Last-Mile Hazard Warning System in Sri Lanka

Empowering rural communities through ICT Policy and Research
CPRsouth II
Chennai, India
15 December 2007

LIRNEasia
Learning Initiatives on Reforms for Network Economies

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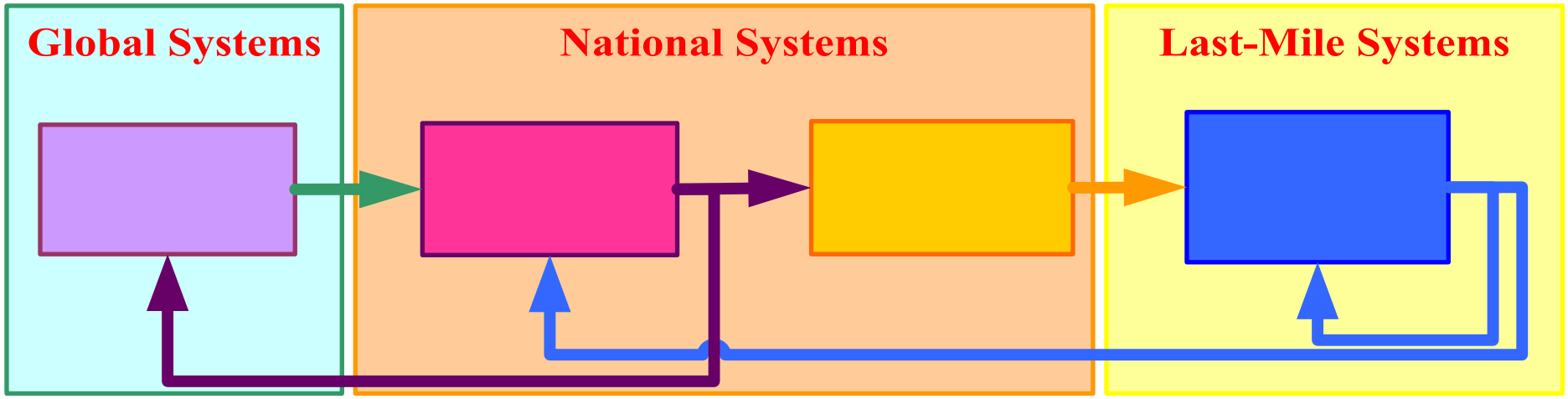
Hazard Detection and Notification Chain of Systems

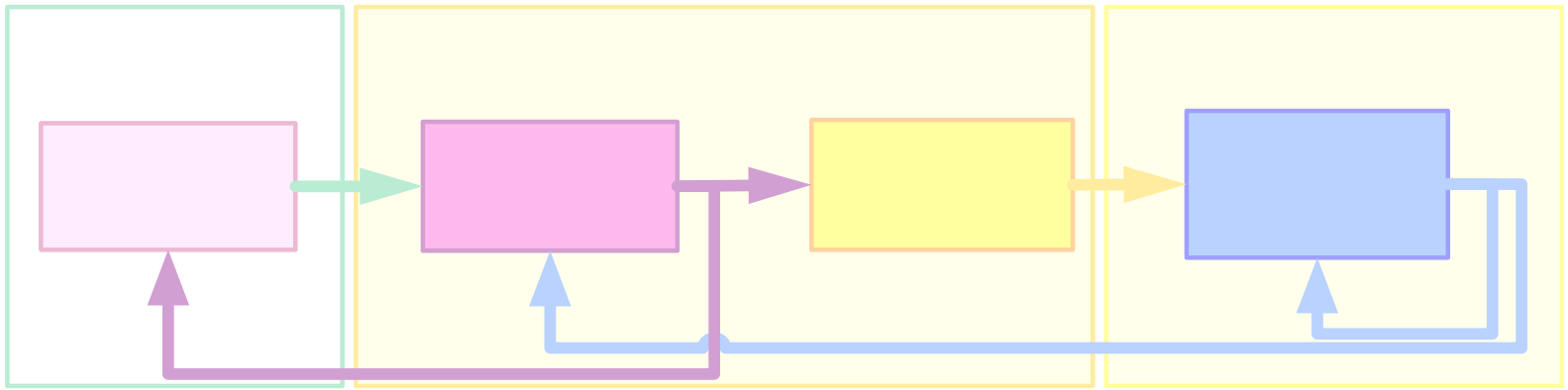


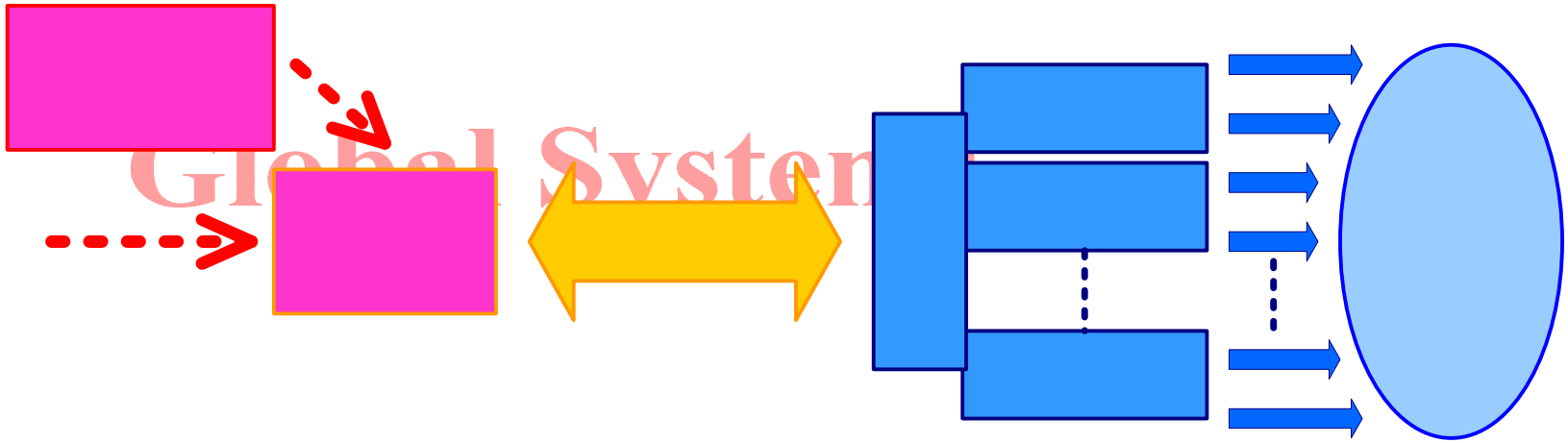
- Det/Mon Systems and NEWS can work as a closed system but purpose of saving lives is defeated if not connected to the Last-Mile; better through ICT Networks
- Without the inputs from NEWS to the Last-Mile they cannot provide feedback to the NEWS to measure its performance and correct the shortcomings; performance of the ICT Networks are also measured through the Community feedback
- Communities have a self-feedback to ensure ERPs are reliable and effective
- Communities can work as standalone closed systems but would require ERPs that can be executed in Zero time; i.e. be able to function without Institutional NEWS but depend on global media, tacit knowledge, and natural observations

Detection and Monitoring

Nat Wa Mes

Components of the Community-based LM-HWS (closed System)

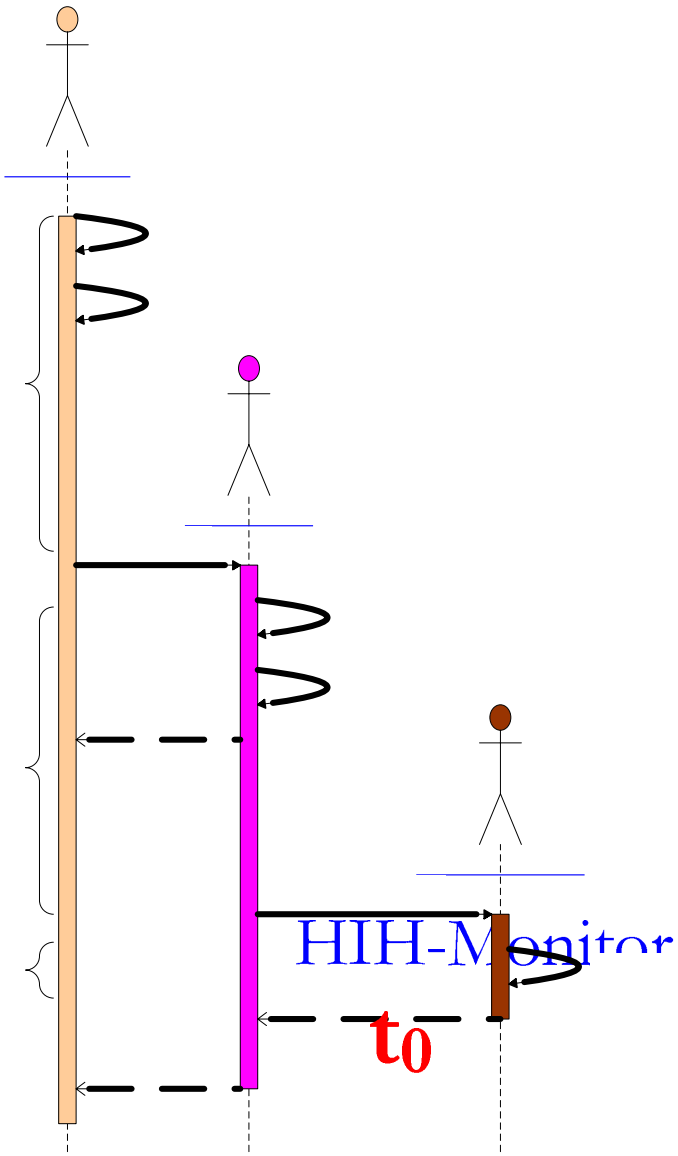




Community-based Model --

- ✓ Works for hazards with time > 30min only; where physical world of hazards are distant from the community such as tsunami, cyclone, floods
- × Does not work for rapid onset hazards such as dam breach, earthquakes

Formula for calculating the EFFECIANCY of Terminal Devices



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

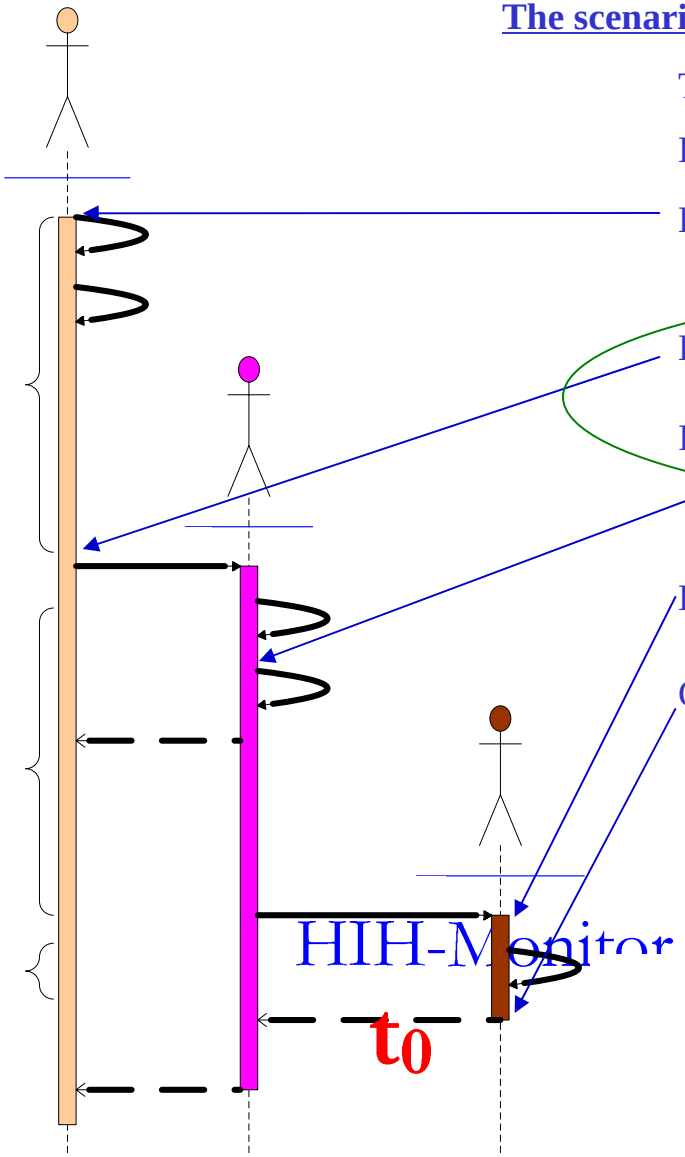
R_i : Reliability of process i

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

Download Alert()

Activate HIH ERP()

Example of Calculating the EFFICINCY



The scenario is based on the Panama (Ampara 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

Efficiency of ICT Network and ICT Guardian activities

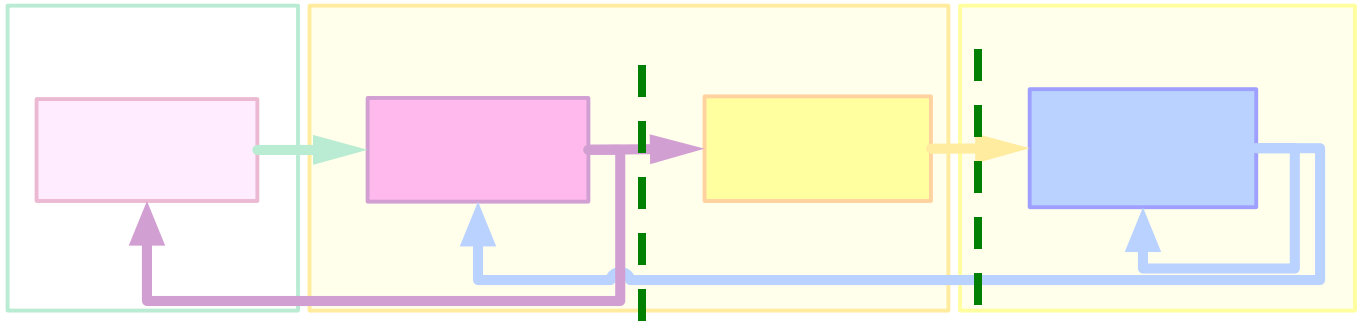
Assumption: since this is the first set of trials and the LM-HWS has no data to calculate an 'expected time we set $E(\bar{T}) = 0$ (i.e. best case scenario)

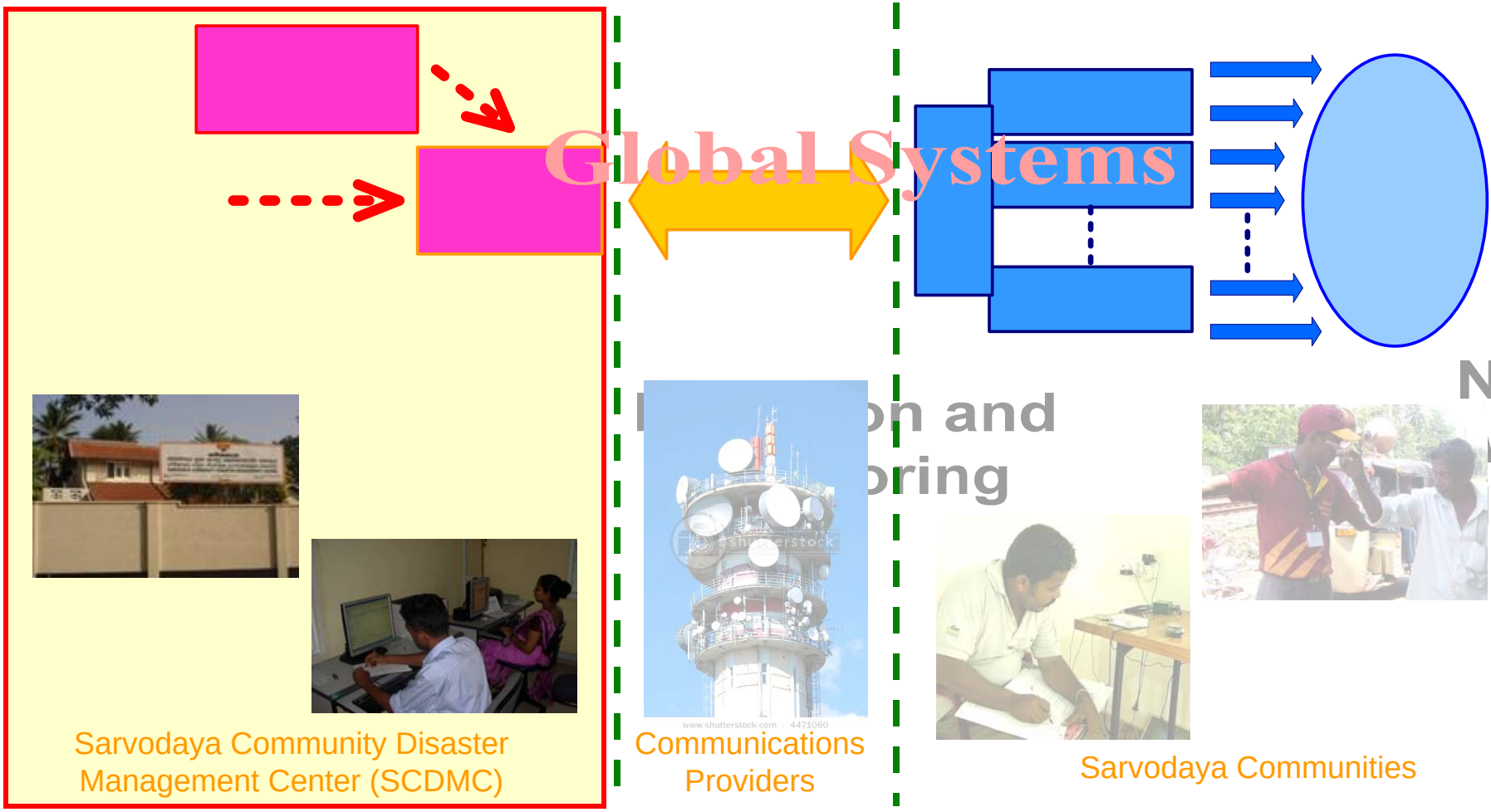
$$R_1 = 1 - \left(\frac{16}{90}\right) = 0.8222$$

Download Alert()

Activate HIH ERP()

Community-based Hazard Warning System – HIH COMPONENTS



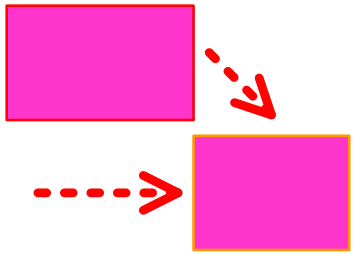


Sarvodaya Community Disaster Management Center (SCDMC)

Communications Providers

Sarvodaya Communities

HIH OPERATIONAL PROCEDURES at the Hazard Information Hub



The HIH will not issue messages that provide specific instructions to local first responders, except those that might be relayed directly from the government.

National Early

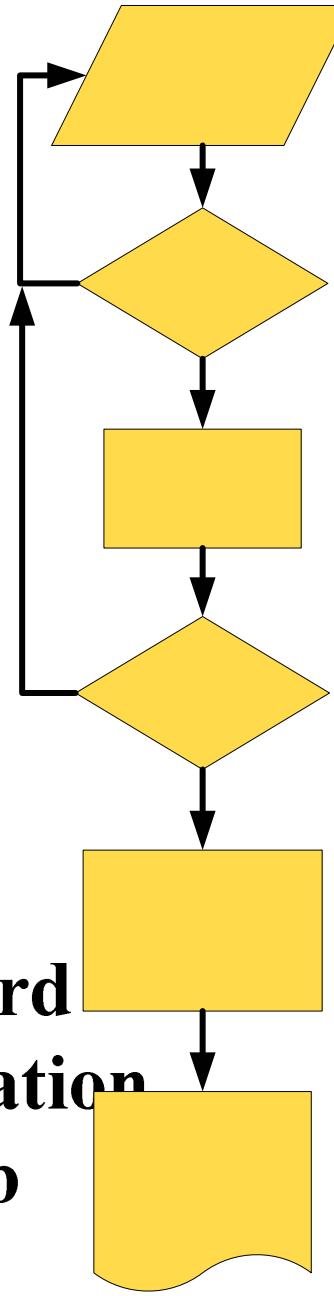
Warning

Center

Hazard

nformation

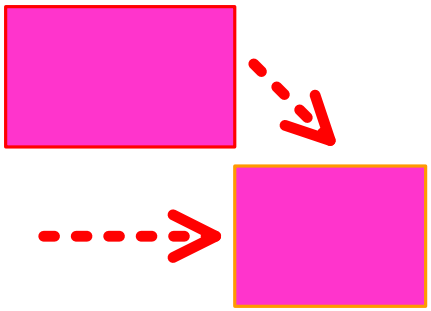
Hub

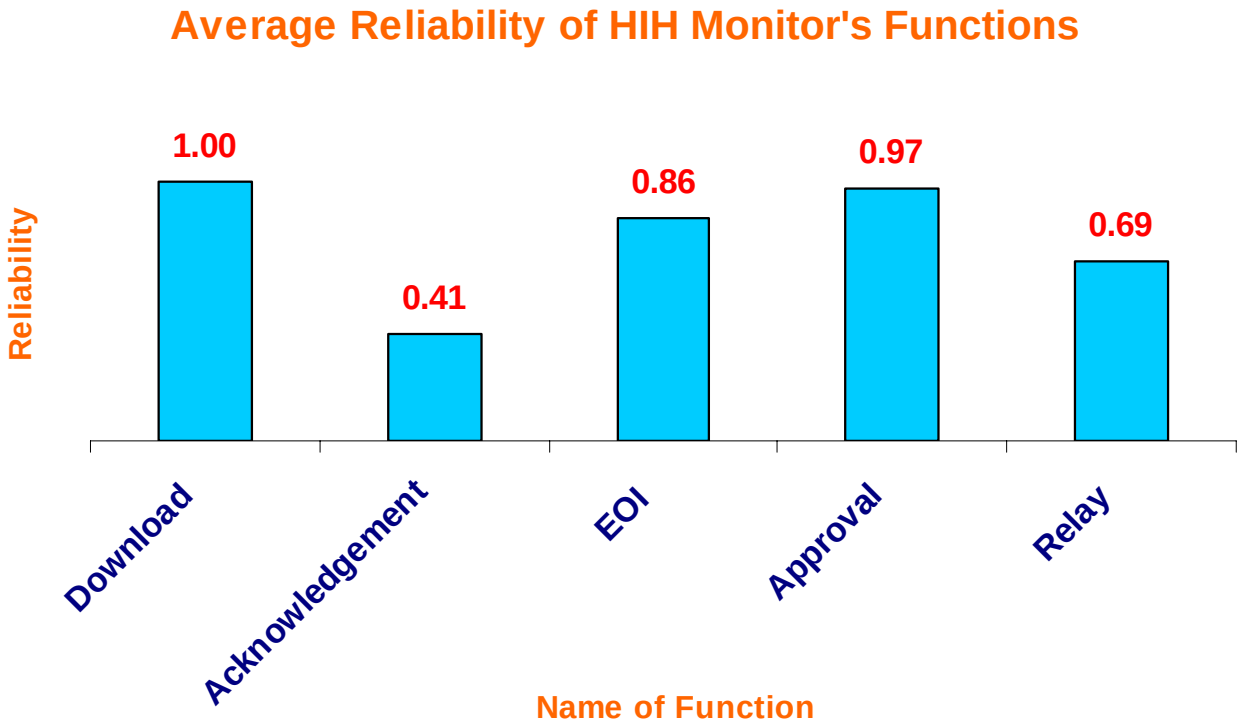


HIH-Monitors at HIH creating and issuing Alerts

Sources

Performance of the HAZARD INFORMATION HUB (SCDMC)





Domestic &

Hazard Information Hub

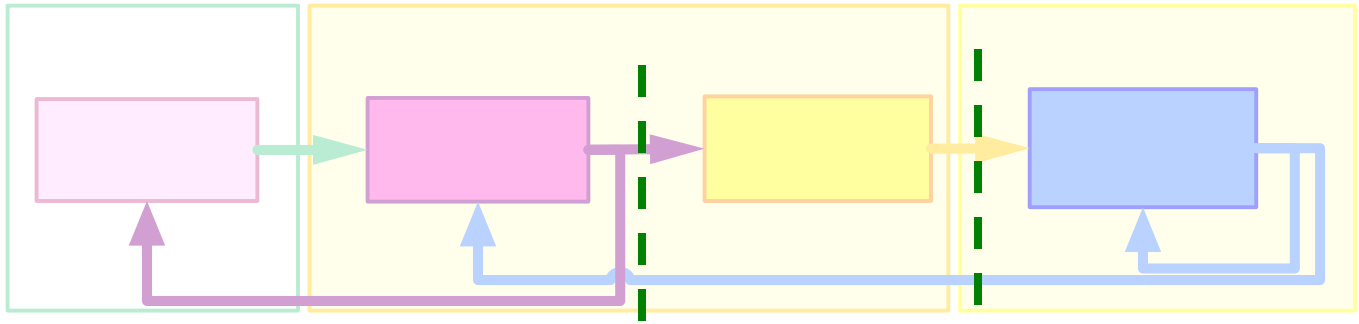
Center

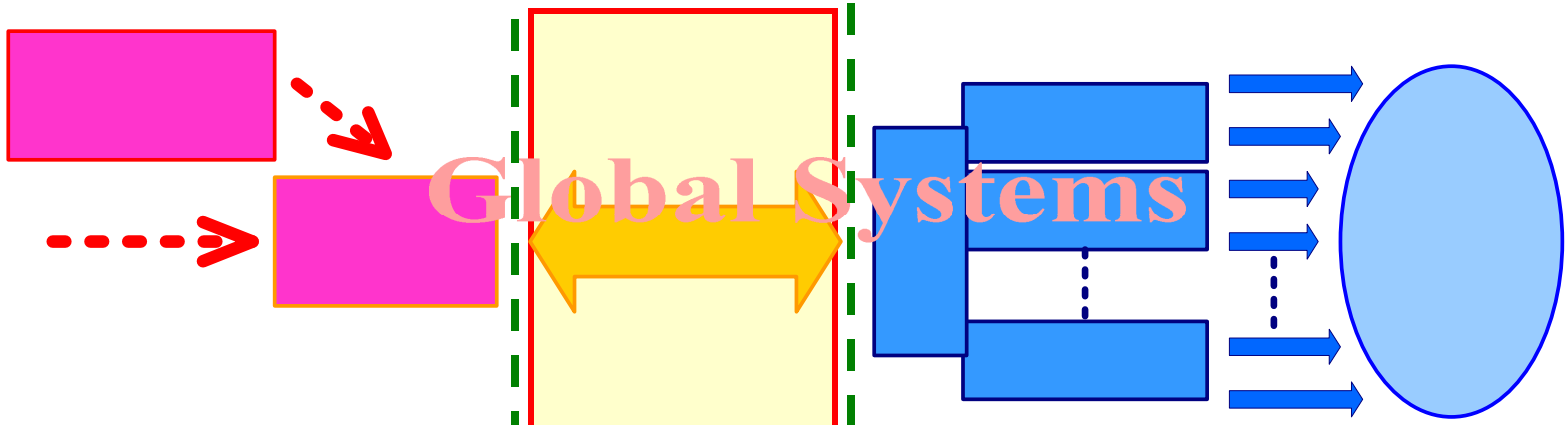
Benchmark
- 95% Reliability and Effectiveness

Current Performance
- Reliability = 78%
- Effectiveness = 83%

Recommendations
- Need to setup better system to force HIH Monitor to acknowledge receipt of alert
- Develop a single input multiple output software application to speedup relaying of alert via multiple ICTs to the communities; i.e. P2P Multilanguage CAP Broker

LM-HWS – ICT COMPONENT





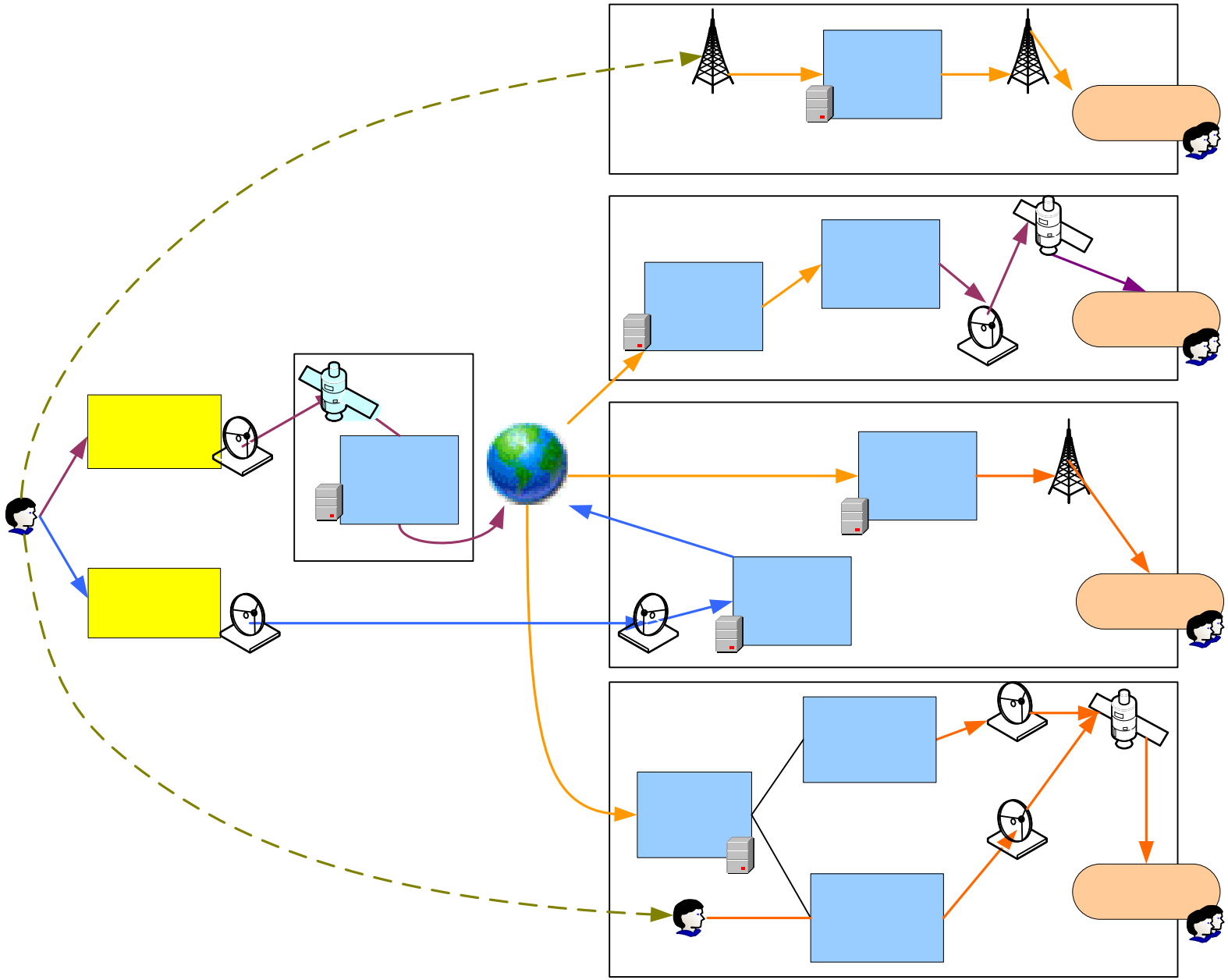
Sarvodaya Community Disaster Management Center (SCDMC)

Communications Providers

Sarvodaya Communities

MULTIPLE Paths, Technologies and Gateways

ICT Networks



COMMON ALERTING PROTOCOL Content Standard to Evaluate the ICTs

CAP Profile for Sri Lanka

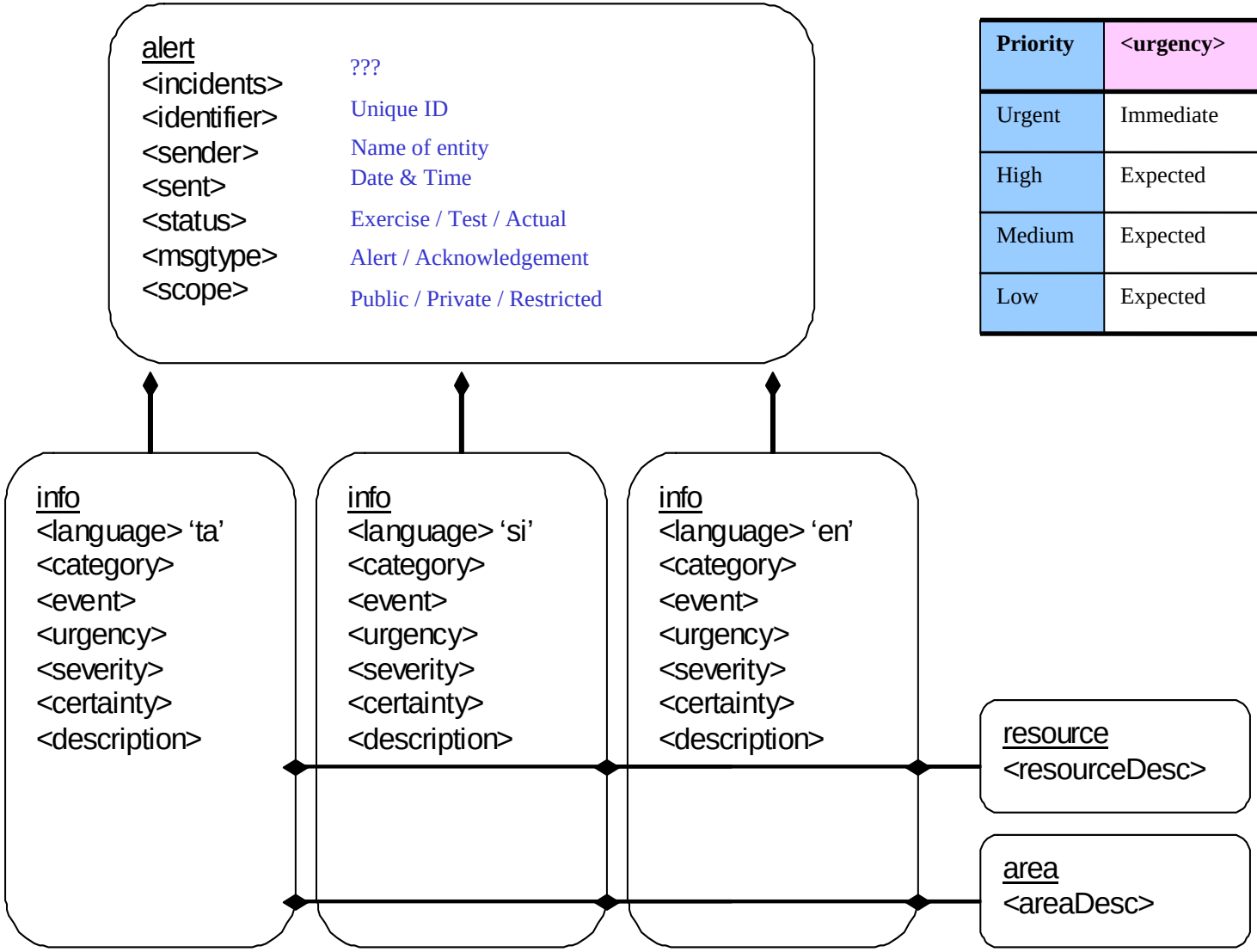


Table to determine priority of the event

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

Example of EMAIL BULLETIN on cyclone alert

TEST 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.

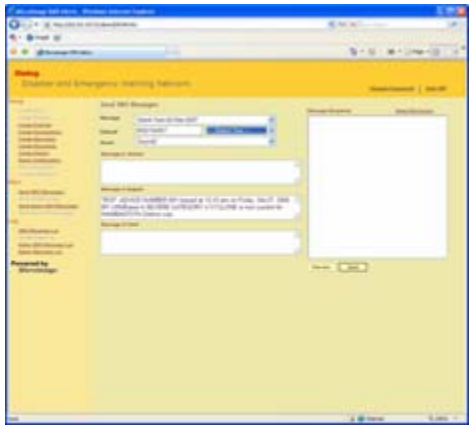
TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST
Last-Mile HazInfo Simulation. No Repeat No Real Event is Effect.

Example of HIH relayed message in CAP

```
<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>
```

Alert input APPLCATION and their respective Terminal DEVICES

DEWNS



ANNY

IPAS

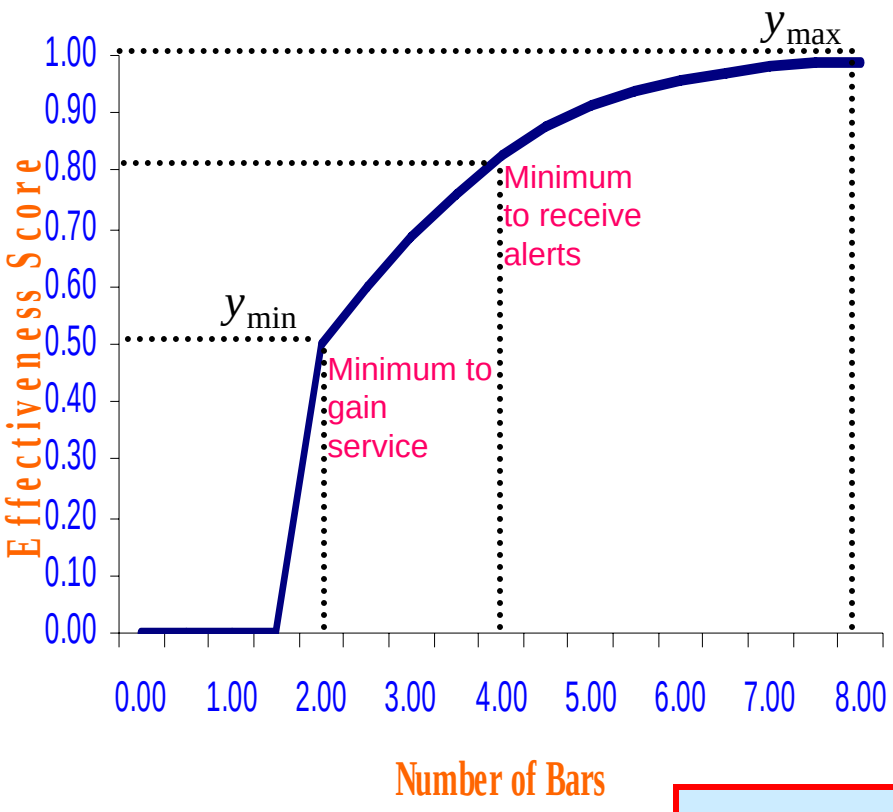
CALL

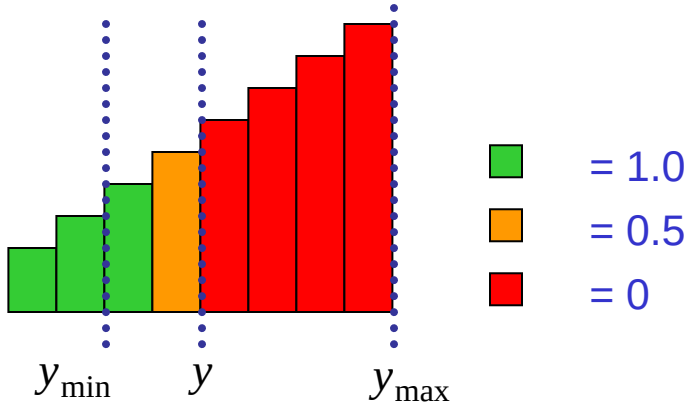
RELIABILITY measure of the Terminal Devices

- Basic question: “Did the ICT work on the day of the exercise?”
- Two aspects of *Reliability* measure: *Certainty* and *Efficiency*
  - *Certainty* is the operational state of the device (variable: R_c)
  - *Efficiency* is the time taken to complete the transmission (variable: R_e)
  - *Reliability* $R = R_c \times R_e$

Formula for Calculating the CERTAINTY of Terminal Devices

Enumaeration of the Effectiveness Parameter: Signal Strength in Terminal Devices





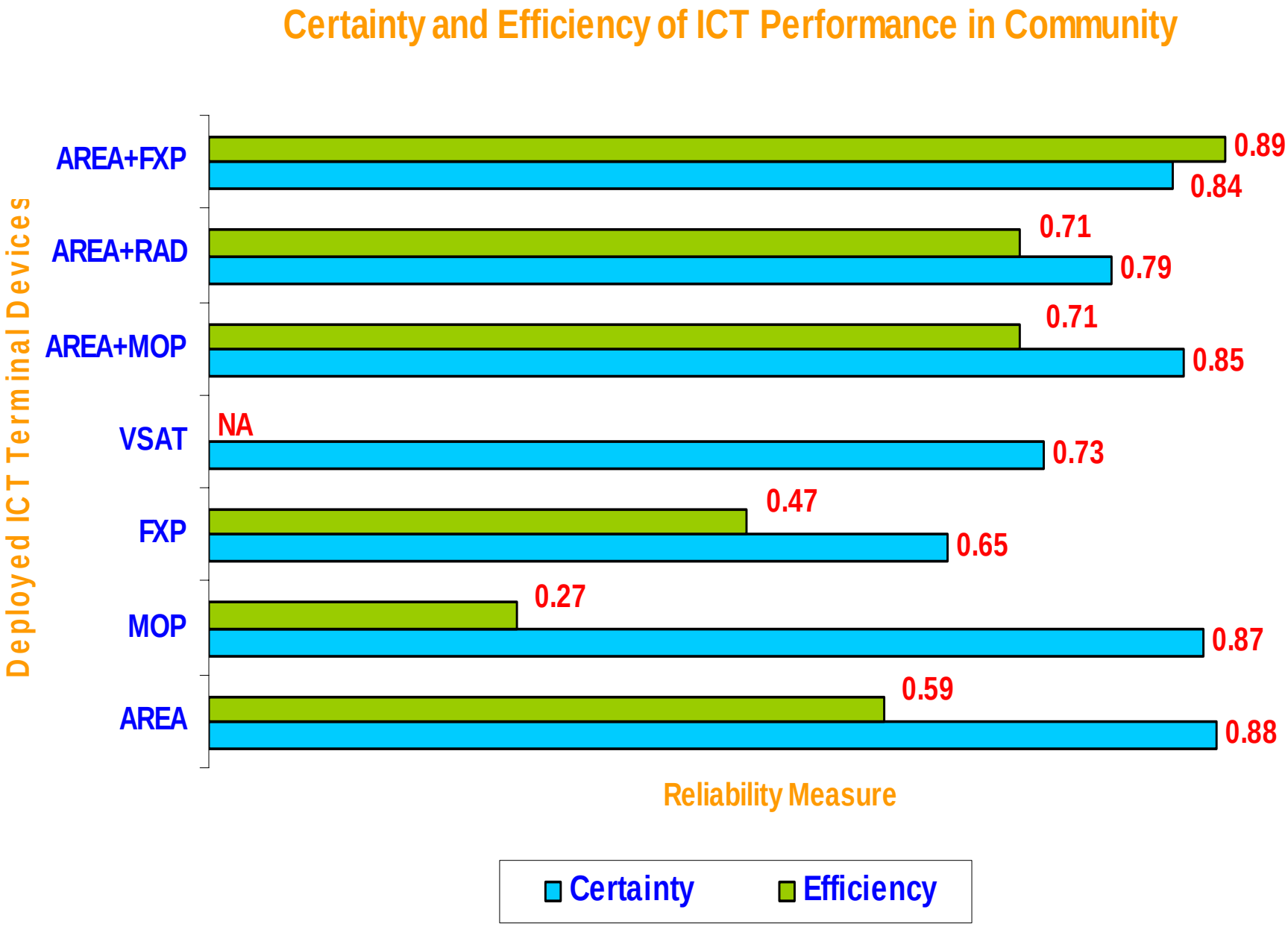
- Maximum available number of bars y_{max}
- Measured number of bars $y \le y_{max}$
- Minimum required number of bars y_{min}

$$R_c = \begin{cases} 1/1+e^{(y_{min}-y)} & , y \ge y_{min} \\ 0 & , y < y_{min} \end{cases}$$

Other factors that drives CERTAINTY of Terminal Devices to ZERO

- *Examples of mishaps during live-exercises in rural communities*
  - User accidentally deletes the tri-language J2ME applet in mobile phone
  - Mobile phone is powered down or battery has zero energy
  - User removes the 2 AA batteries and powers down the AREA
  - Antenna in AREA is not aligned for maximum signal strength
  - CDMA phone bill was not paid and service is discontinued
  - User covers VSAT modem ventilation shafts with news paper and over heats modem
  - VSAT Network Internet proxy blocks IPAS packets returning to PC
  - RAD not registered under correct District in DEWNS Internet based alerting application

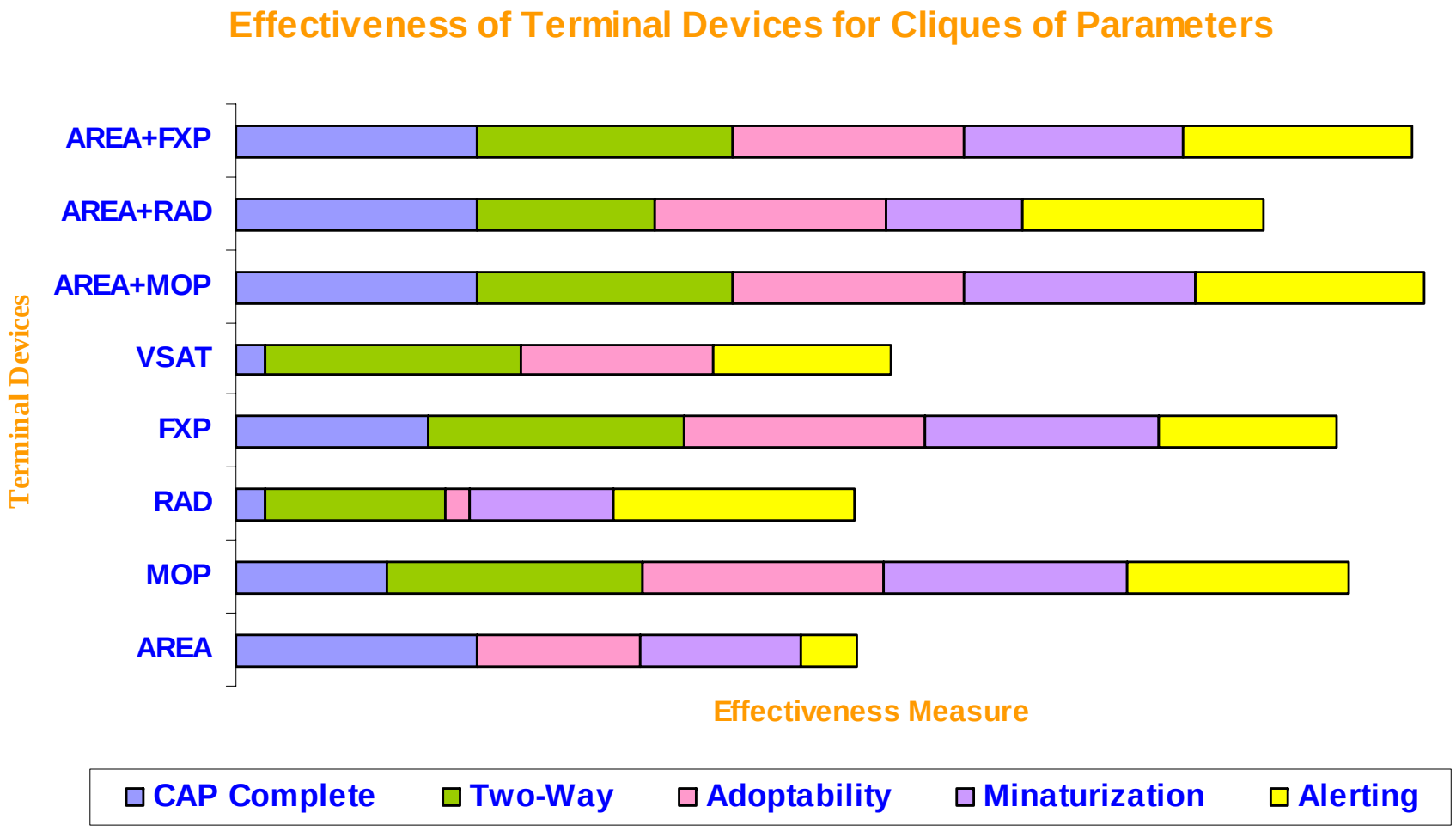
RELIABILTIY of ICT Terminal Devices in a LM-HWS



Parameters to determine the EFFECTIVENESS of ICs

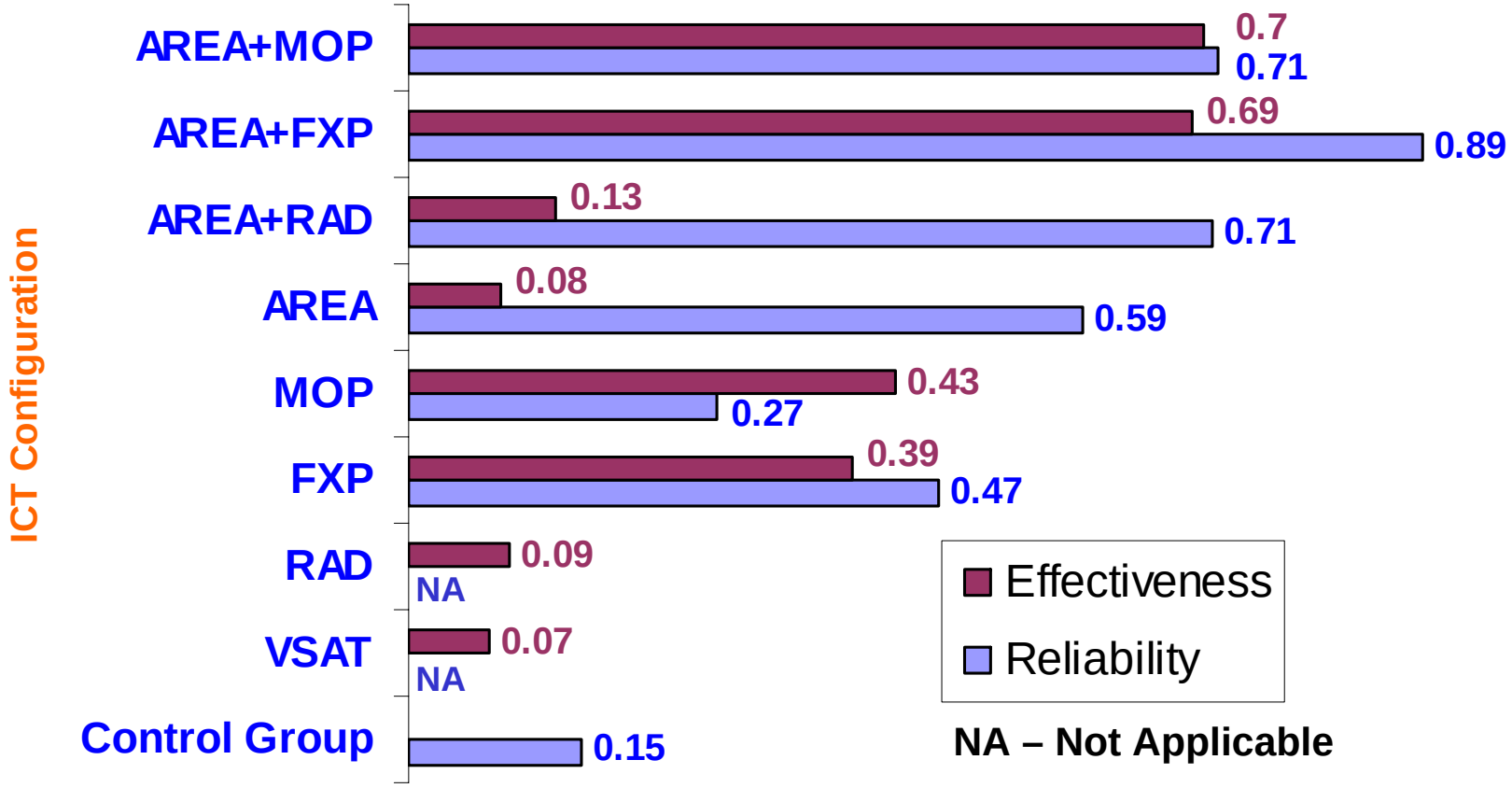
Clique	Abbreviation	Parameter
CAP Complete	Ethnicity	Language Diversity
	All-media All-hazards	Full CAP Messaging
	Multimedia	Audio and Text Medium
Two-Way	bi-directionality	Upstream Downstream Communication
Adoptability	Utilization	Integration in to communit daily life or development
	affodability	Total Cost of Ownership
Minaturization	Weight	Weight of wireless ICT terminal
	Longevity	DC Power Consumption
	Volume	Dimensions of Terminal Device
Alerting	accountability	Acknowledgement message receipt
	wakeup	Active alerting function

EFFECTIVENESS of ICT Terminal Devices in a LM-HWS

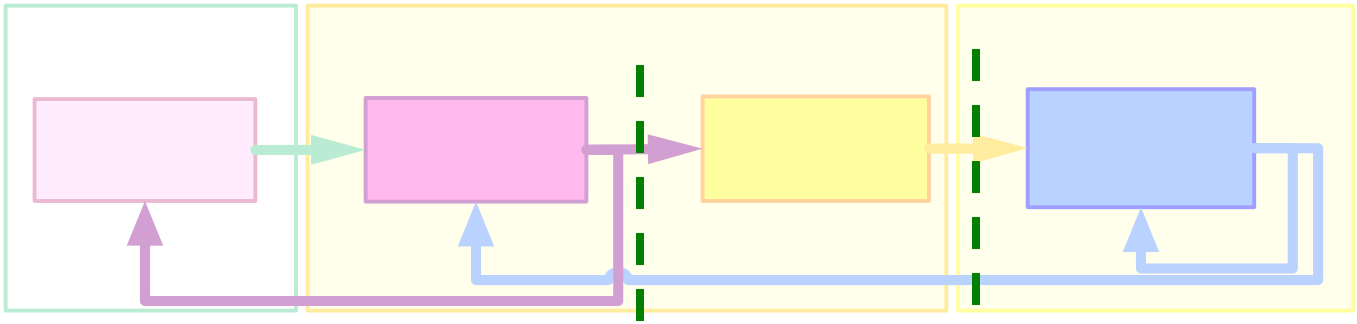


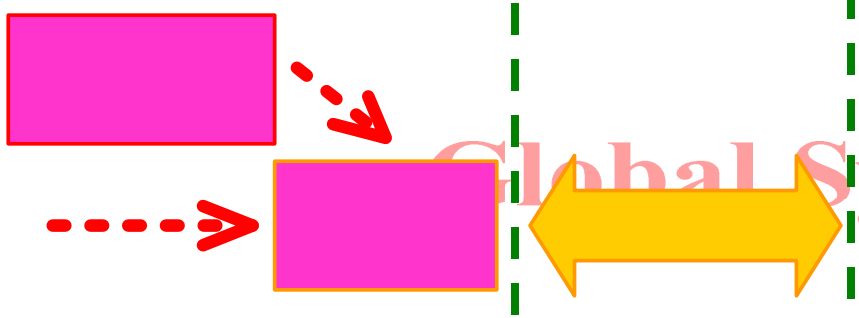
PERFORMACE of ICT Terminal Devices in a LM-HWS

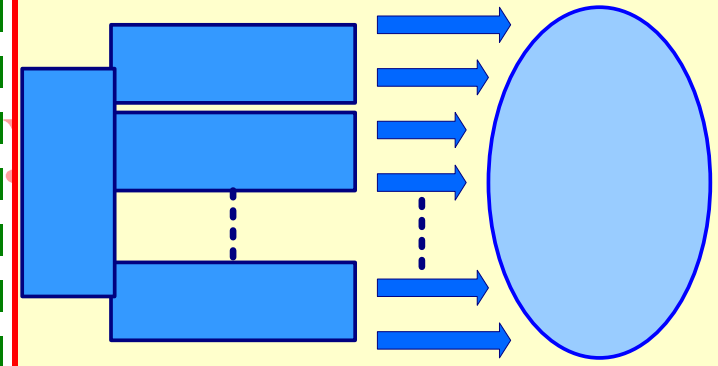
Comparison of Reliability and Effectiveness of ICT as a Warning Technology in a LM-HWS



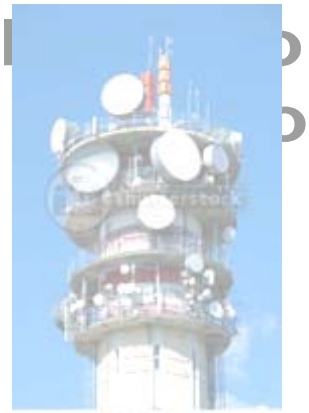
LM-HWS – Community Components







Sarvodaya Community Disaster Management Center (SCDMC)

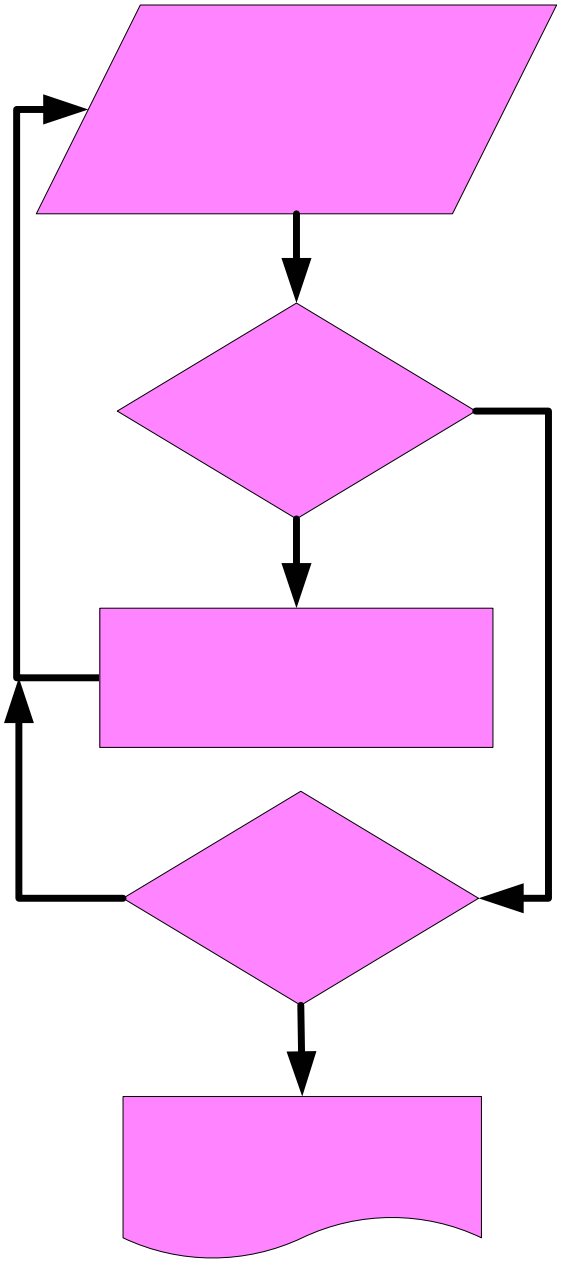


Communications Providers

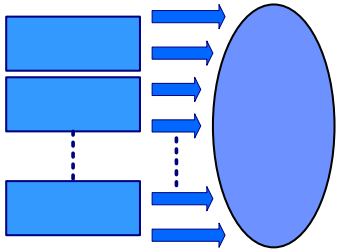
Sarvodaya Communities

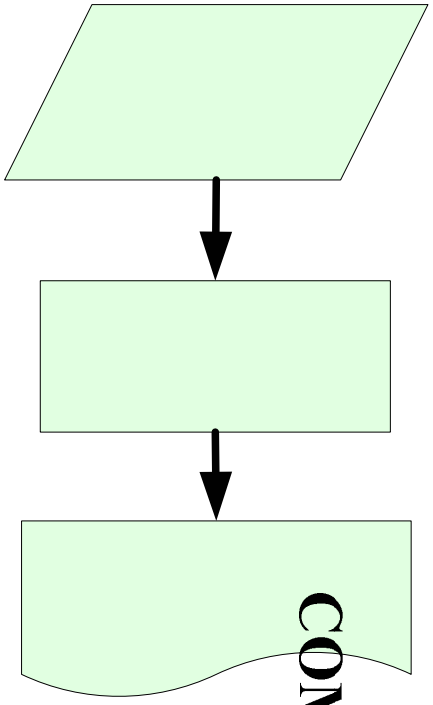
ICT GUARDIAN Functions and Workflows

ICT-G receiving alert from HIH via ICT



ICT ERP COORDINATOR Functions and Workflows





ERP-C(n,1)

ERP-C(n,2)

ERP-C(n,m)

COMMUNITY (n)

ICT-G informing ERP-C

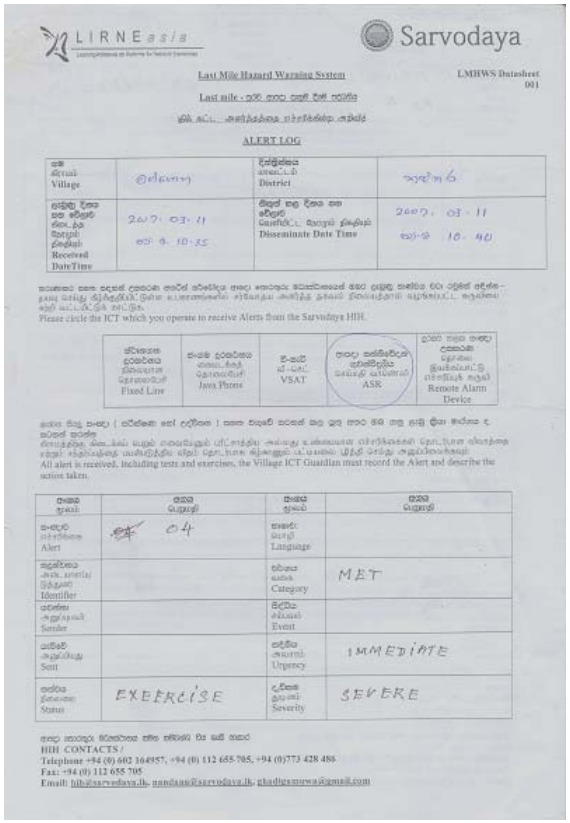
ERP-C Informing Community

ERP-C Evacuating Community

Measure of EFFECTIVENESS of Community Actions

- Effectiveness of the ***ICT Guardian*** was measured based on whether they were capable of --
  - Recording the mandatory elements of the CAP Profile in the “Alert Log”
  - Interpreting the priority of the alert

- Effectiveness of ***ERP Coordinator*** was measured based on weather they were capable of –
  - Activating the first-aid, security, dissemination, and evacuation teams
  - Providing accurate instructions to the households
  - Getting all the notified house holds to participate



LIRNEasia

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Last Mile Hazard Warning System

LMHWS Datasheet 001

Last mile - අවසාන පියවර විපත් අවවාදය

ALERT LOG

ගම Village	මේඛලාව	දිස්ත්‍රික්කය District	කුරුණෑගල
ලැබුණු දිනය සහ වේලාව Received DateTime	2017. 03. 11 හවු 9. 10:35	බිඳහැර යවූ දිනය සහ වේලාව Disseminate Date Time	2017. 03. 11 හවු 9 10. 40

Please circle the ICT which you operate to receive Alerts from the Sarvodaya HIH.

Fixed Line | Java Phone | VSAT | ASR | Remote Alarm Device

All alert is received, including tests and exercises, the Village ICT Guardian must record the Alert and describe the action taken.

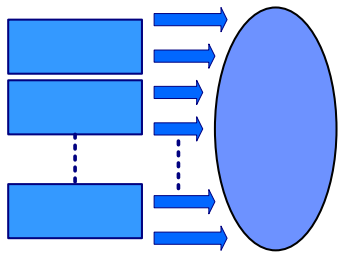
Alert	04	Language	
Identifier		Category	MET
Sender		Event	
Sent		Urgency	IMMEDIATE
Status	EXERCISE	Severity	SEVERE

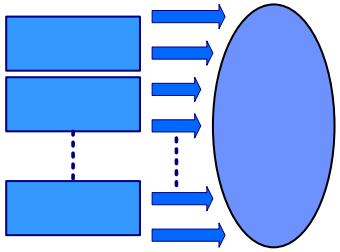
HIH CONTACTS /

Telephone +94 (0) 602 164957, +94 (0) 112 655 705, +94 (0)773 428 488

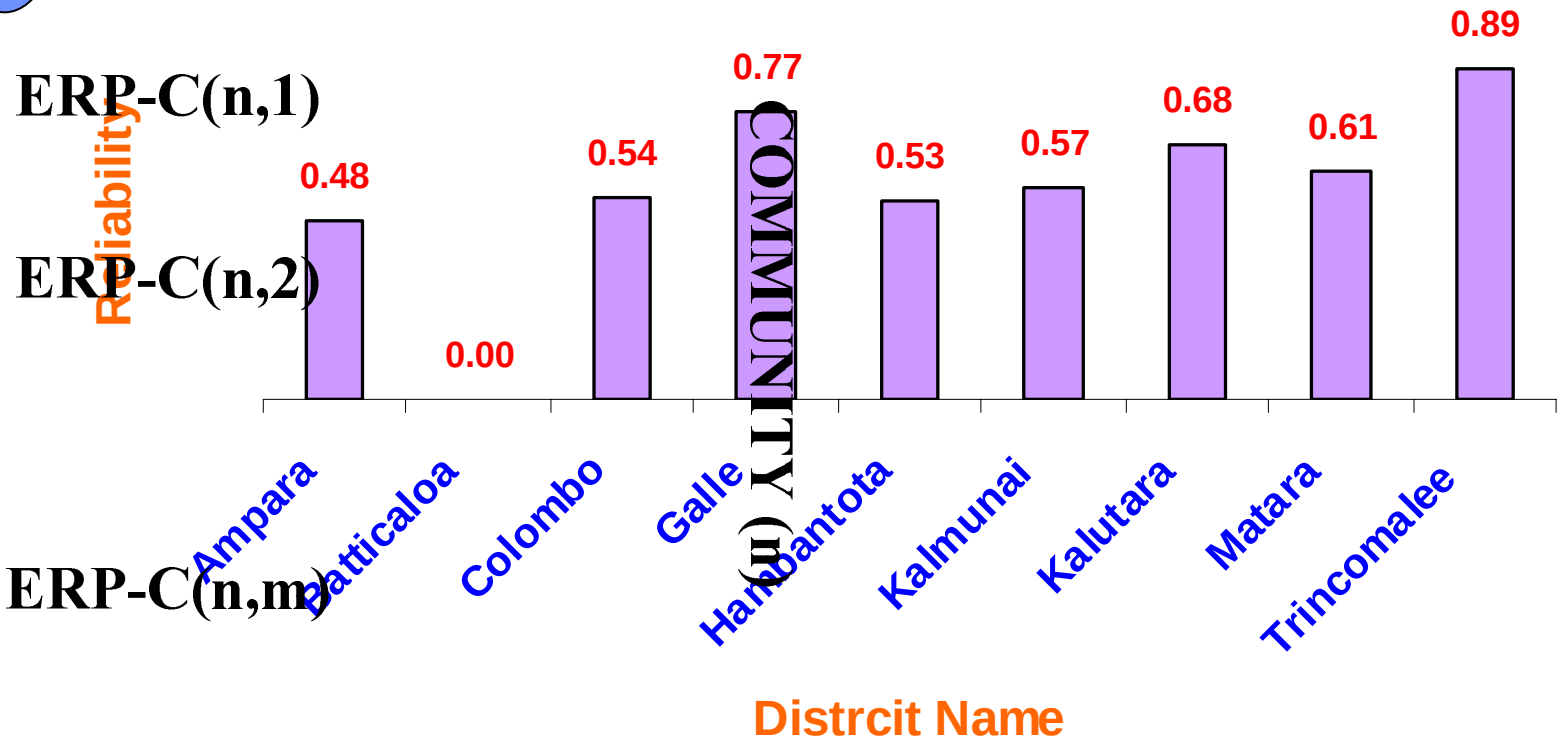
Fax: +94 (0) 112 655 705

Email: hih@sarvodaya.lk, nandana@sarvodaya.lk, ghadigamuwa@gmail.com





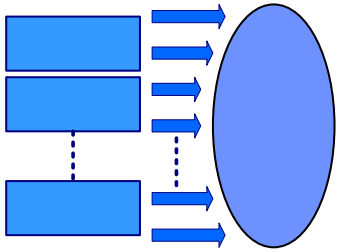
Average Reliability of Community Perfromance by District



Current Performance

- Reliability = 64%
- Effectiveness = 10%

- Given the complexities in communities 64% efficiency is tolerable but bench mark should be 85%
- Effectiveness can be improved if and only if entire community participates in training and simulations as well be prepared for “all-hazards”; effectiveness is low because very few participated in training and drill and also were prepared only for tsunami evacuations



Problems encountered in the Communities

ERP-C(n,1)

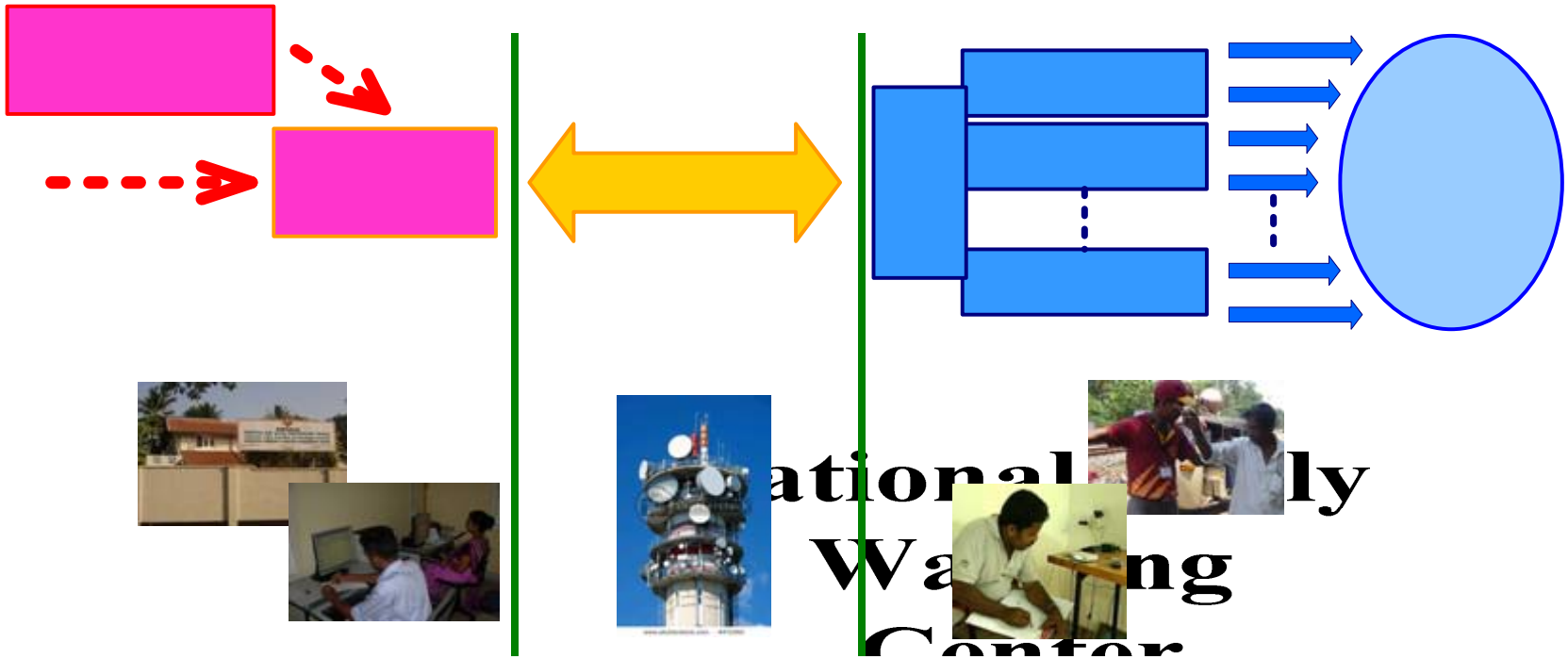
ERP-C(n,2)

ERP-C(n,m)

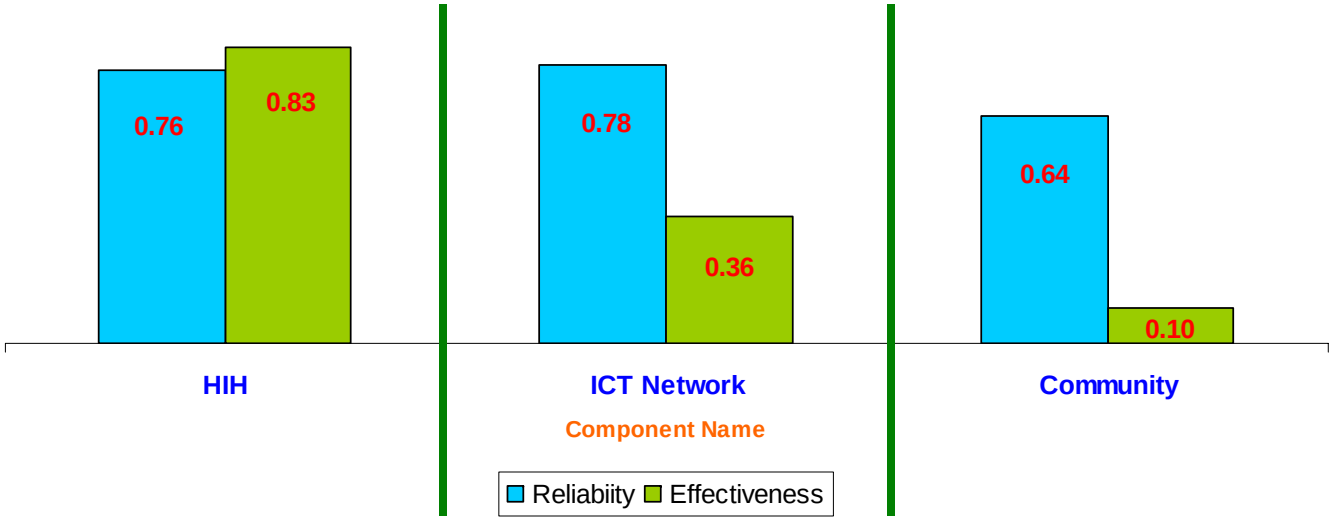
COMMUNITY (n)

- Exercising Tsunami ERP when issued Cyclone warning
- Did not hear the temple bell or mosque announcement
- Church wall preventing people to use shortest path to assembly point
- ICT Guardian having trouble locating ERP Coordinator to relay message
- People afraid to leave homes because no mechanism to lock homes
- Planned method of using gun shots could not be exercised due to conflict situation in country
- Readying event for big-shot official to make speech and not readying for simulation drills
- Rivalry between Sarvodaya and Non Sarvodaya members in same village

How do we Evaluate the to Community-based Warning System?



Average Reliability and Effectiveness of Independent Components



BEST PRACTISES drawn from the Research: (TRAINING)

- ***Conduct simulations in 3 stages*** systematically
  - *First* - 'Table Top' exercises for all local hazards with the Community Firs Responders
  - *Second* - informed and properly planed drills for subset of the community with a surprised hazard event
  - *Third* - with notification of date but surprise with the time and hazard

- ***Planning and Simulation*** are a necessary condition for Early Warning System development

BEST PRACTISES drawn from the Research: (TECHNOLOGY)

- Communication must be in the local language using a ‘all-hazards’ ‘all-media’ approach with the use of the ***Common Alerting Protocol***; (i.e. full CAP messaging to avoid ambiguity)

- Deploy multiple terminal devices with the aim of achieving “***complementary redundancy***” in reliability and effectiveness

Thank You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Learning Initiatives on Reforms for Network Economies


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