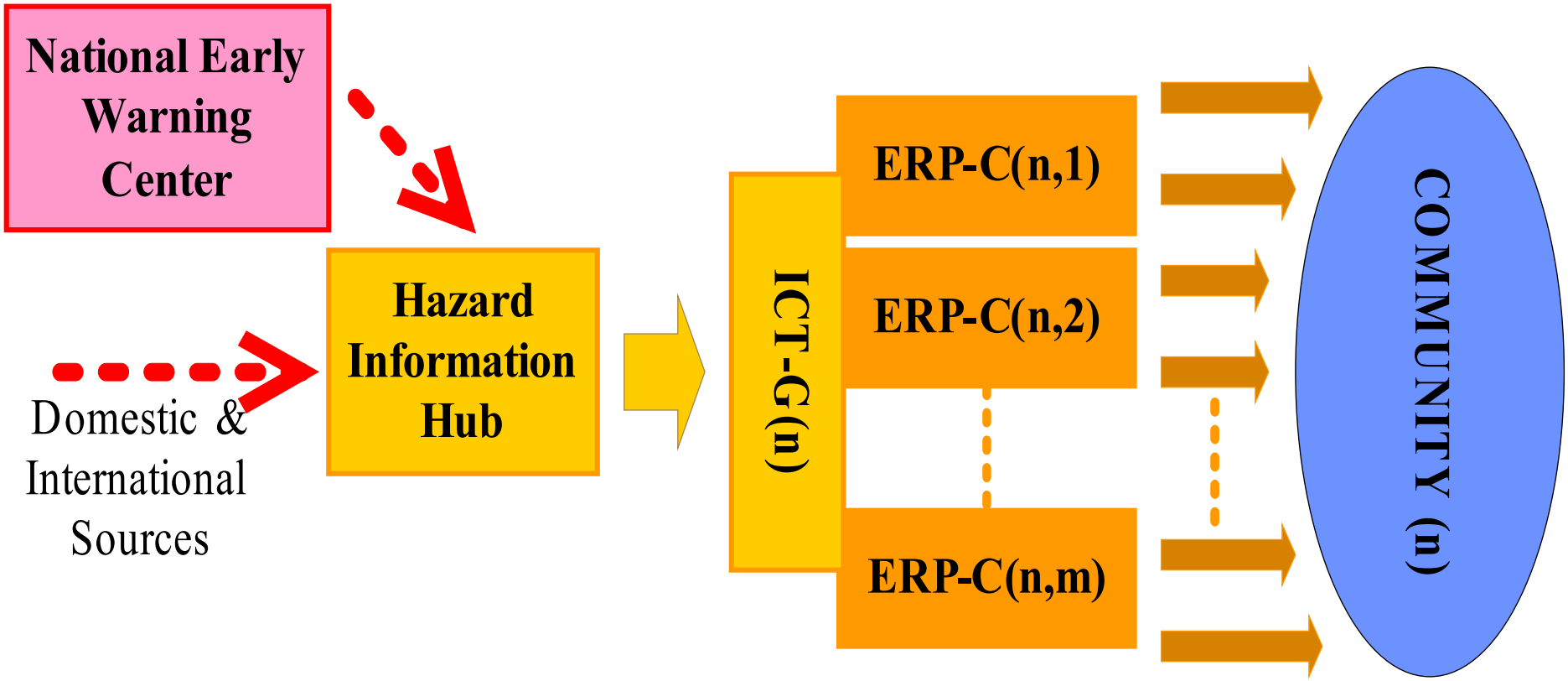
- **Results from Simulations w.r.t Specific Research Objectives:**
  Reliability and Effectiveness of the ICT a warning technology
  Operational complexities of the Hazard Information Hub

- **Conclusions and Recommendations**
  MIMO vs. SISIO, P2P Multilanguage CAP Broker

Typical Public Warning System used by Governments

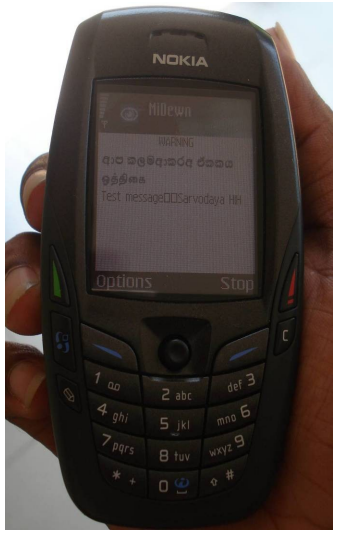


Community-based Hazard Warning System



5 ICTs Tested for Reliability and Effectiveness in the Last-Mile

CDMA Fixed Phone



GSM Mobile Phone

Remote Alarm Device

Addressable Radios for Emergency Alerts

Very Small Aperture Terminals

HazInfo Project Research Design

	With ERP Training				No ERP Training			
Sarvodaya Stage 1, 2, 3	**VSAT** Urawatha (Galle)	**MoP** Nidavur (Batticalo)	**FxP** Thirukadalar (Trincomalee)	**AREA** Moratuwella (Colombo)	**MoP** Meddhawatha (Matara)	**MoP** Thambiluvil (Kalmunai)	**FxP** Oluville (Kalmunai)	**AREA** Maggona (Kalutara)
	AREA + RAD Modarapallassa (Hambantota)	**AREA + FxP** Wathegama North (Matara)	**AREA + MoP** Palmunnai (Batticalo)	Control Village Abeyasinghepura (Ampara)	**AREA + RAD** Thondamanar (Jaffna)	**AREA + FxP** Karathivu (Kalmunai)	**AREA + MoP** Munnai (Jaffna)	Control Village Modara (Colombo)
Sarvodaya Stage 4	**VSAT** Modaragama (Hambantota)	**MoP** Diyalagoda (Kalutara)	**FxP** Periyakallar (Batticalo)	**AREA** Panama North (Ampara)	**MoP** Satur-kondagnya (Batticallo)	**MoP** Samodhagama (Hambantota)	**FxP** Indivinna (Galle)	**AREA** Brahamana-wattha (Galle)
	AREA + RAD Kalmunai II (Kalmunai)	**AREA + FxP** Samudragama (Trincomalee	**AREA + MoP** Valhengoda (Galle)	Control Village Mirissa South (Matara)	**AREA + RAD** Venamulla (Galle)	**AREA + FxP** Kottegoda (Matara)	**AREA + MoP** Thallala South (Matara)	Control Village Thalpitiya (Kalutara)

AREA: Addressable Radio for Emergency Alerts, Class B configuration of WorldSpace System

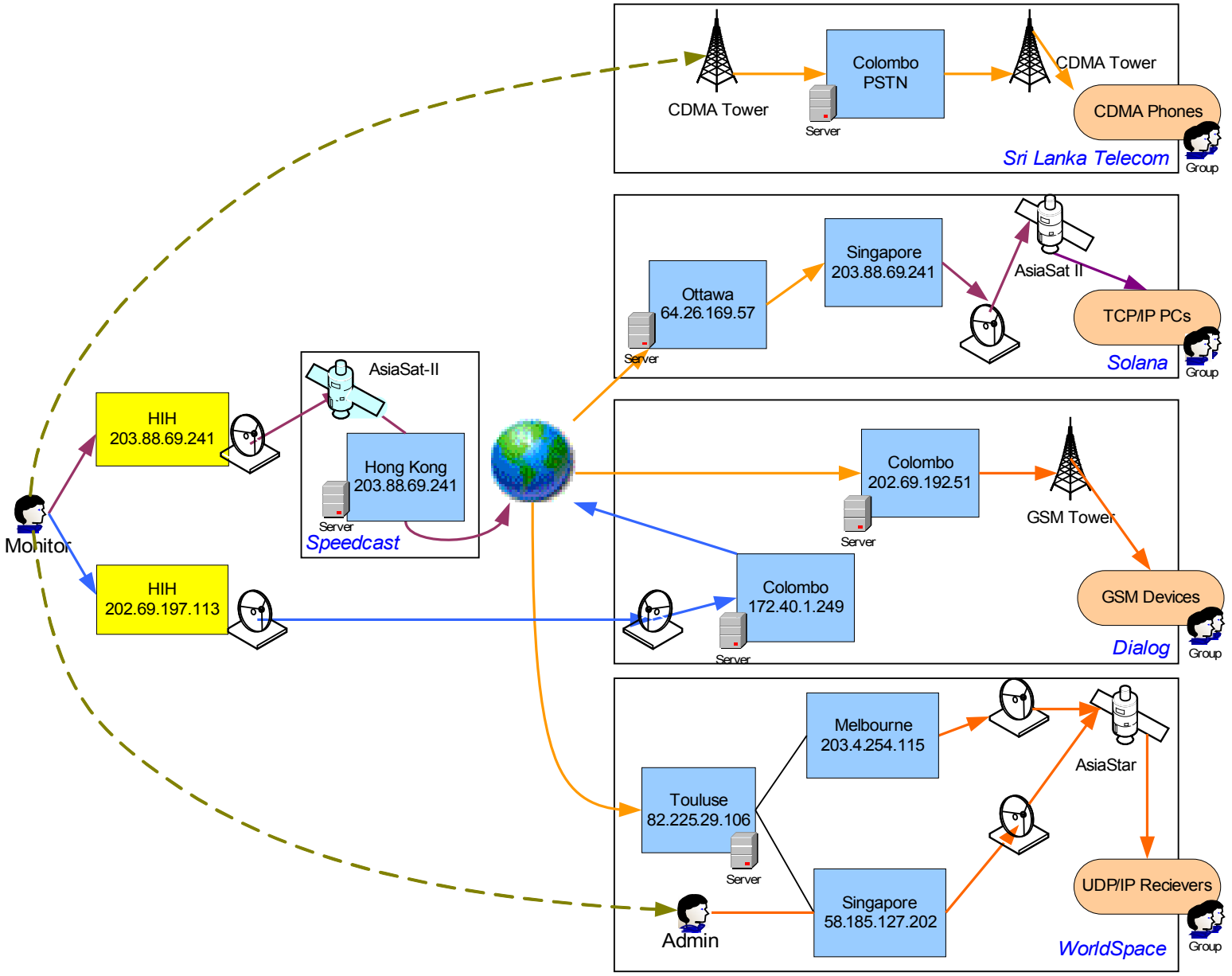
MoP: Java enabled Mobile Phone, Dialog-Microimage innovation MiDews application

RAD: Remote Alarm Device, Dialog-University-of-Moratuwa Innovation

FxP: CDMA Wireless Fixed Phones with 1xRTT functions, Sri Lanka Telecom

VSAT: Very Small Aperture Terminals coupled with Internet Public Alerting System Innovative-Tech & Solana Networks

Multiple Paths, Multiple Technologies and Multiple Gateways



Common Alerting Protocol Content Standard to Evaluate the ICTs

CAP Profile for Sri Lanka

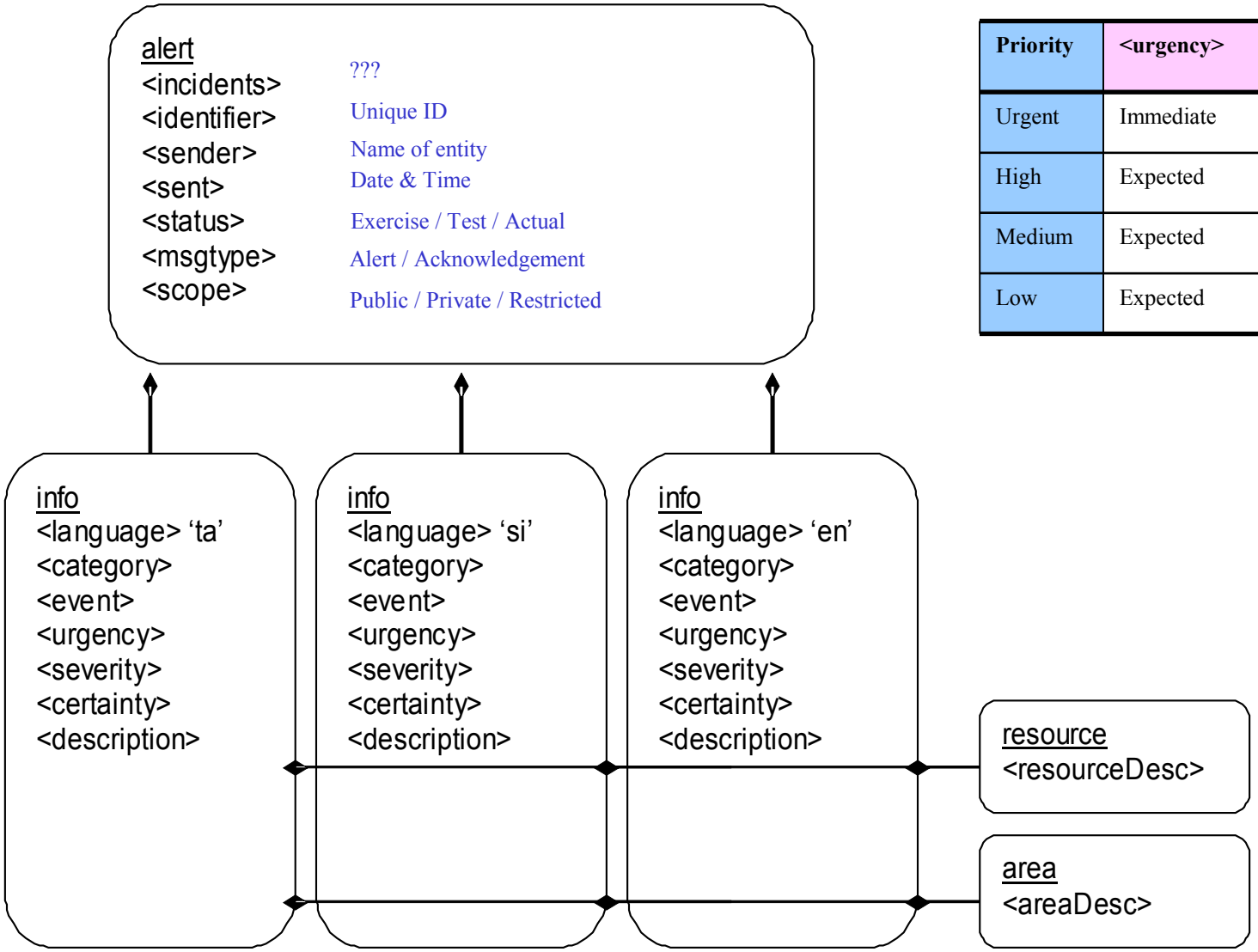


Table to determine priority of the event

Priority	<urgency>	<severity>	<certainty>
Urgent	Immediate	Extreme	Observed
High	Expected	Severe	Observed
Medium	Expected	Moderate	Observed
Low	Expected	Unknown	Likely

Example of Input Message to the last-Mile Hazard Warning System

TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST
Last-Mile HazInfo Simulation. No Repeat No Real Event is Effect

TROPICAL CYCLONE ADVICE NUMBER 001
Issued at 09:55 am on Monday, December 11, 2006
BY Anonymous

A **SEVERE CATEGORY 4 CYCLONE** is now current for AMPARA and MATARA District coastal areas. At **06:00 am** local time SEVERE TROPICAL CYCLONE MONTY was estimated to be **80 kilometres northeast of Ampara District** and moving southwest at **10 kilometres per hour**. Severe Tropical Cyclone Monty is expected to cross the coast in the vicinity of Ampara and Matara Districts during Monday. Gales with gusts to 180 kilometres per hour are likely in coastal communities in Ampara and Matara District during the day.

This is to **alert** the residents of Ampara and Matara District about the potential of a very **dangerous storm** tide as the cyclone centre approaches the coast. **Tides are likely** to rise significantly above the normal high tide mark with very dangerous flooding, damaging waves and strong currents.

Widespread heavy rain and further flooding are likely in southern parts of the Ampara and Matara Districts over the next few days.

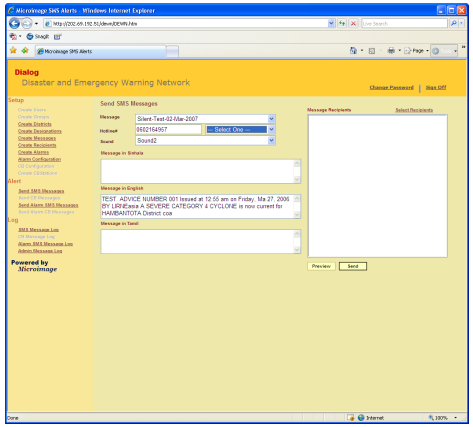
TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST
Last-Mile HazInfo Simulation. No Repeat No Real Event is Effect.

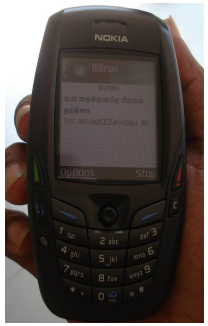
Example of Output Message from Hazard-Information-Hub to the Last-Mile

<alert>
<identifier>**HIH-2006-12-11T143500**</identifier>
<sender>**hih@sarvodaya.lk**</sender>
<sent>**2006-12-11T10:20:25.0000000+06:00**</sent>
<status>**Exercise**</status>
<msgType>**Alert**</msgType>
<source>**hazard@lirne.net**</source>
<scope>Restricted</scope>
<info>
<language>**en-US**</language>
<category>**Meto**</ category>
< event>**A Sever Category 4 Cyclone**</event>
<responseType>**Prepare**</responseType>
<urgency>**Expected**</urgency>
<severity>**Severe**</severity>
<certainty>**Observed**</certainty>
<description>**At 06:00 am local time SEVERE TROPICAL CYCLONE MONTY was estimated to be 80 kilometers northeast of Ampara District and moving southwest at 10 kilometers per hour. Severe Tropical Cyclone Monty is expected to cross the coast in the vicinity of Ampara and Matara Districts during Monday. Gales with gusts to 180 kilometers per hour are likely in coastal communities in Ampara and Matara District during the day.**
This is to alert the residents of Ampara and Matara District about the potential of a very dangerous storm tide as the cyclone centre approaches the coast. Tides are likely to rise significantly above the normal high tide mark with very dangerous flooding, damaging waves and strong currents. Widespread heavy rain and further flooding are likely in southern parts of the Ampara and Matara Districts over the next few days. </description>
</alert>

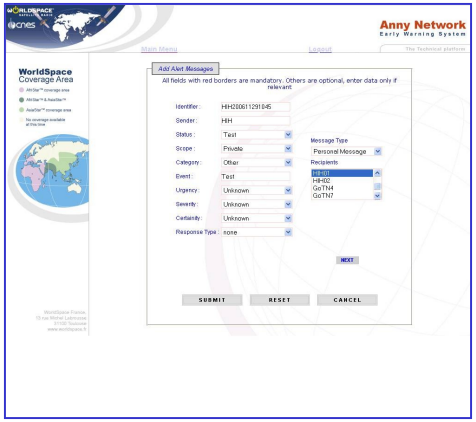
Single Input Single Output, Internet based, Alerting Applications

DEWNS

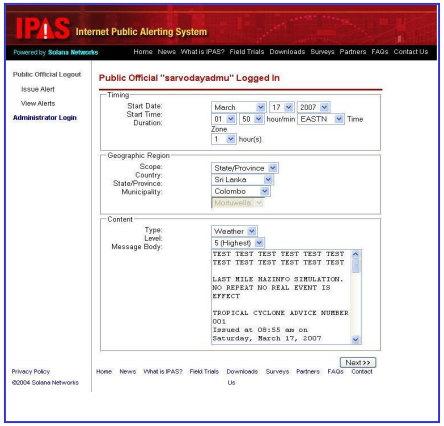




ANNY



IPAS



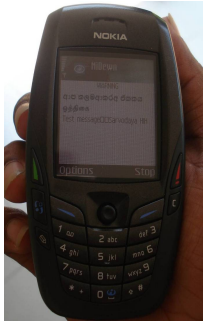
CALL

Effectiveness of CAP Alerts over AREA-B

Interface	*HIH Monitor issued CAP Message*	*Receiver Device and {Medium}*	*ICT Guardian received Message elements*
ANNY Internet Browser (AREA)	All sub elements in <Alert> element and message in <Language>en only.	AREA – B {Text}	<msgType>Alert <Scope>restricted <Sender>hih <Status>exercise <Category>met <Urgency>expected <Severity> sever <Certainty>observed <Event>A SEVERE CATEGORY 4 CYCLONE … {restricted 250 characters}

Effectiveness of CAP Alerts over Mobile Phones & RADs

Interface	*HIH Monitor issued CAP Message*	*Receiver Device and {Medium}*	*ICT Guardian received Message elements*
DEWN Internet Browse	<info> sub element with <Language>en <Description> … {no size restriction} <Language>si <Description> … {no size restriction} <Language>tm <Description> … {no size restriction}	MP {Text}	"Warning" <info> <Language>en <Description> A SEVERE CATEGORY 4 CYCLONE… <Language>si <Description> …{sinhala} <Language>tm <Description> … {tamil} {restricted by 140 characters}
		RAD {Text}	



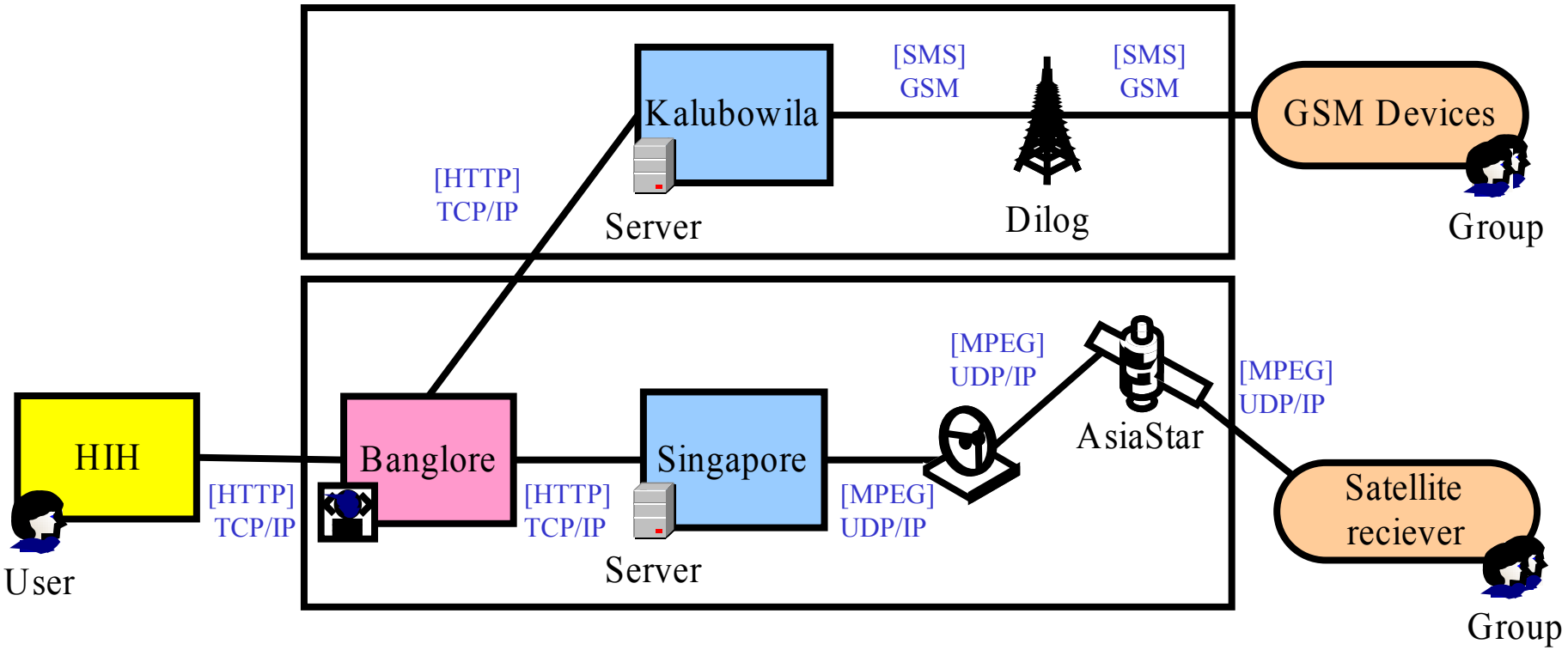
Effectiveness of Internet Public Alerting (~~CAP~~) over VSAT

Interface	*HIH Monitor issued Message*	*Receiver Device and {Medium}*	*ICT Guardian received Message elements*
IPAS Internet Browser	<Description> with <Language>en only … {no size restriction}	Personal Computer {Text}	<Description> A SEVERE CATEGORY 4 CYCLONE … {no size restriction}

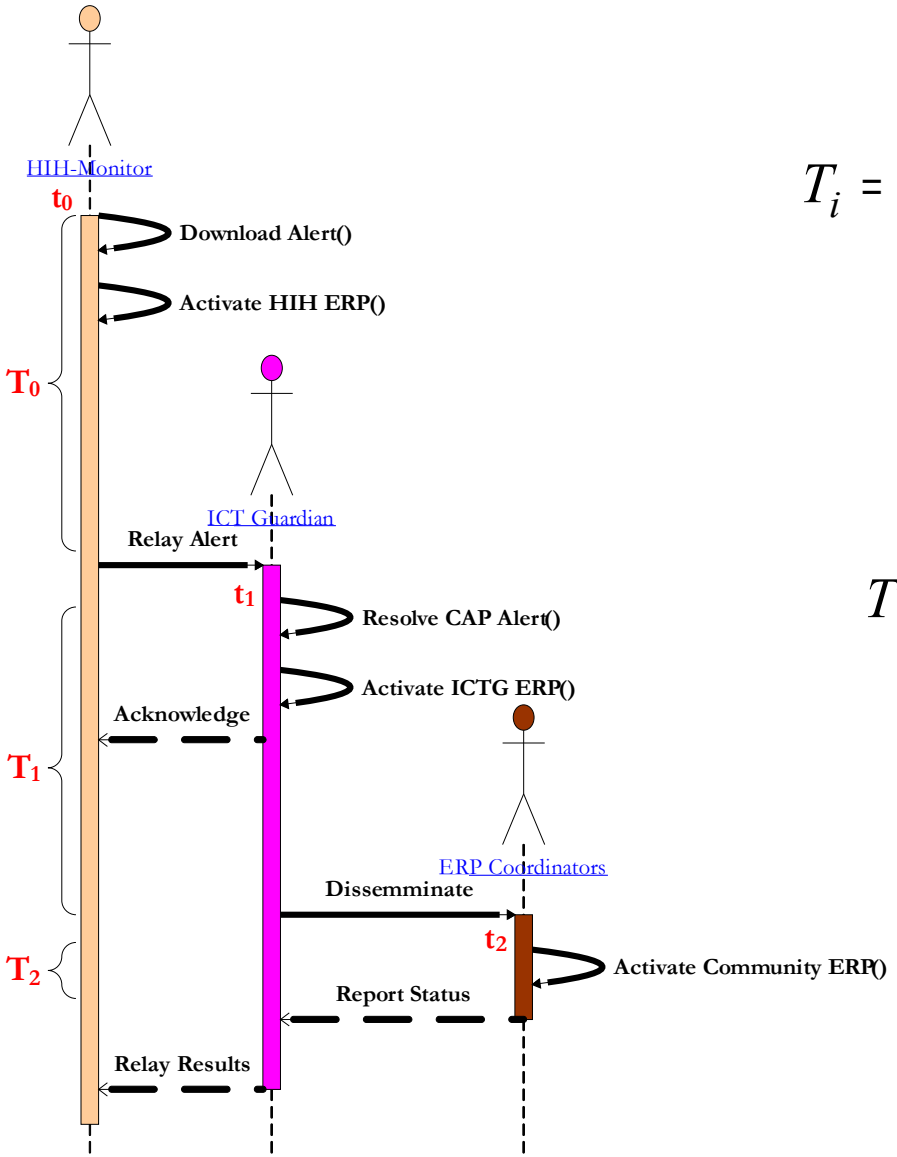
Voice Alerts over CDMA

Interface	HIH Monitor issued CAP Message	Receiver Device and {Medium}	ICT Guardian received Message elements
CDMA 2000 1x_RTT	<Description> … {no size and language restriction}	CDMA2000 1x_RTT Telephones {Audio}	<Description> A SEVERE CATEGORY 4 CYCLONE … {no size restriction}

CAP Interoperability Silent Tests



Formula for calculating the Reliability LM-HWS Processes



t_i : time process $i = \{0, 1, 2\}$ is initiated

$t_i^{'}$: time process $i = \{0, 1, 2\}$ is terminated

$T_i = t_i^{'} - t_i$: time interval taken to complete process i

$E(T_i)$: expected value of time interval

d : minimum distance between epicenter and impact zone

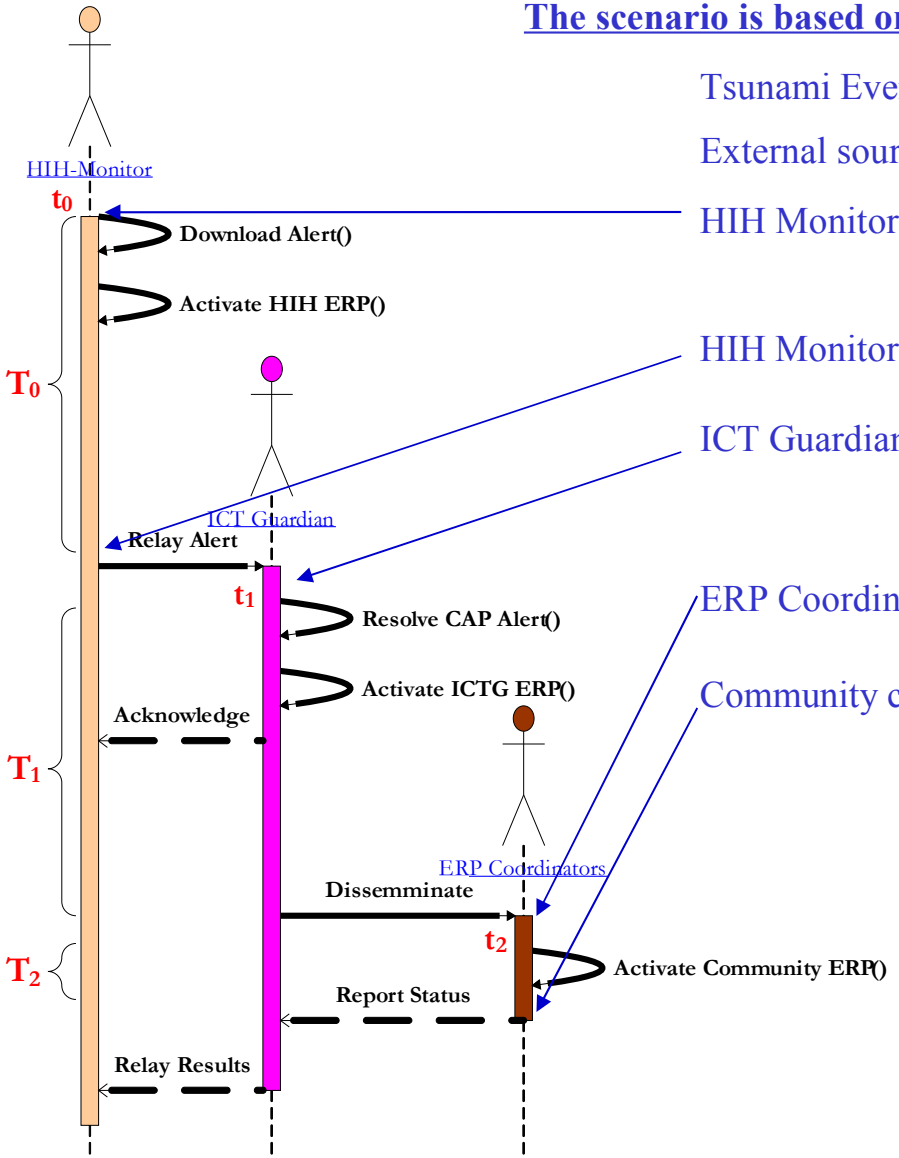
S : speed at which hazard is traveling

$T = d/s$: minimal allowable time interval to impact

R_i : Reliability of process i

$$R_i = \begin{cases} 1 & \text{when } T_i \leq E(T_i) \\ 1 - \left(\dfrac{T_i - E(T_i)}{T} \right) & \text{when } T_i > E(T_i) \\ 0 & \text{when } i < j : t_i^{'} > E(t_j) \end{cases}$$

Example of Calculating the Reliabilities



The scenario is based on the Brahamanawatta (Galle District) simulation data

Tsunami Event occurred at 10:15am and will impact at 11:45

External source issued email bulletin at 10:25am

HIH Monitor receives email at **10:35am**

HIH Monitor issues CAP alert at **10:46am**

ICT Guardian receives CAP alert over AREA-B at 11:02am

ERP Coordinator receives alert information at 11:08am

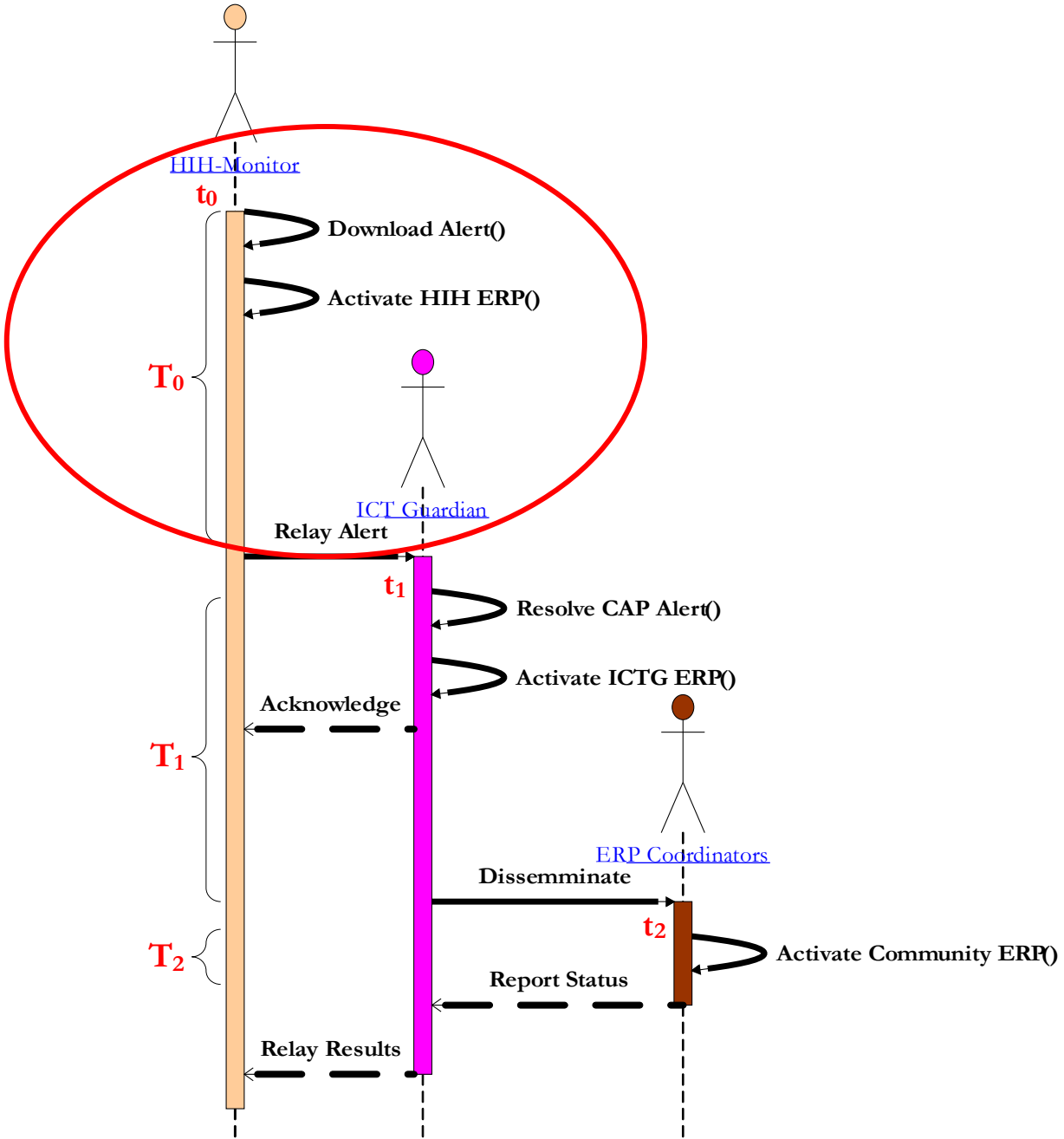
Community completes evacuation at 11:08am

Calculate the Reliability of HIH Monitor activities

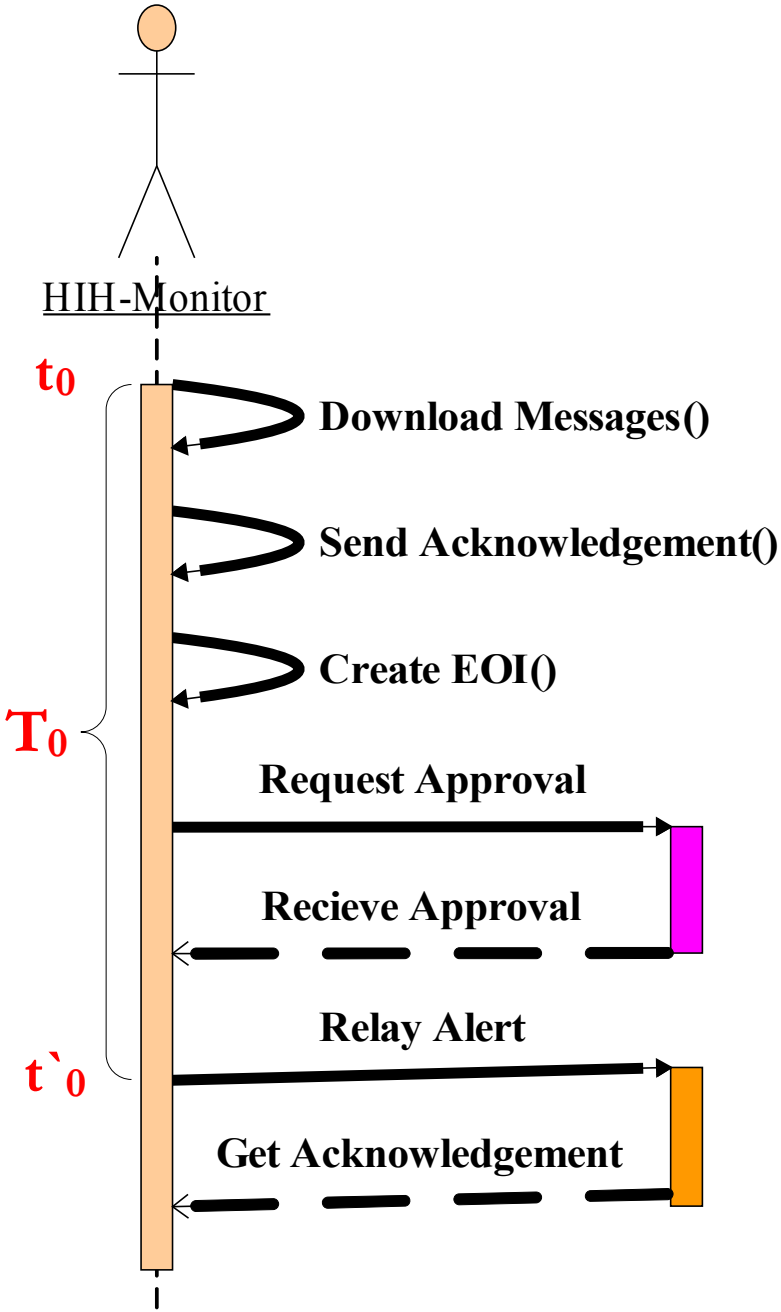
Assumption: since this is the first set of trials and the LM-HWS has no data to calculate an 'expected time we set $E(T_0) = 0$ (i.e. best case scenario)

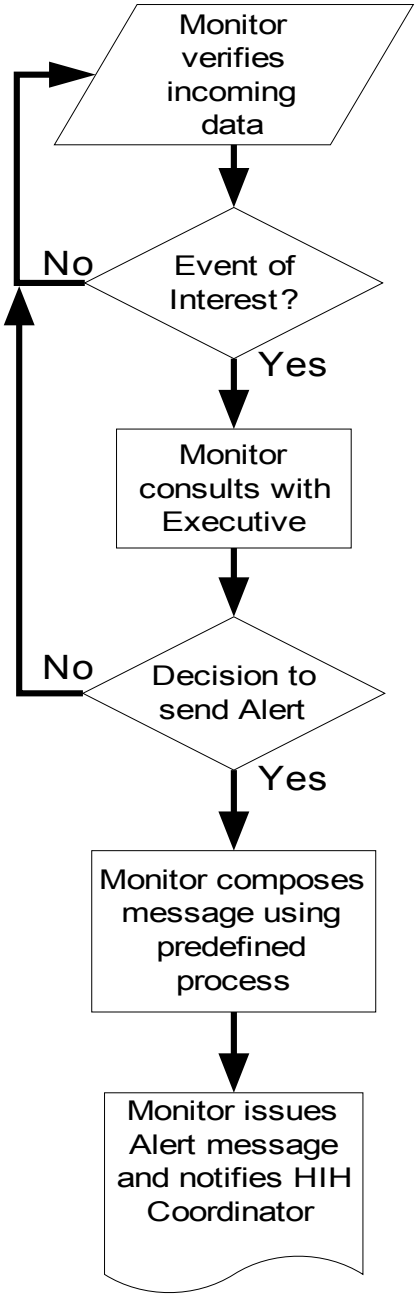
$$R_0 = 1 - \left(\frac{11}{90}\right) = 0.8777$$

Comparison to study Reliability of ICT in LM-HWs

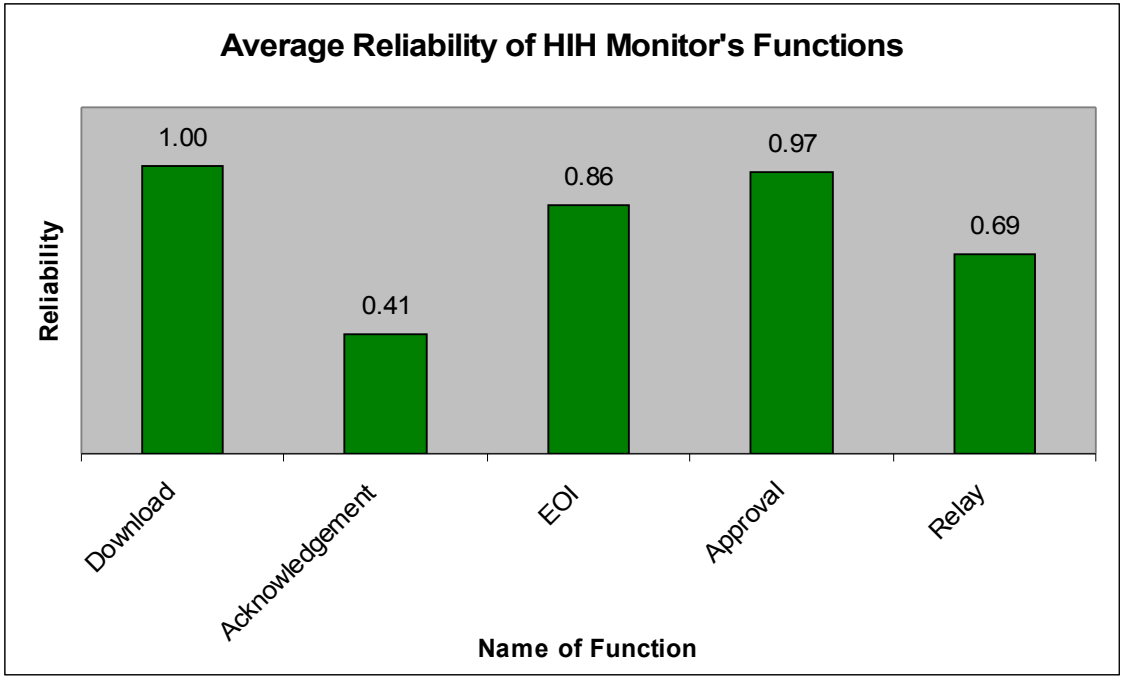


Hazard Information Hub Monitor's Tasks





Hazard Information Hub Monitor Performance in Live-Exercises

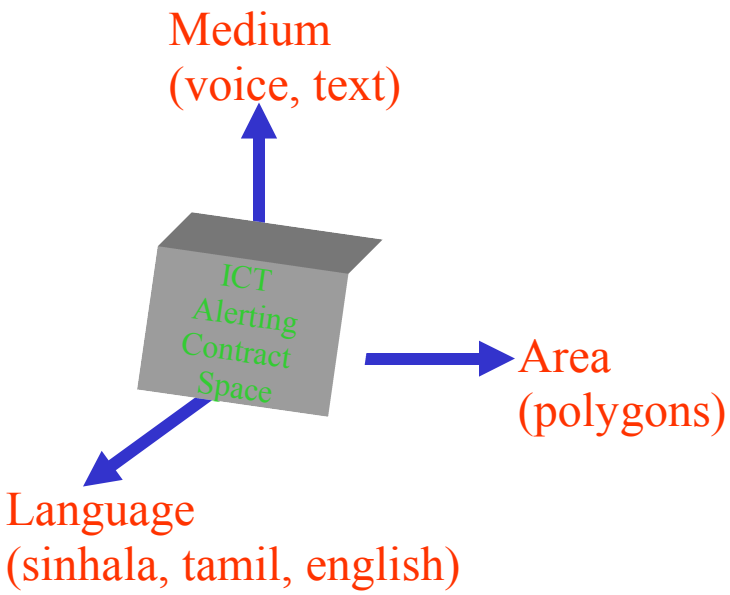


	Average	*Variance*
HIH Monitor Message Relay Process	0.7825	0.0609

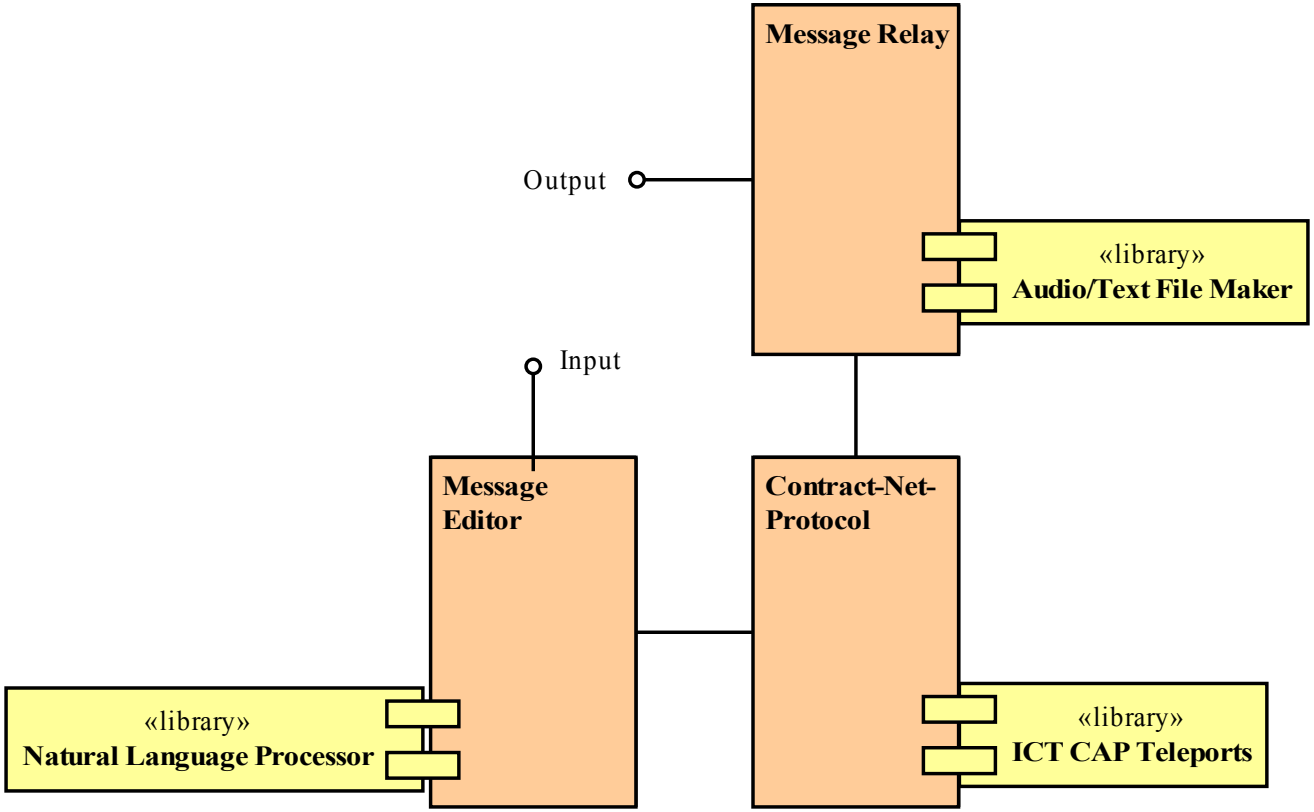
Expected value = 95%

For example an event such as the December 2004 Tsunami that had a minimal 90 minute duration between time of hazard initiating and the time of impacting Sri Lanka. With a 78% Reliability, the function: Relaying of Message (i.e. completing the tasks described above) to the Last-Mile alone would take at least 20 minutes. Assuming the sensor and relay networks would get a confirmed bulletin across to the HIH in 15 minutes and the HIH takes another 20 minutes, then the Last-Mile Communities would have less than 55 minutes to execute the Community ERPs.

Future Work – P2P Multilanguage CAP Broker



who are the actors that can issue alerts…
what are the types of alerts they can issue…
who can receive alerts …
in what Languages …
via which communication providers …
what Mediums can the ICTs accommodate …
what areas are covered by which ICT providers



Xiexie!
Thank you!