

Interactive Voice Uncertainties for Emergency Communication Suspends Automation

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Sarvodaya



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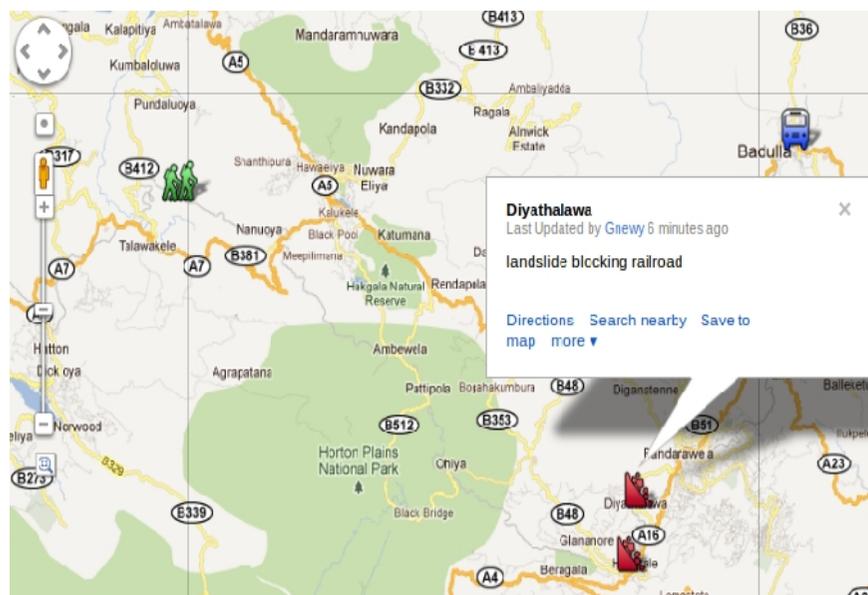
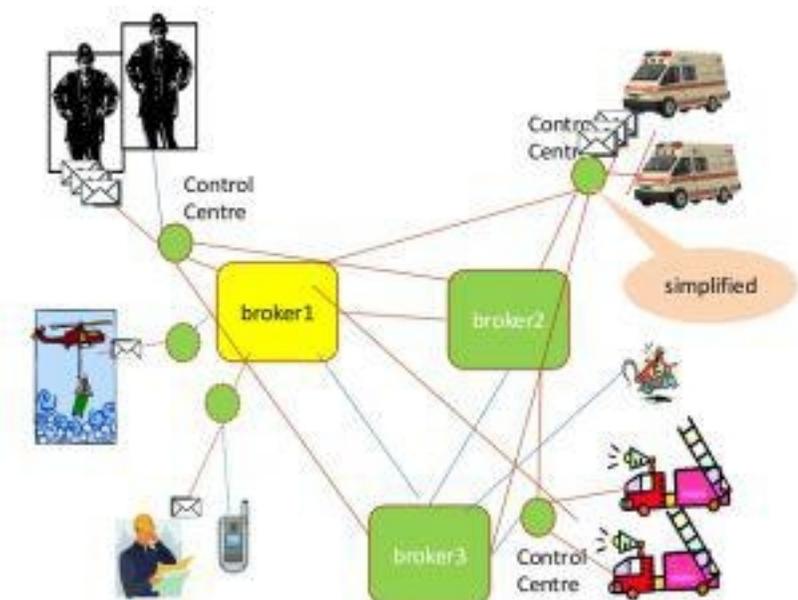
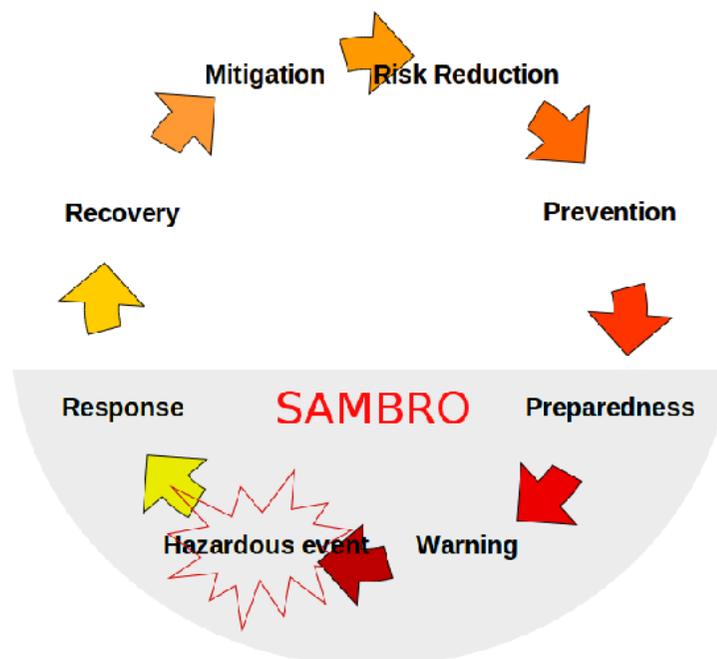


LIRNEasia

www.lirneasia.net

LIRNEasia's Emergency Communication Research Focus

- LIRNEasia is in EWS space of DM; i.e. **HazInfo**:
 - *Projects* :: Webhamuwa, NEWS:SL, Dam-safety, LM-HWS, CB, Biosurv, FF4EXL
- Bleeds in to "preparedness" and "response"
 - "plans w/o drills and drills w/o plans are useless" → action research
- Advocate interoperability
 - common procedures (registry of alerting authorities)
 - data standards (e.g EDXL)

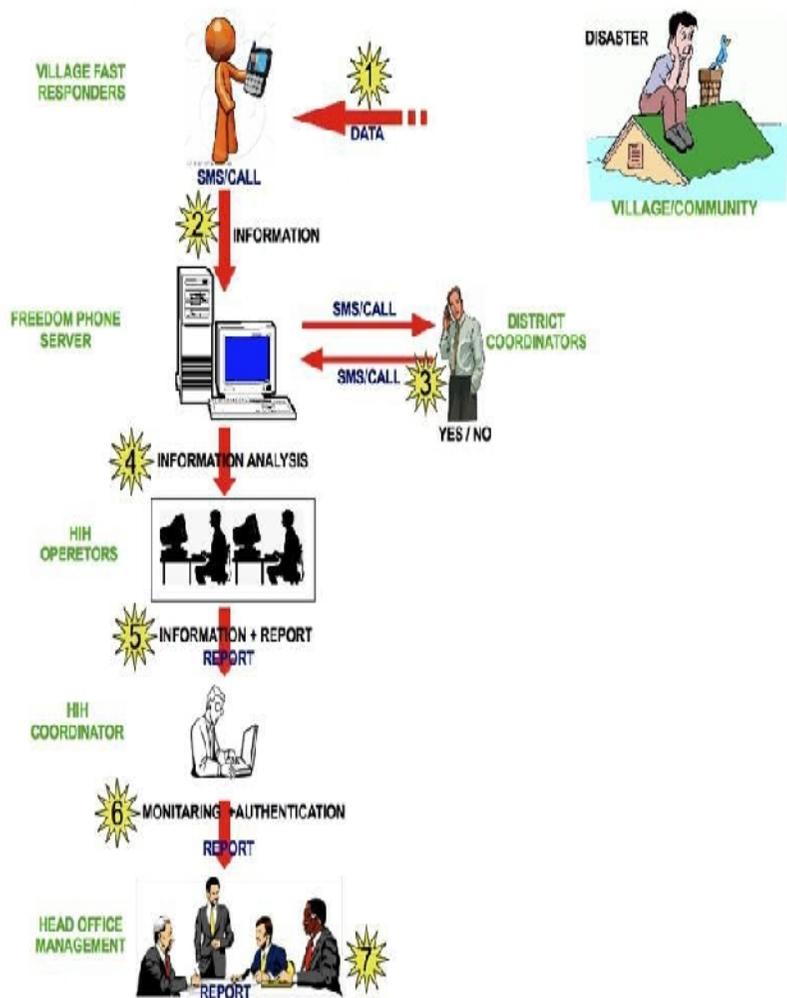


“Sarvodaya Samana Thetha” Community-based Disaster Management Center Emergency Information Needs



[Voice for Alerting and Response >> Full Story](#)

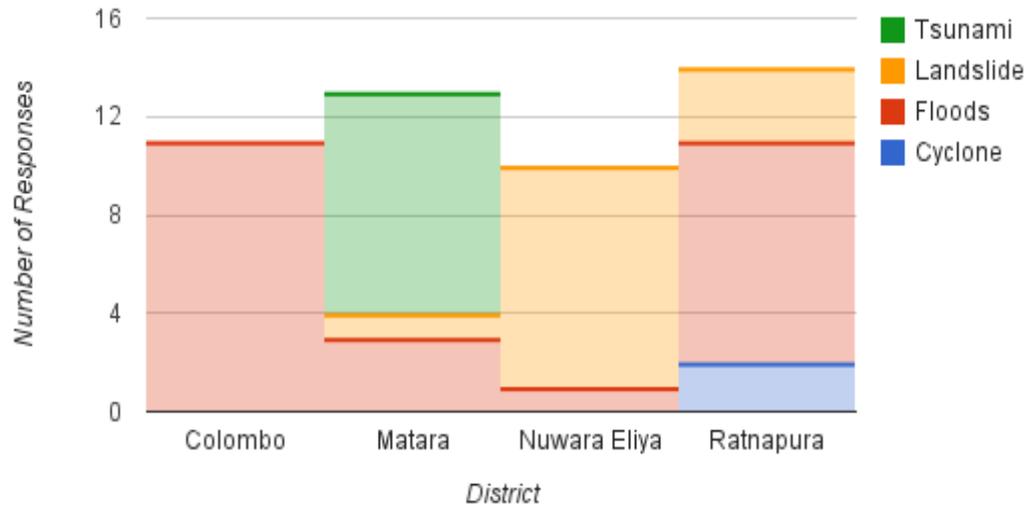
Situational Information Communication Procedure



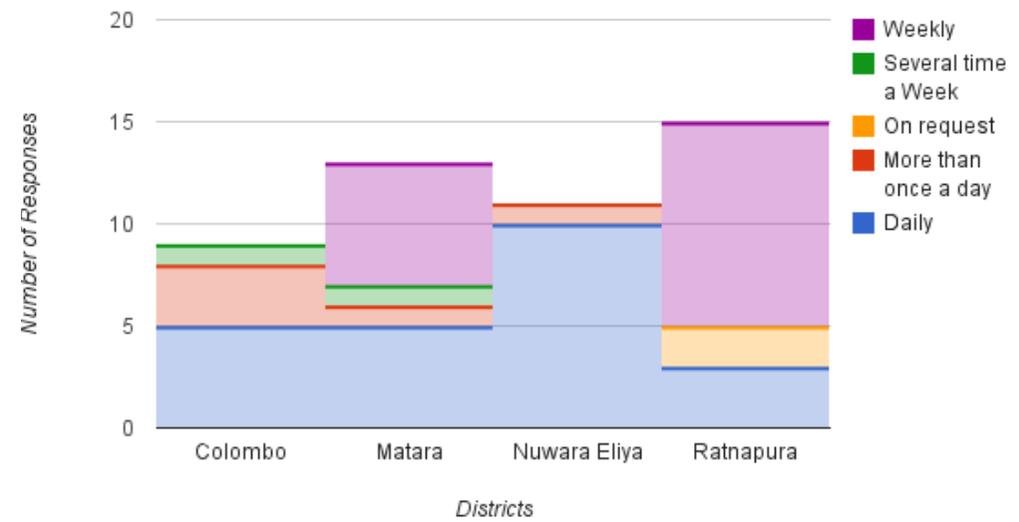
- Community members (victims or associates)
 - call the District or Head Office
 - report of incidents.
- Collect ground truth
 - 2011 Floods, SCDMC dispatched youth with cameras, laptops, and dongles
- Blog situation on www.sarvodaya.org
- Get word to media and donors
- Secure response resources

Sarvodaya use telephones to communicate, daily/weekly, IDP Info

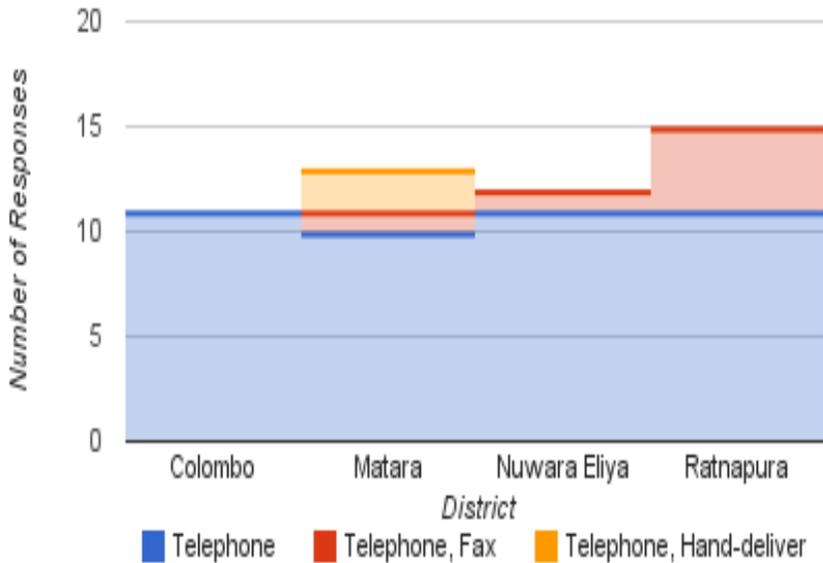
2003 to 2011 Sarvodaya District Staff Responded Hazard Categories (n=51)



Sarvodaya Emergency Information Communication Frequency (n=51)



Sarvodaya Emergency Information Communication Methods (n=51)



IDP information



Survey - Emergency Communications Requirements

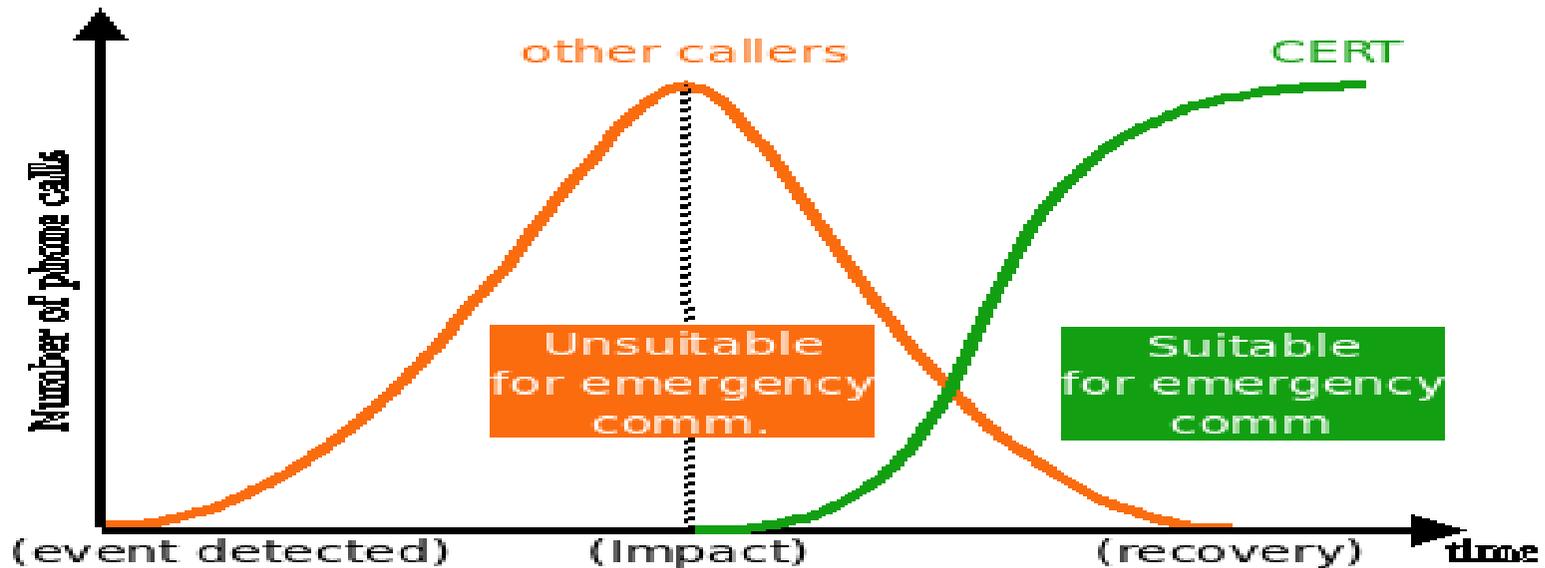
Disaster Information
 Problem to be solved: emergency communications

(a) Disaster Type:
 Most common type of disaster was cyclone (40%), followed by floods (20%), landslides (10%), and tsunami (10%).

(b) Frequency of communication:
 Daily
 More than once a day
 On request
 Several times a week
 Weekly
 Other



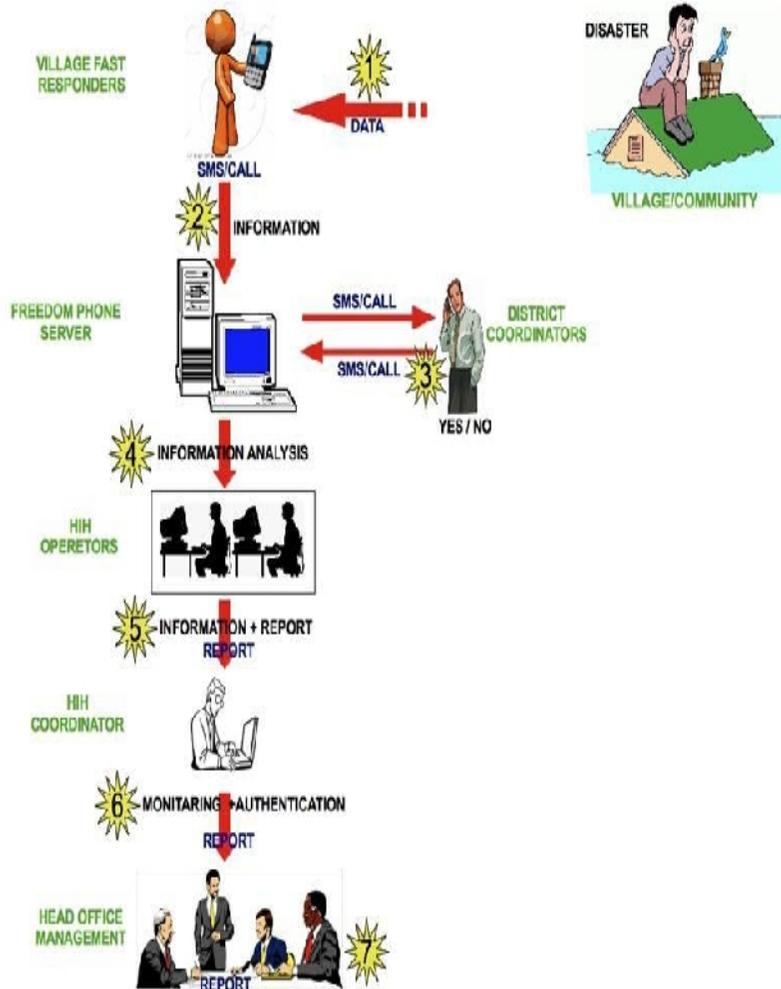
Positioning Voice for Emergency Communication



- **Dropped calls** are high during hazard events
 - Voice best after the *N*th hour from disaster impact
 - Recommended for **disaster response phase** (rescue and relief)
 - Can be used for other none critical disaster management activities
- Canada use IVR for rapid on-set tsunami warnings (< 60 min window)
 - But too expensive for developing countries
 - Definitely not for community-based organizations
- **IVR** removes language and computer literacy barriers
 - **less burden on training regime**

Two key consecutive operations for community-based emergency response

Situational Information Communication Procedure



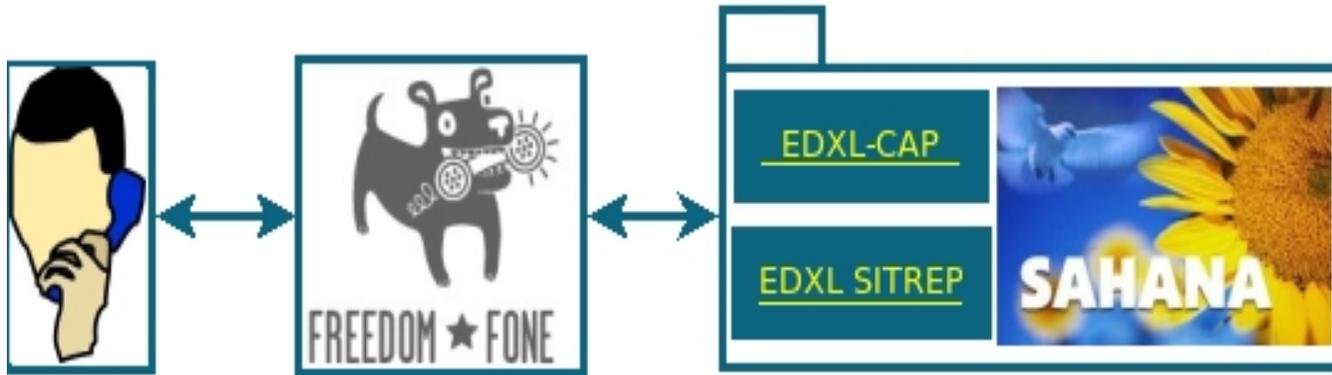
ALERTING

REPORTING

Following a hazard event activate CERT members and HIH operators to identify the incidents, then report the field observation

Receive field observation reports, process them at the Hazard Information Hub to create Situational Reports

Decoupled Software Systems

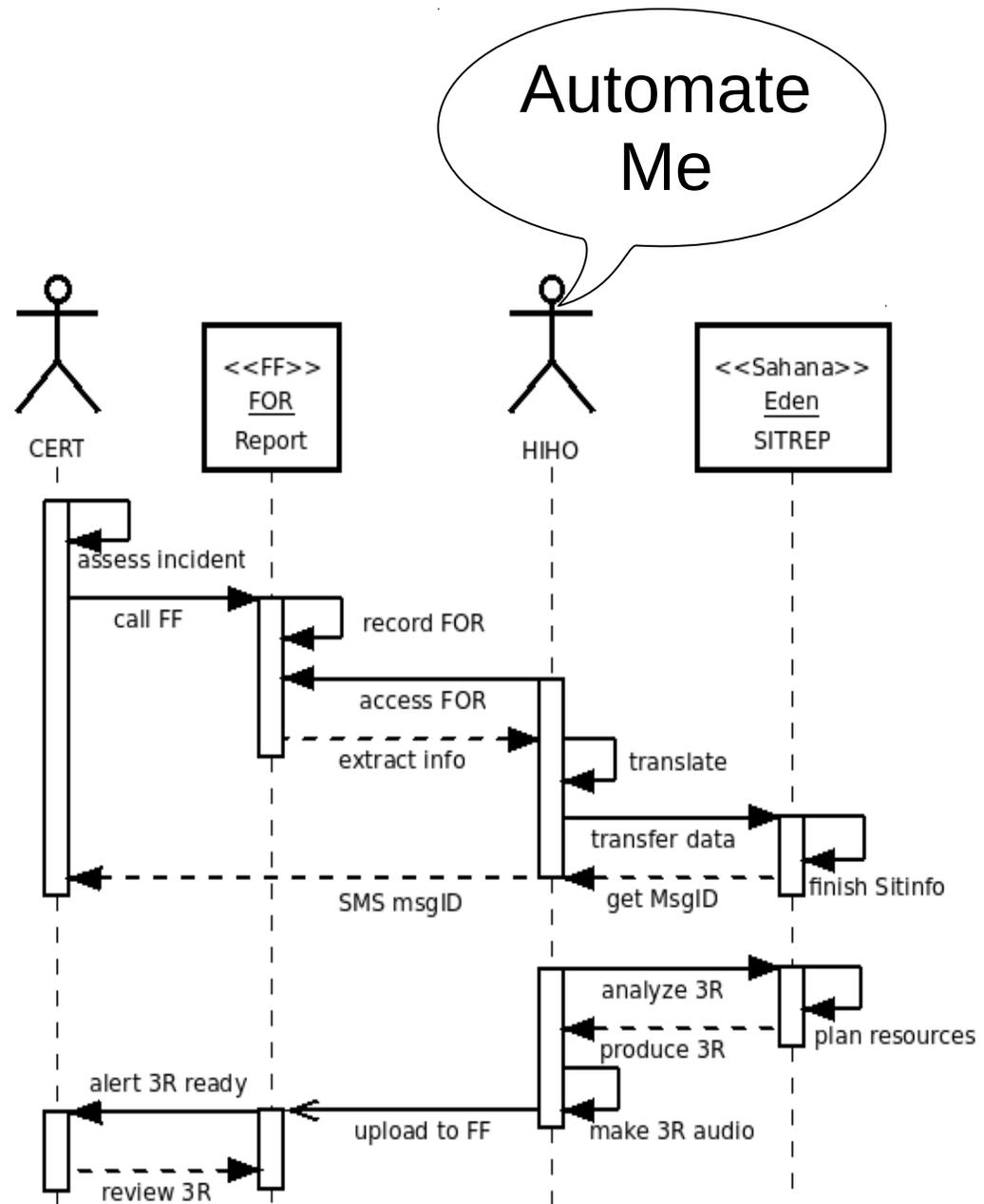


- **Sahana Disaster Management System** (www.sahanafoundation.org)
 - _ FOSS humanitarian ICT tool but in several flavors: Agasti and Eden
 - _ supported by a global community of software engineers and emergency managers
 - _ categorical data important for decision support
 - _ Believes in interoperability
- **Freedom Fone** (www.freedomfone.org)
 - _ FOSS IVR tool
 - _ Don't need Internet
 - _ Infrastructure: GSM modem + cheap PC
 - _ User Interface: standard telephones (mob + fix)
- **Audacity**
 - _ FOSS tool for making audio files

REPORTING

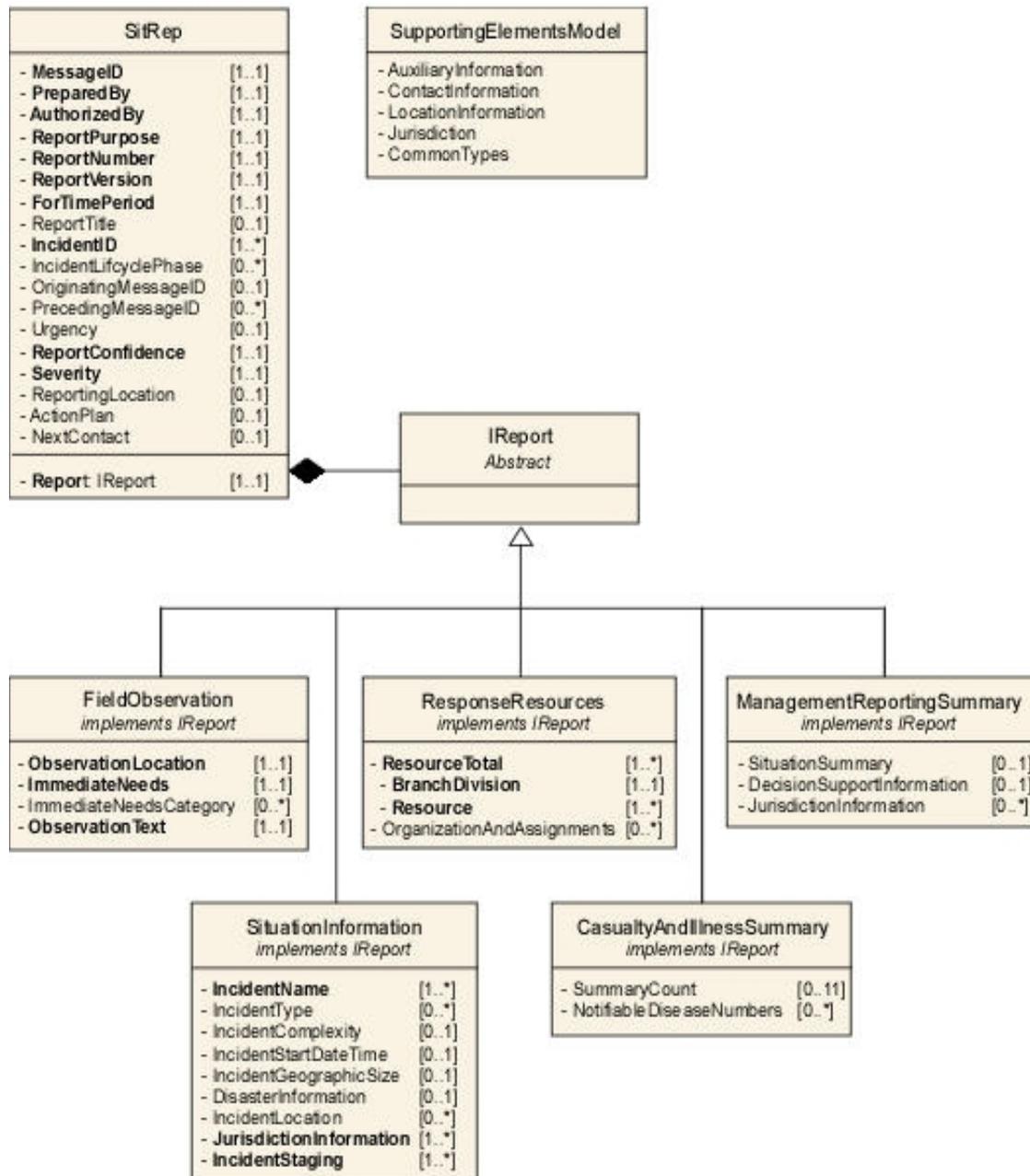
Upstream communication sequence

- 1) CERT members record, local lingo Field-Observation voice reports in Freedom Fone IVR
- 2) Incident coordinators (HazInfoHub Operators) translate/transform those voice messages to EDXL-SITREP categorical info
- 3) Then enter that plus other info in Sahana SitRep module
- 4) Incident managers derive Response Resource reports for actions



REPORTING

Emergency Data Exchange Language (EDXL) Situational-Reporting (SITREP)



1) **SitRep**: root element with qualifying elements

2) **iReport**: the type of report

- **Field Observation**: report sent by CERT members identifying incidents

- **Situation Information**: additional information for comprehensive information

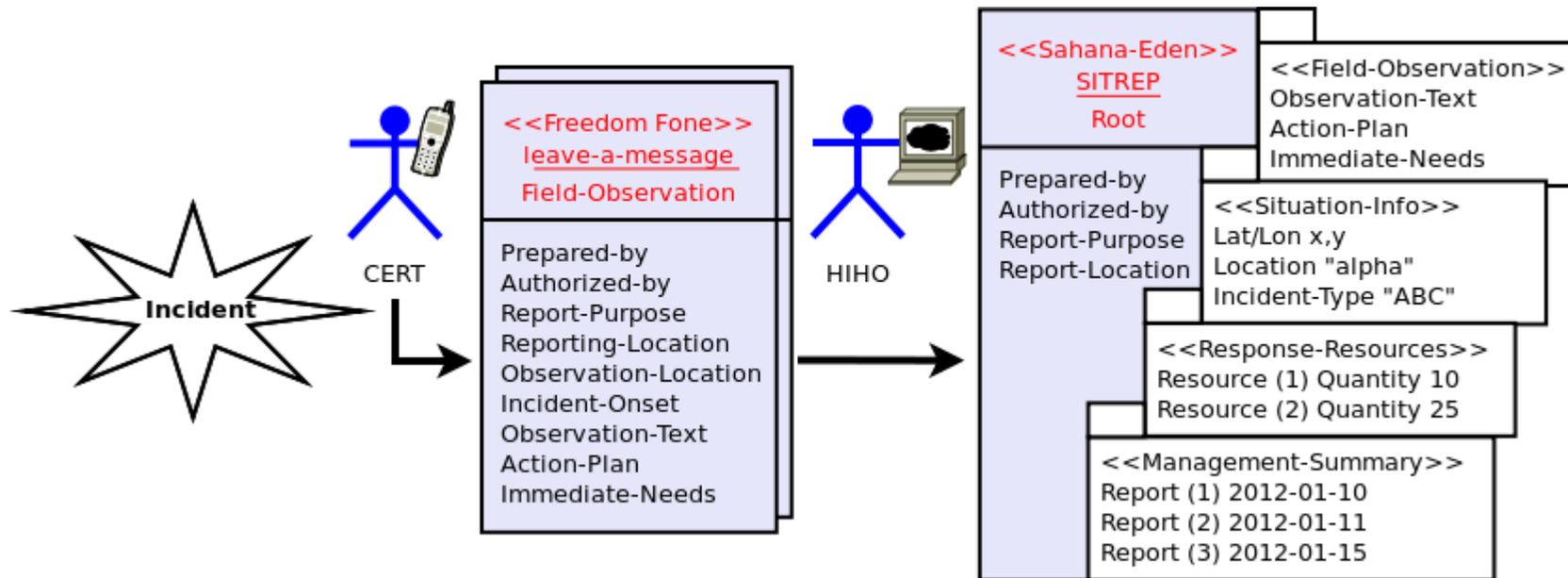
- **Response Resources**: derived resources to deploy

- **Casualty/Illness Summary**: injury and health related information

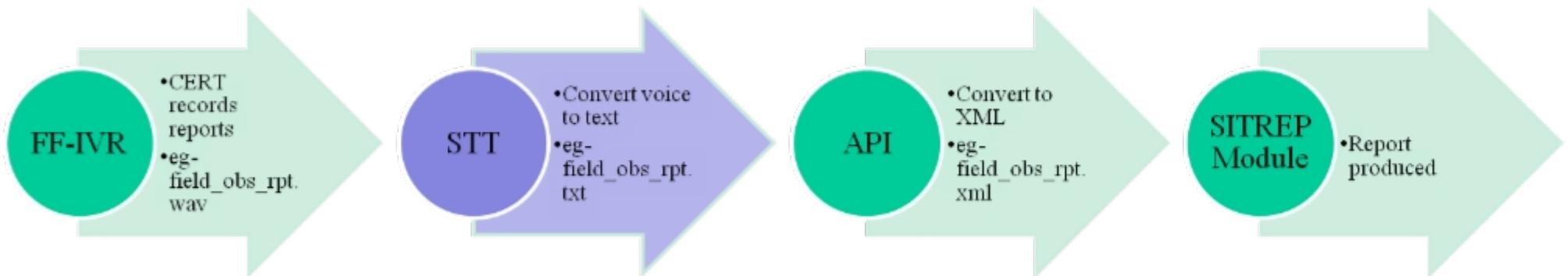
- **Management Summary**: periodic summary of overall picture

REPORTING

Software components

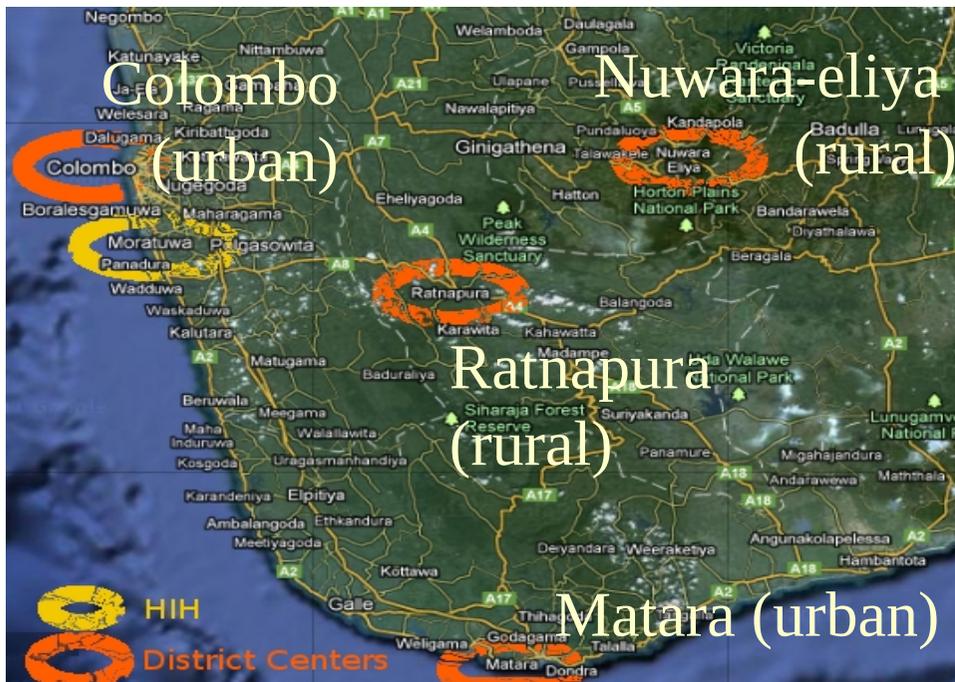


Automation required to reduce the human work load



Research Design

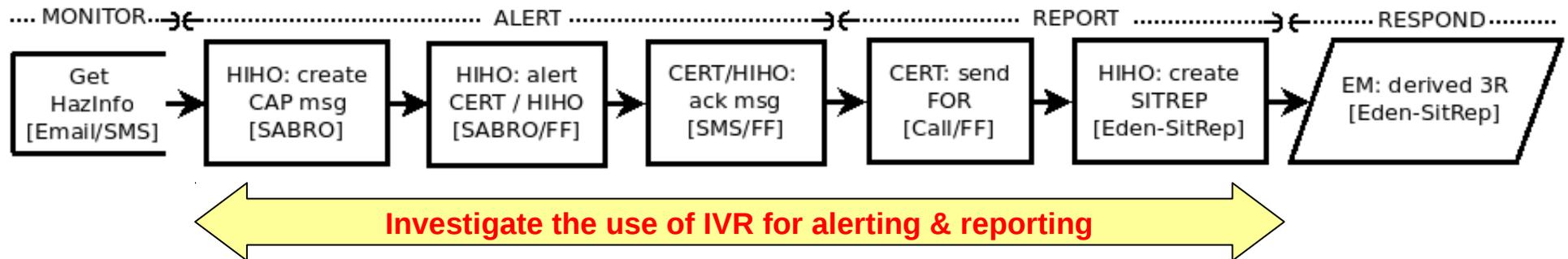
- Principal: Lanka Jathika **Sarvodaya** Shramadana Sangamaya
 - Sri Lanka's largest community development NGO
 - Also provide humanitarian services
- Hazard Information Hub @ Community Disaster Management Center, Moratuwa, HIH Manager, 3 HIH Operators
- Four Districts: Colombo, Matara, Nuwara-eliya, Ratnapura, ~ 10 - 15 CERT members from each district: Divisional/District Coordinators, Staff



Formative Evaluation Method

Controlled Exercises

- Discussed operating procedures (goal, intention, action)
- Executed those procedures (execution, perceiving, interpreting SoW)
- Evaluated the outcomes (Performance, Usability)



Complexity:

- Interaction techniques (HCI)
- Reliability - mean time to completion & **voice quality (ITU-T)**

Usability:

- Human action cycle (HCI)
- Gulf of execution/evaluation (HCI - what system allows and understanding of SoW)

Utility:

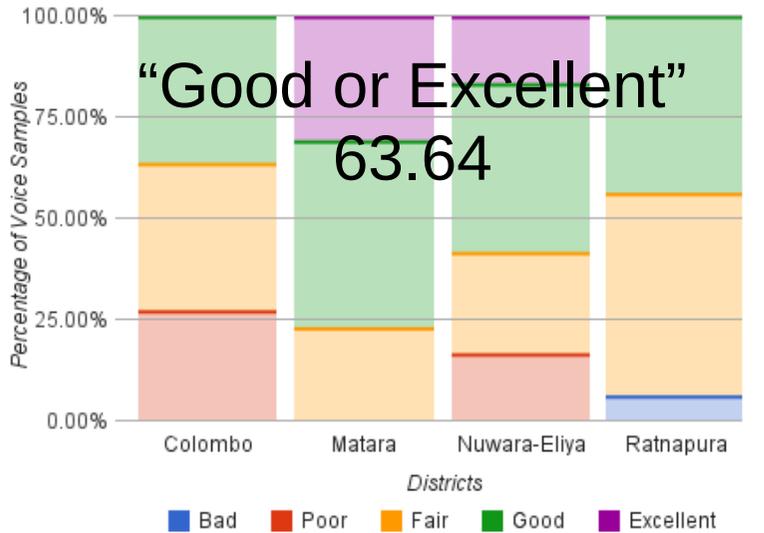
- Ease-of-Use, Usefulness, and Attitude (TAM)

General observations, CERT multiple attempts with Freedom Fone

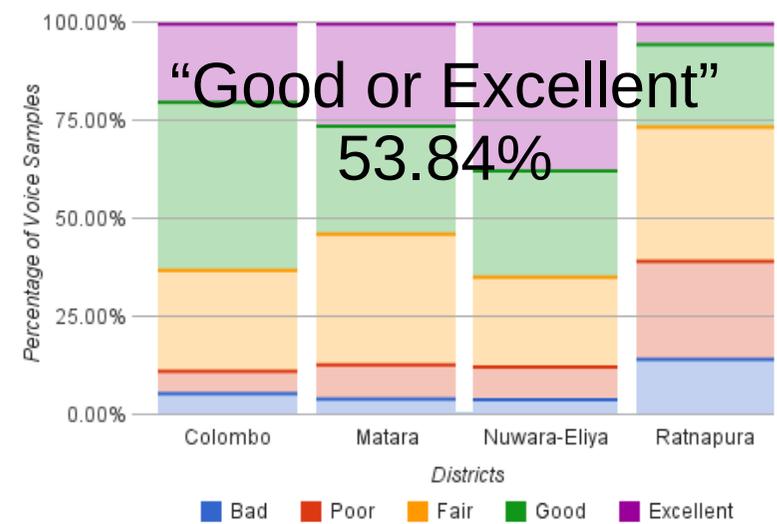
- User who claimed Freedom Fone to be difficult had not been exposed to IVR prior to this; very much used to dial a number of occasional SMS
- Unlike mobile or computer application with display, IVR has no visual of transitions; hence, sometimes get lost in the menu trees
- Frustrations caused by unbranded cheap phones not interacting well (e.g. keypad entries not recognized)
- Some carriers not passing the DTMF signal through for IVR interactivity; menu options not recognized.

Mean Opinion Score

MOS distribution for Speaker-dependent exercise (n=51, m=3)



MOS distribution for Speaker-independent exercise (n=48, m=7)

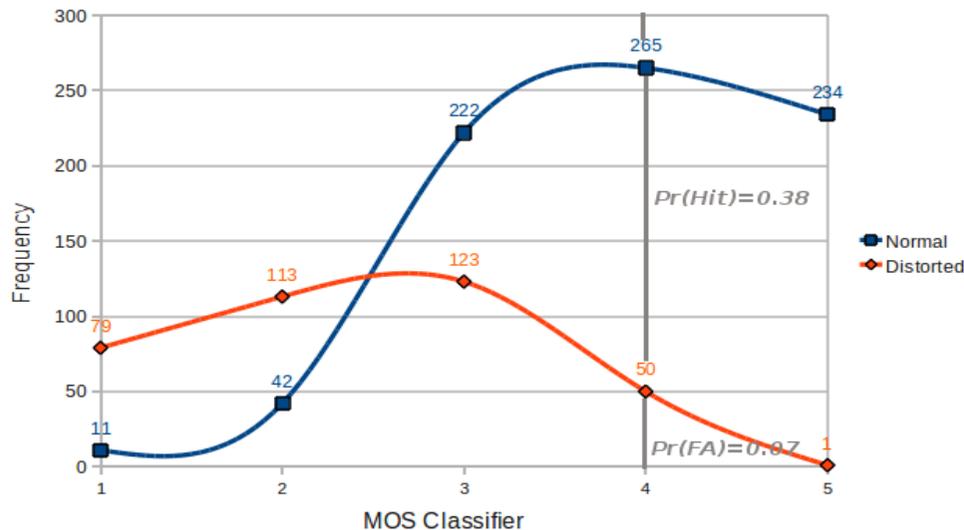


Speaker-dependent
MOS=3.39

Emulates

Speaker-Independent
MOS=3.52

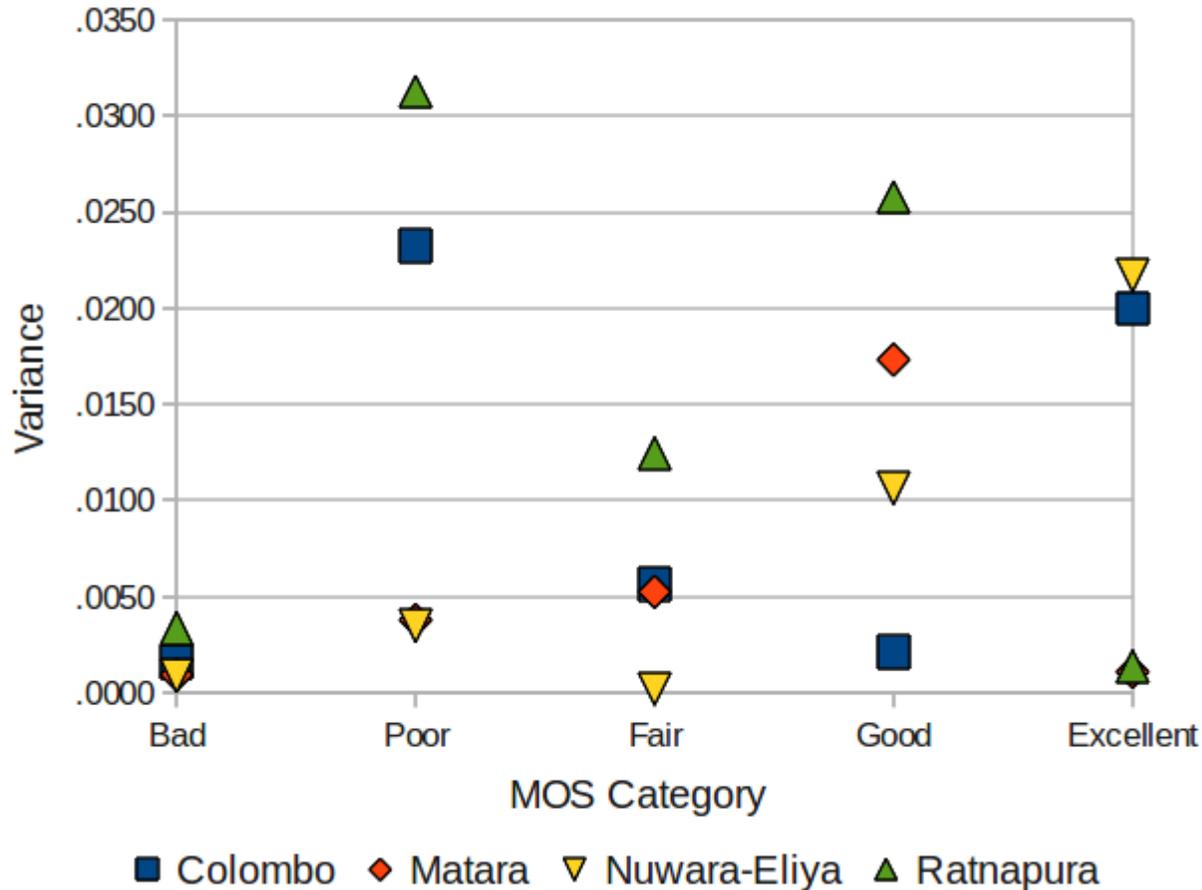
Frequency of Normal and Distorted Voice Samples



- Circuit (mechanical) and environmental noise prevalent
- Approx. 50% bad, poor, and fair
- Calling CERT member to confirm info would be inefficiencies
- MOS cut-off = 4.0 is a reliable choice for setting a cap for emergency comm IVR applications

Variance between the speaker-dependent and speaker-independent MOS scores

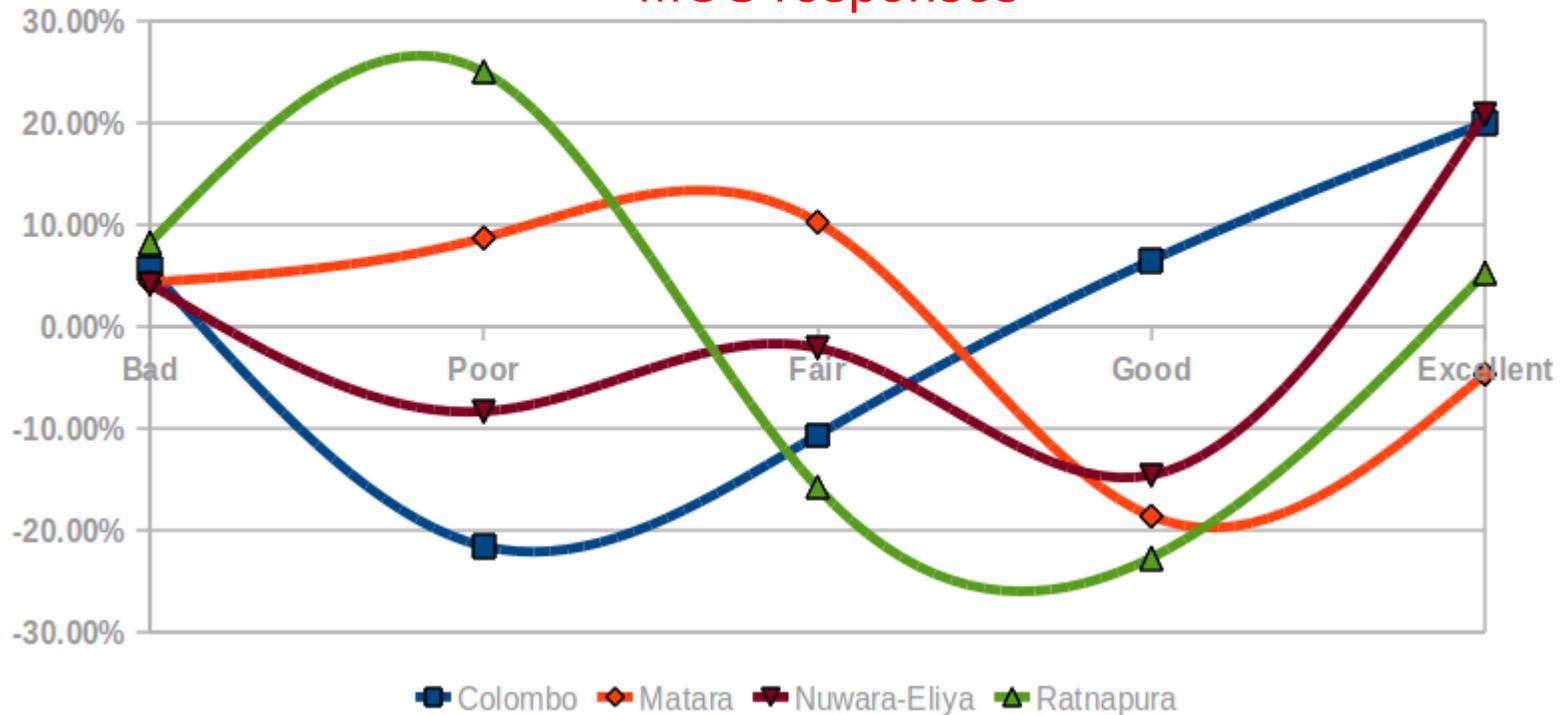
Variance in First and Second Exercises



Doesn't say much?

The responses are off phase

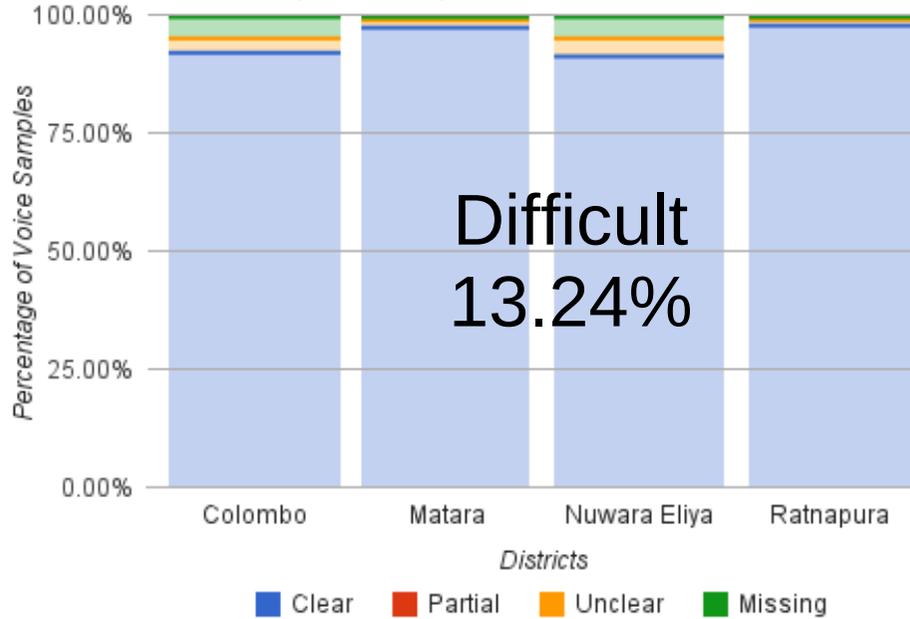
Difference between the
Speaker-dependent and Speaker-independent
MOS responses



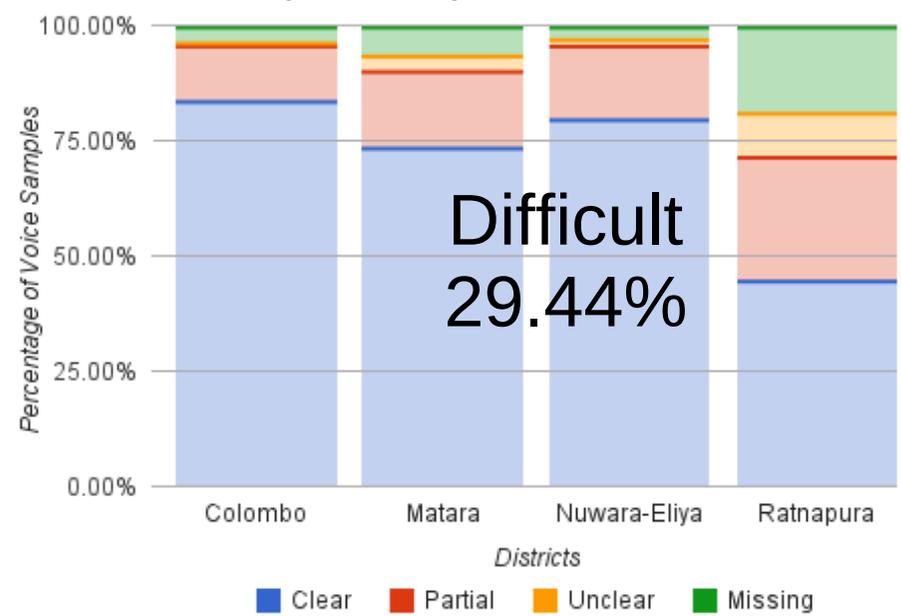
May be there is some hidden pattern?

Percent Difficulty

PD distribution for Speaker-dependent exercise (n=51, m=3, l=10)



PD distribution for speaker-independent exercise (n=48, m=7, l=9)



Speaker-dependent
Given MOS=3.39

Emulates

Speaker-Independent
Given MOS=3.52

- Partial, Unclear, or Missing emergency info can lead to false predictions/actions
- Speaker-dependent: survey with set words to speak
 - Evaluators could predict (**trained**)
- Speaker-independent: gave reporting attributes but free to speak
 - Evaluators unaware (**untrained**)
- User variability → speaker-dependent unfavorable (i.e. impractical to train each user)
- Perhaps a hybrid

Conclusions

- Forget about Speech-To-Text or Text-To-Speech
 - Structures the information to better apply ASR or TTS with compensator
 - Provides a guide for developing interoperable systems
- Forget about Speech-To-Text or Text-To-Speech
 - STT/ASR still in development for Sri Lankan local languages
 - GSM Voice quality too bad for automating transformation
 - FCC has suspended TTS for EDXL-CAP voice messaging
- VoIP quality is better (i.e. MP3)
 - Lookout for 4G voice broadcasts
 - may takes us closer towards automation with TTS/ASR
 - Don't need to invest in GSM modems (unreliable and expensive)
- Daily use of IVR in Sarvodaya business
 - will make it always “on” and “ready to use”
 - Opportunity for CERT with difficulties to improve

What's ahead for us ...

1. Improving CAP messaging with Sahan-Eden (GSoC 2012) better streamline the Voice-text alerting
2. Consolidate/Integrate Sahana Eden SITREP with Resource Management, Incident Reporting System, and other already available components
3. Integrate Freedom Fone with Sahana Eden to extend IVR and Voice-enabled last-mile interfaces for low skilled, voluntary, non-text savvy grassroots users
4. Advocate for reliable ASR and TTS for Sinhala and Tamil
5. Conduct quasi experimental summative evaluation

Proposal, URS, SRS, evaluation methodology, technical report

See Project Page: <http://lirneasia.net/projects/2010-12-research-program/ff4edxl/>

Thank You