

Design and Development of Decision Support System Using Near Cloud for Disaster Management and Risk Reduction

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Multi-platform ICT Decision Support System UAVs, Vehicle Hubs, Ubiquitous Computing for Disaster Risk Reduction

Critical Information System for Evacuations, Early
Response, and Mission Planning.

Dr. N. Libatique, Dr. G Abrajano, Dr. G Tangonan
C. Favila, D. Solpico, D. Lagazo



Overview



Ateneo Innovation Center



Introduction



Research Teams

UAV and UGV Team (9:00, Wed)

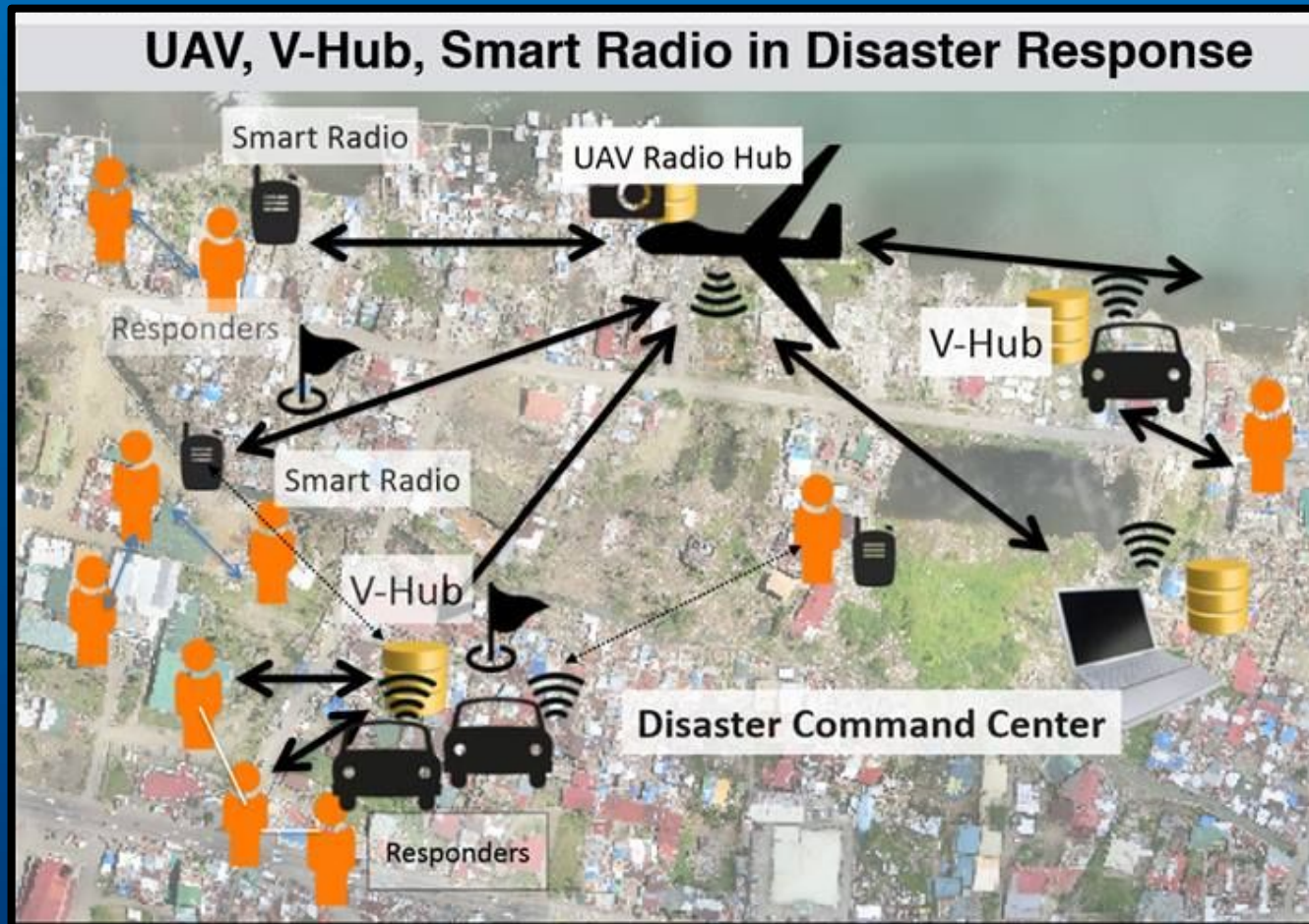
Modeling and Simulation Team (10:30, Th)

IBR-DTN Team (10:00, Th)

Mission Control



Bigger Picture



Situational Awareness



Objective

This research aimed to design and develop an information management and visualization system for post disaster situational awareness and decision support.



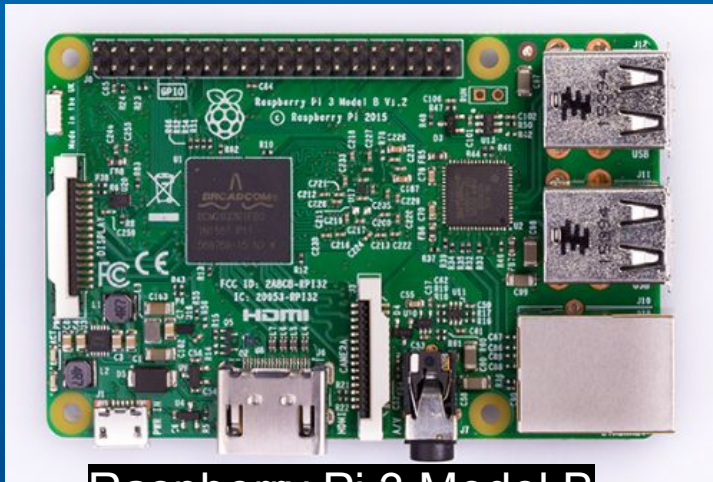
Accomplishments

- Design post-disaster information system based on near cloud nodes
- Develop use cases for field-deployable kiosks and command and control post-disaster environments
 - Broadcast Mode
 - Mapping
 - Data Mining-ready
 - Facial Recognition-ready
 - Context Tagging Decision Support
 - Raspberry Pi Near Cloud
 - Live Message Board
 - On Premise File Sharing
- Develop a near cloud-based multi-interfaced enabling platform for future use cases



Technological Approach

Hardware



Raspberry Pi 3 Model B



915 MHz RF
Antenna

- **A 1.2GHz 64-bit quad-core ARMv8 CPU**
- **802.11n Wireless LAN**
 - Bluetooth 4.1
 - Bluetooth Low Energy (BLE)
- **1GB RAM**
- **4 USB ports**
- **40 GPIO pins**
- **Full HDMI port**
- **Ethernet port**
 - Combined 3.5mm audio jack and composite video
 - Camera interface (CSI)
 - Display interface (DSI)
 - Micro SD card slot (now push-pull rather than push-push)
 - VideoCore IV 3D graphics core



LCD SCREENS



Terabyte Hard Drives

Technological Approach

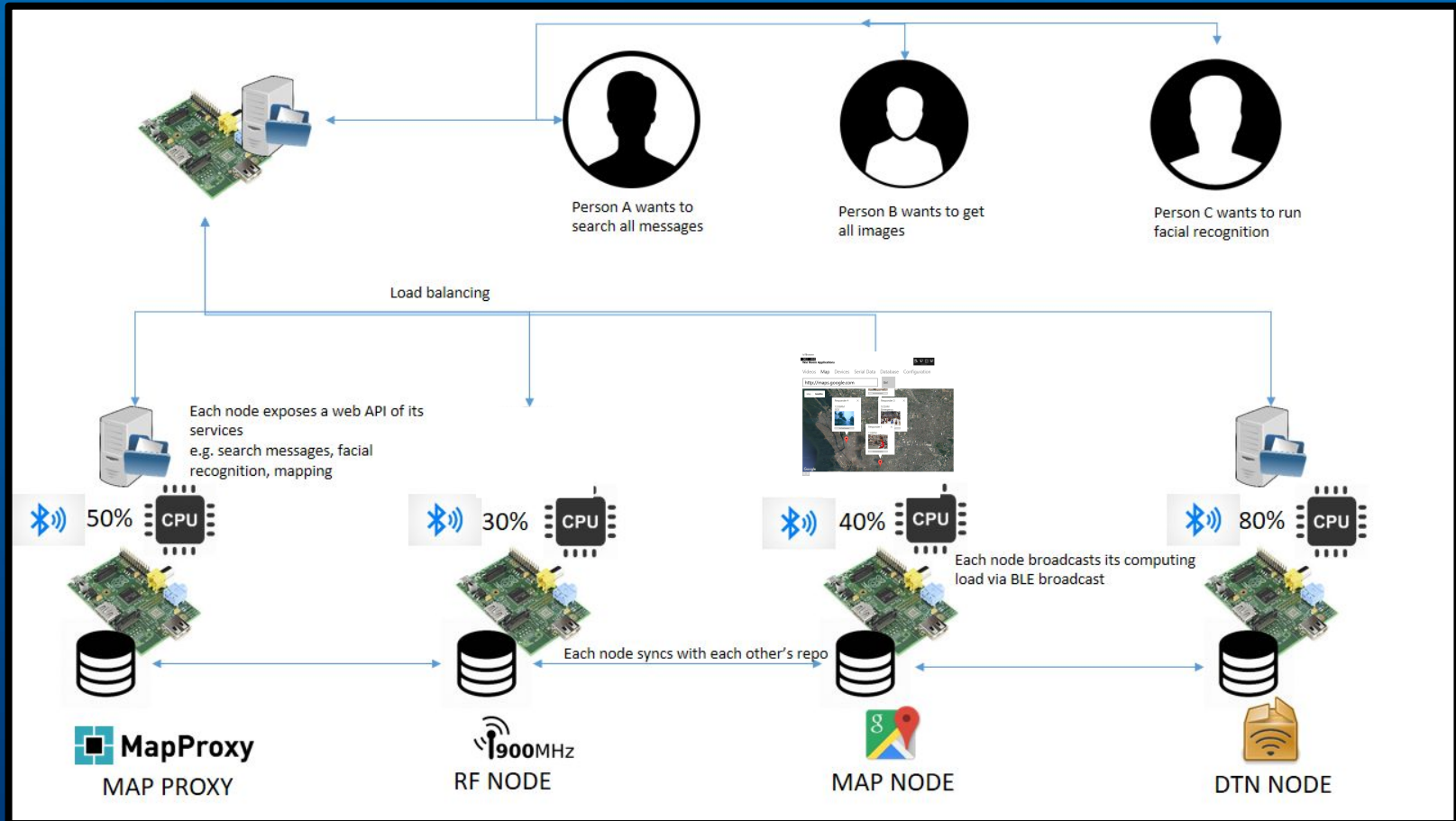
Software



Raspbian and Windows IoT Core

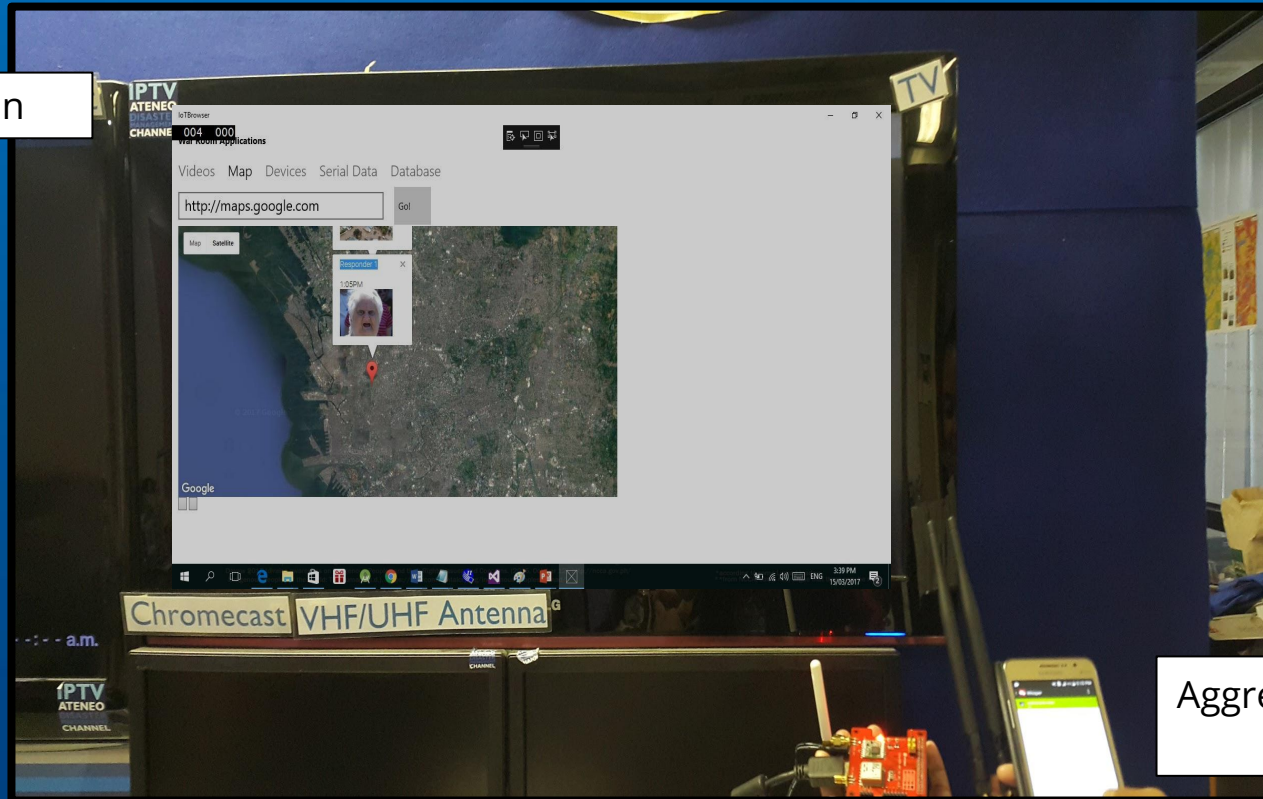


System Architecture



Mobile Command Center

Screen

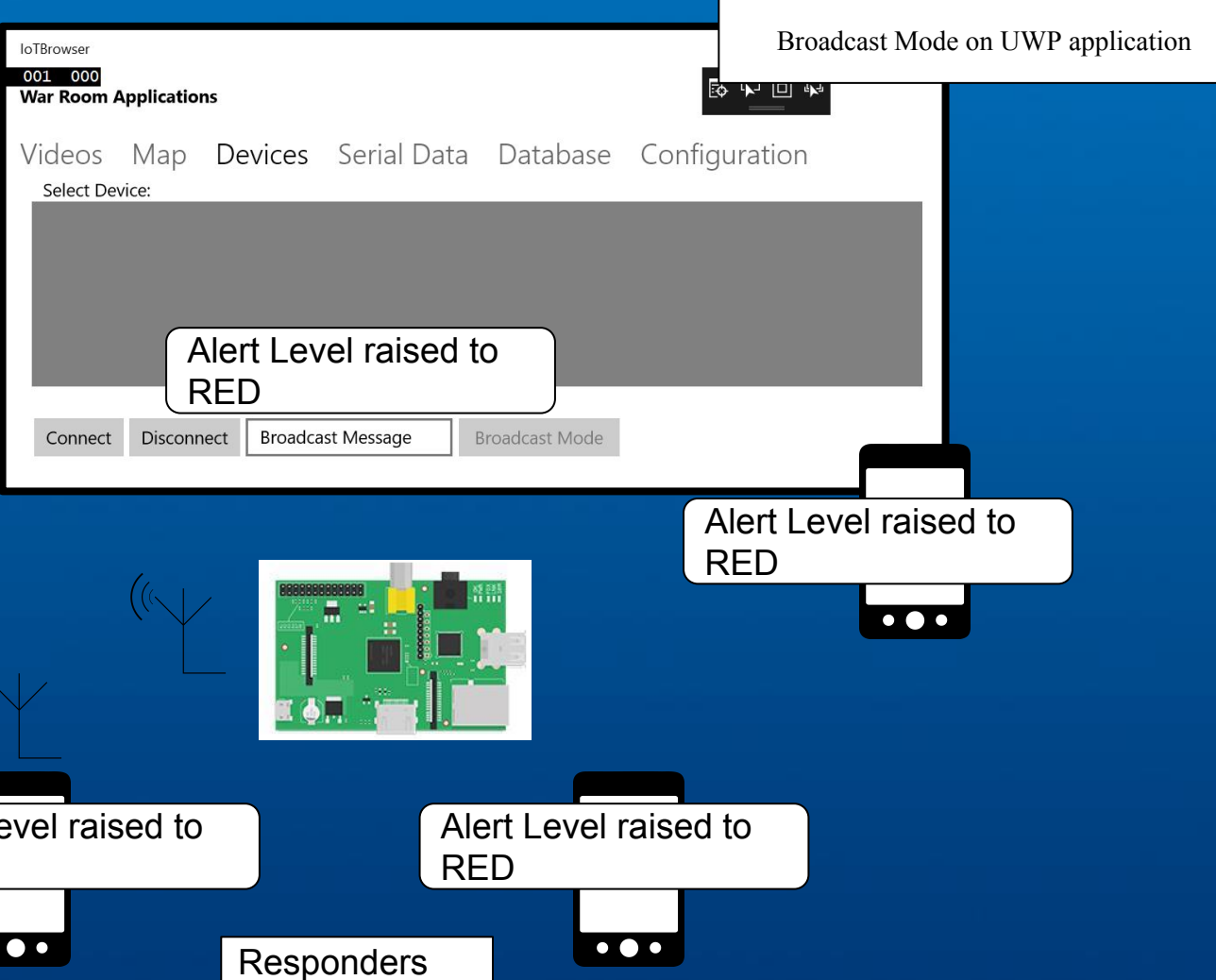


Aggregator phone with RF

RPi with RF



Application 1: Broadcast Mode



Application 1: Broadcast Mode (code)

```
private void toggleButton_IsCheckedChanged(object sender, RoutedEventArgs e)
{
    if (broadcastMode.IsChecked == true)
    {
        System.Diagnostics.Debug.WriteLine("Broadcast mode is on");
        timer = new DispatcherTimer();
        timer.Interval = TimeSpan.FromMilliseconds(10000);
        timer.Tick += Timer_Tick;
        timer.Start();
    }
}

private void toggleButton_IsUncheckedChanged(object sender, RoutedEventArgs e)
{
    if (broadcastMode.IsChecked == false)
    {
        System.Diagnostics.Debug.WriteLine("Broadcast mode is off");
        timer.Stop();
    }
}
```



Application 2: Mapping

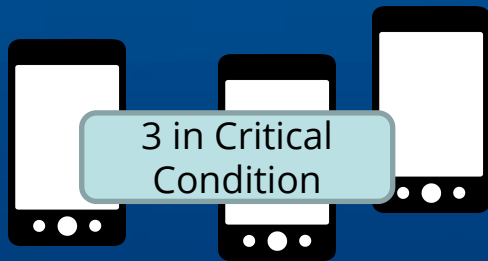
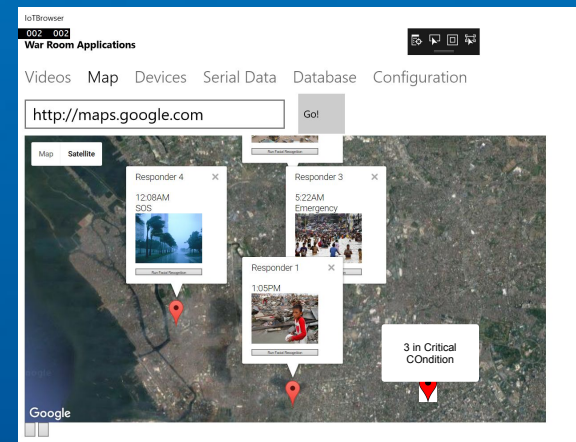
The screenshot displays a web browser window titled "IoTBrowser" with the address bar containing "http://maps.google.com" and a "Go!" button. The page content is titled "War Room Applications" and includes a navigation menu with "Videos", "Map", "Devices", "Serial Data", "Database", and "Configuration". The "Map" application is active, showing a satellite view of a city with three red location pins. Each pin has an associated information window:

- Responder 4:** 12:08AM SOS, with a photo of a street scene.
- Responder 3:** 5:22AM Emergency, with a photo of a crowd of people.
- Responder 1:** 1:05PM, with a photo of a child in a red shirt.

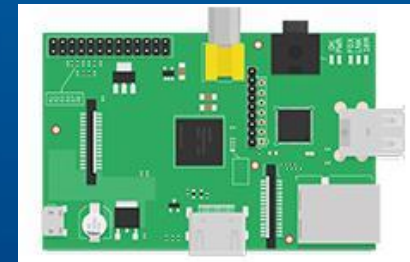
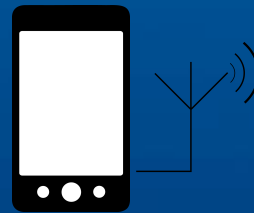
Each information window includes a "Run Facial Recognition" button. The Google logo and search input field are visible at the bottom left of the map interface.

Application 2: Mapping

Mobile Kiosk



Responders



Application 2: Mapping (code)

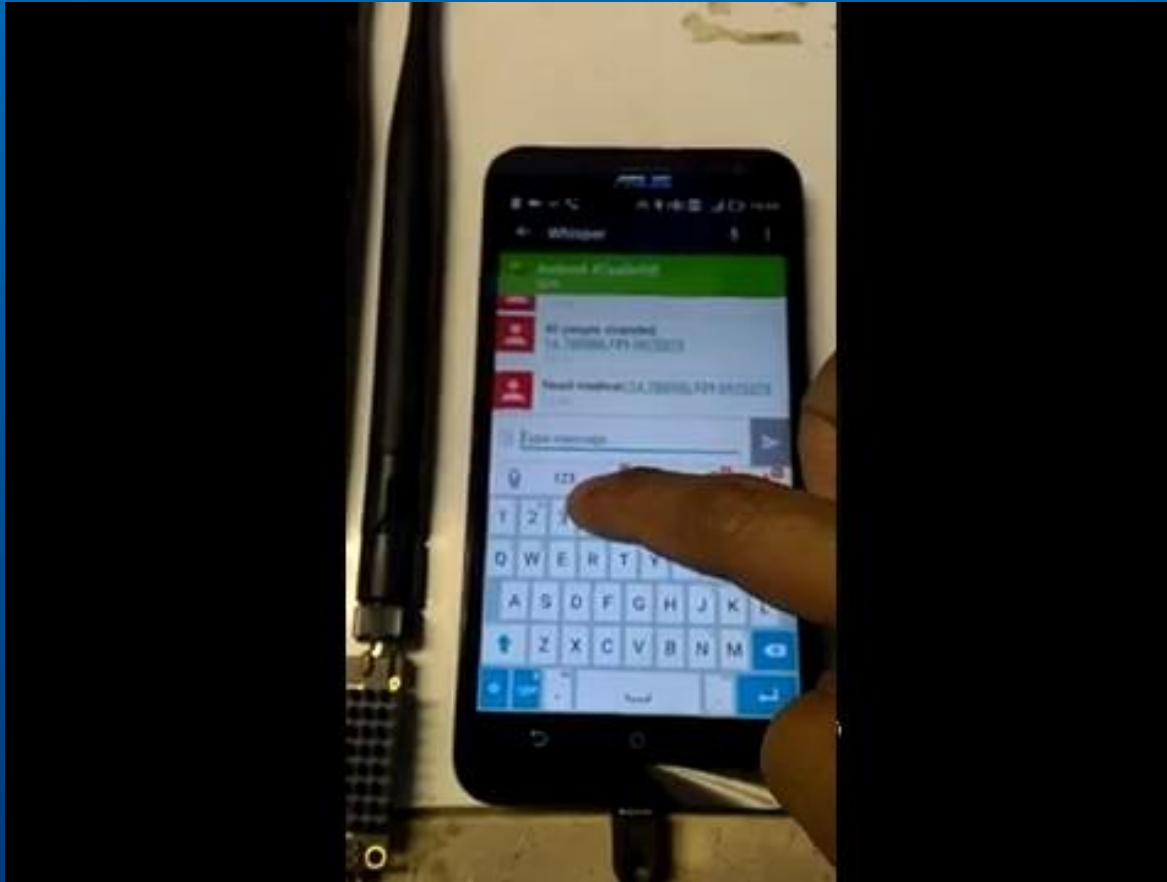
```
var marker = new google.maps.Marker({
    position: myLatLng,
    map: map,
    title: id
});

var infowindow = new google.maps.InfoWindow({
    title: id,
    content: "<b>" + id + "</b><br/><br/>" + stamp + ": " + msg
});

infowindow.open(map, marker);
marker.addListener('click', function () {
    infowindow.open(map, marker);
});
markers.push(marker);
infowindows.push(infowindow);
```

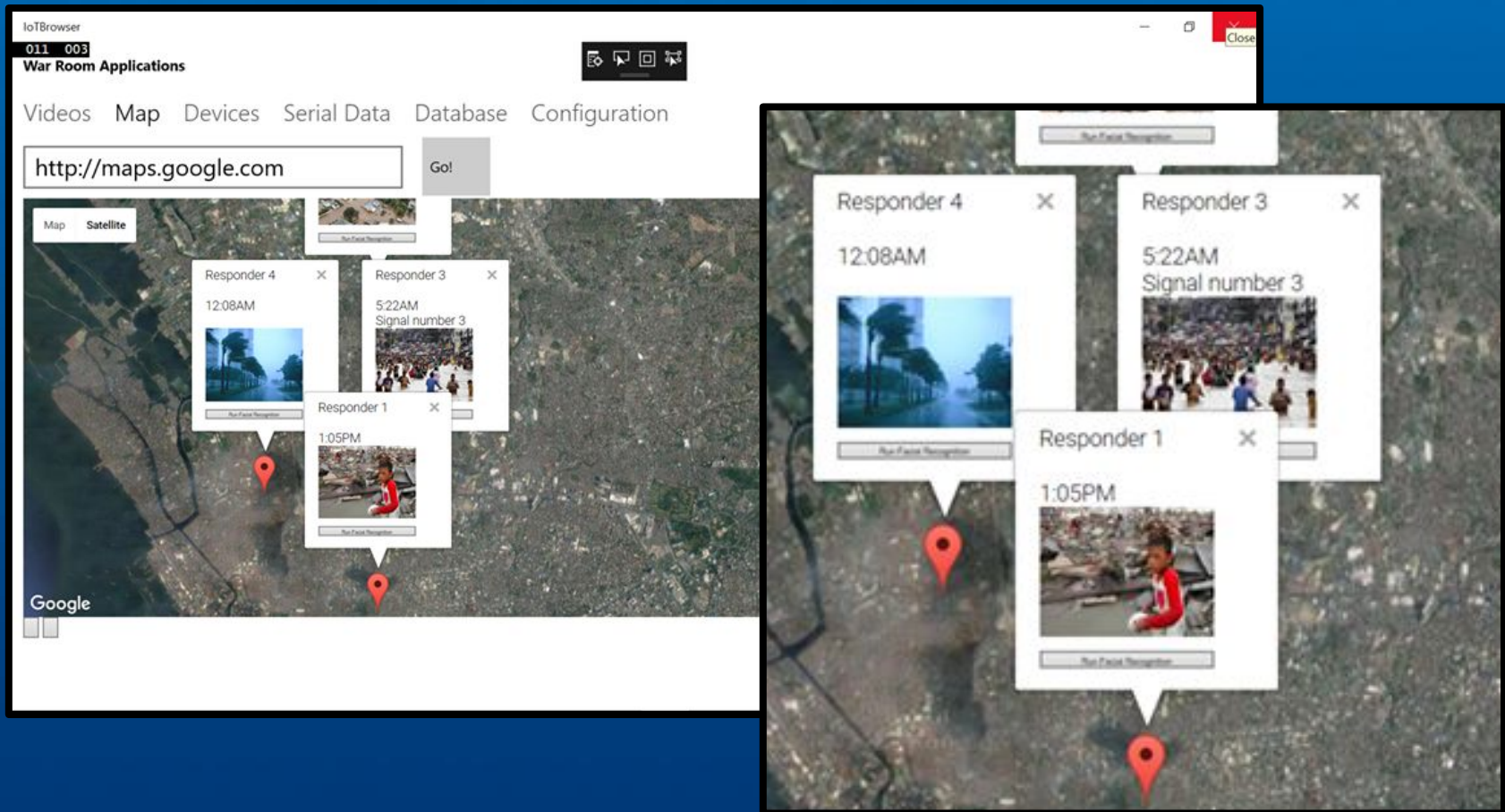


Application 2: Mapping (video)



1. Responder 1 sends a message using IBR-DTN: "Need Medivac"
2. Mobile Command Center receives message and displays it on the map.
3. Responder 2 sends a message using IBR-DTN: "40 people stranded"
4. Mobile Command Center receives message and displays it on the map.

Application 3.1: Data Mining-ready, Facial Recognition-Ready



Application 3.2: Data Mining-ready, Context Tagging for Decision Support

The screenshot displays a web browser window titled "IoTBrowser" with a status bar showing "002 001". The main heading is "War Room Applications". Below this, there are navigation tabs: "Videos", "Map", "Devices", "Serial Data", "Database", and "Configuration". A search bar contains the URL "http://maps.google.com" and a "Go!" button. The main content area shows a satellite map from Google Maps with a red location pin. Four data windows are overlaid on the map, each representing a responder:

- Responder 2:** 6:08PM, Area flooded. Includes a small satellite image of a flooded area.
- Responder 4:** 12:08AM, SGC. Includes a small image of a road scene.
- Responder 3:** 3:22AM, Emergency. Includes a small image of a crowd of people.
- Responder 1:** 1:05PM. Includes a small image of a person in a red shirt.

The interface also features a "Map" / "Satellite" toggle and a "Google" logo at the bottom left of the map area.

Application 3.2: Data Mining-ready, Context Tagging for Decision Support

IoTBrowser

001 004

War Room Applications

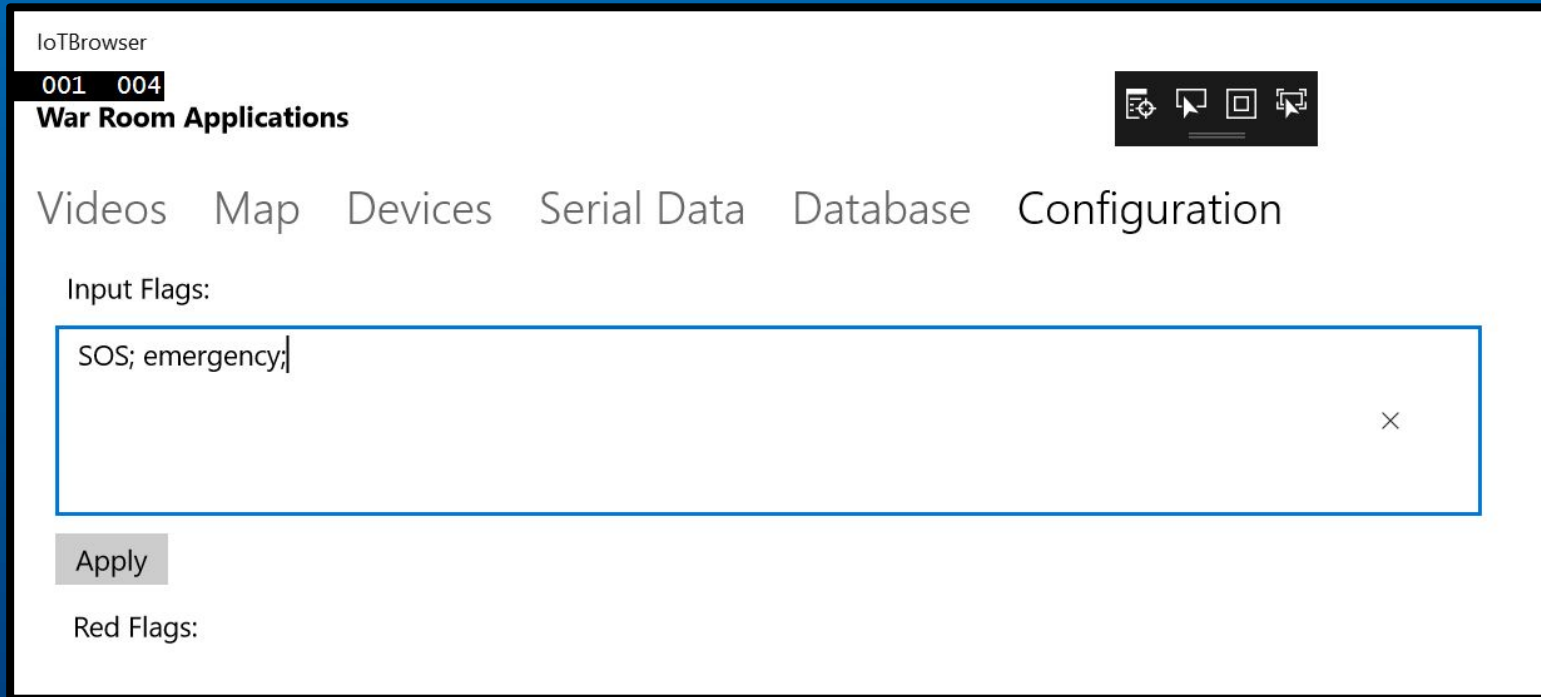
Videos Map Devices Serial Data Database Configuration

Input Flags:

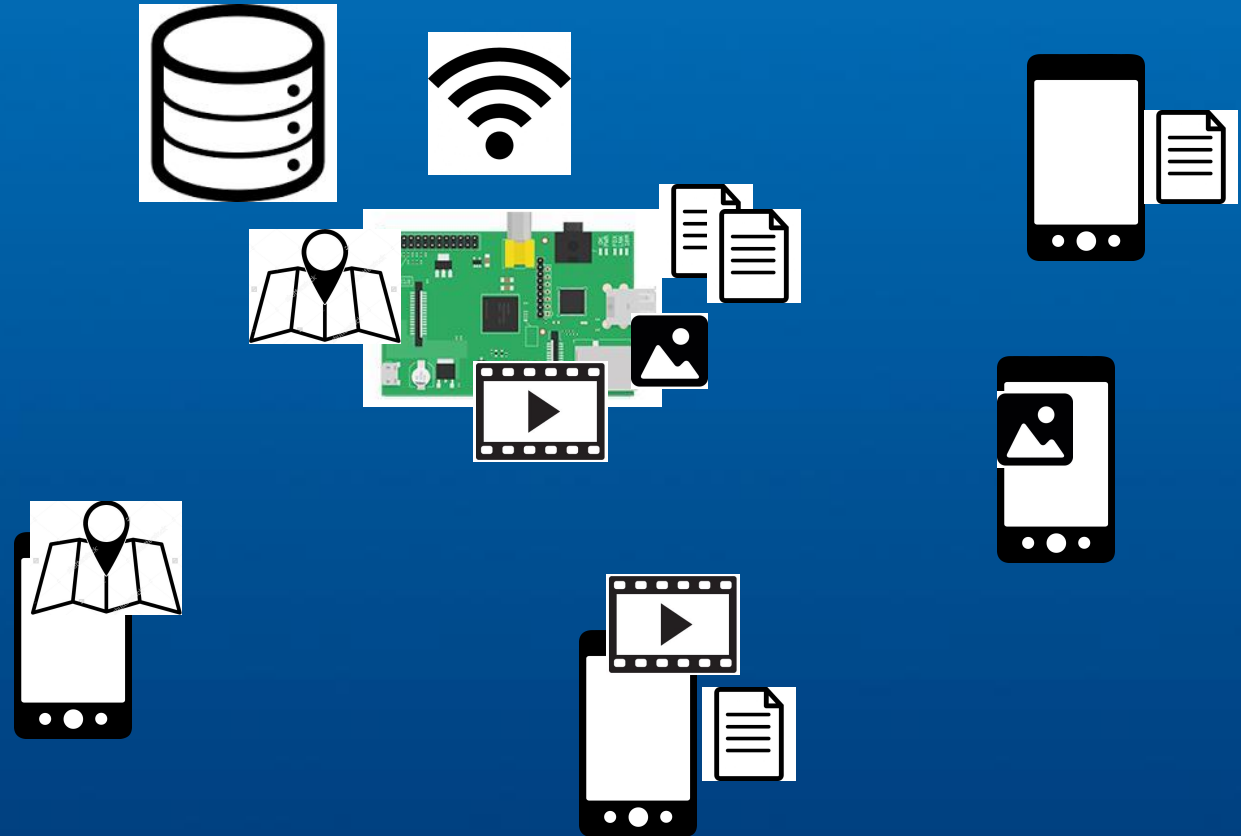
SOS; emergency;

Apply

Red Flags:

The screenshot shows a web browser window titled 'IoTBrowser'. At the top, there are two small black boxes containing the numbers '001' and '004'. Below them is the heading 'War Room Applications'. A navigation bar contains the following menu items: 'Videos', 'Map', 'Devices', 'Serial Data', 'Database', and 'Configuration'. Under the heading 'Input Flags:', there is a large text input field with a blue border containing the text 'SOS; emergency;'. To the right of the input field is a small 'x' icon. Below the input field is a grey button labeled 'Apply'. At the bottom, the text 'Red Flags:' is visible.

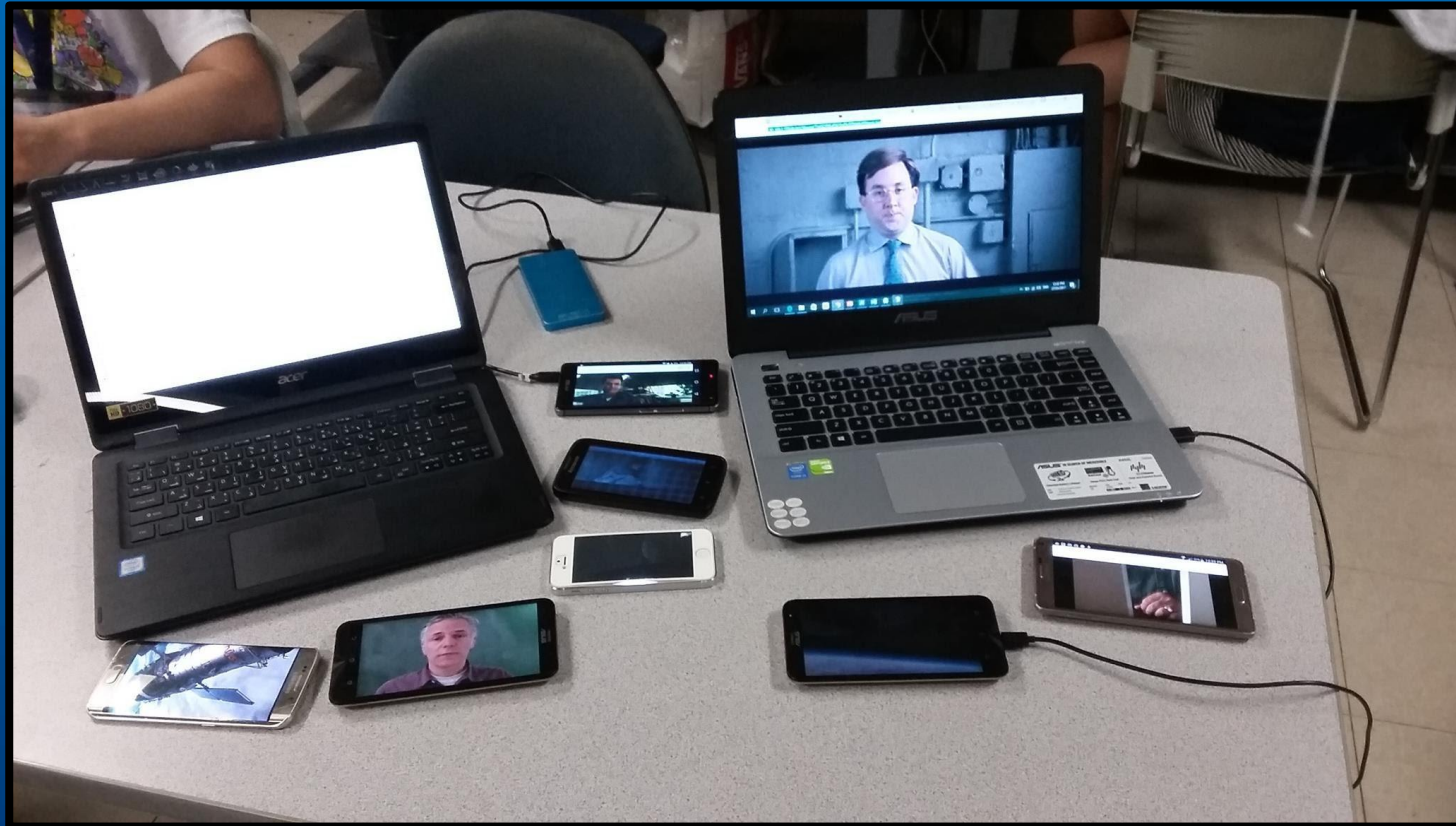
Application 4: Raspberry Pi Near Cloud



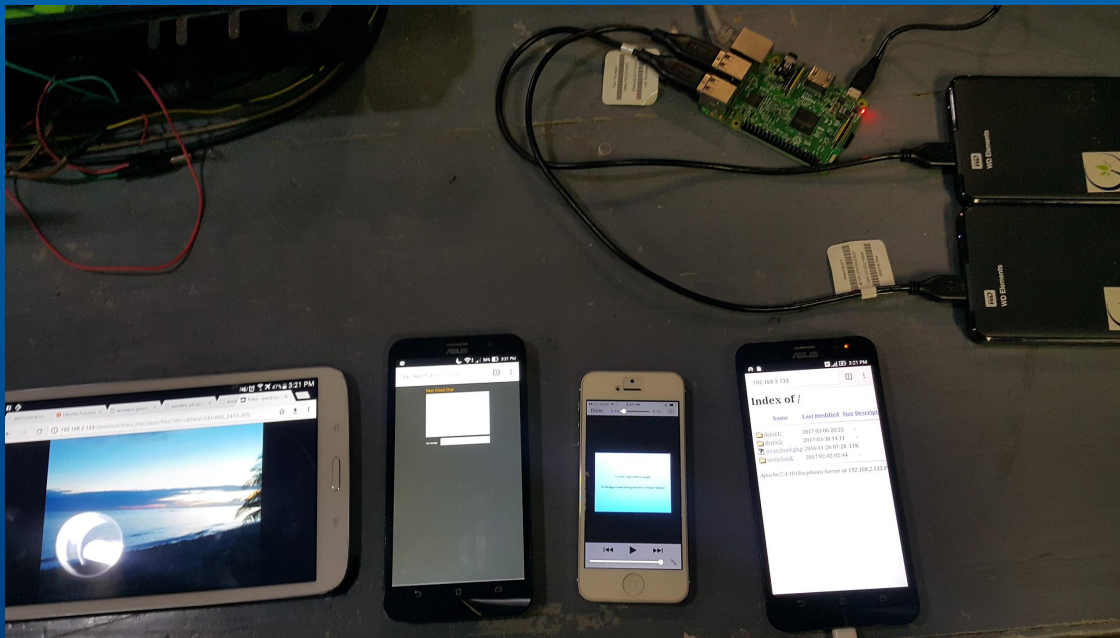
Raspberry Pi Near Cloud
with hotspot and attached storage



Scalability Test

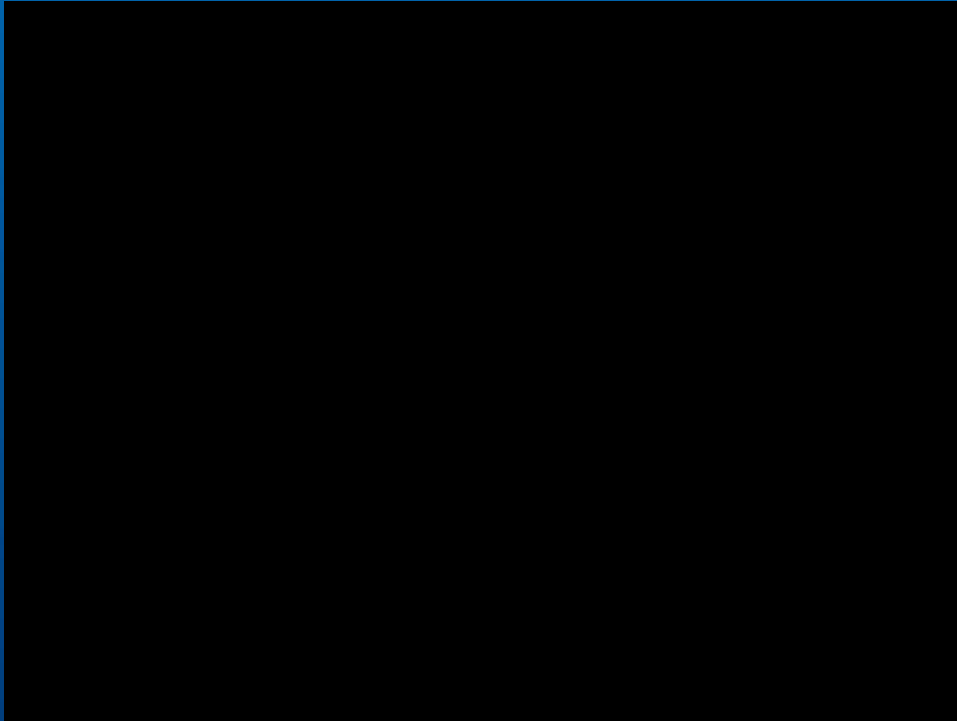


Application 4: Raspberry Pi Near Cloud



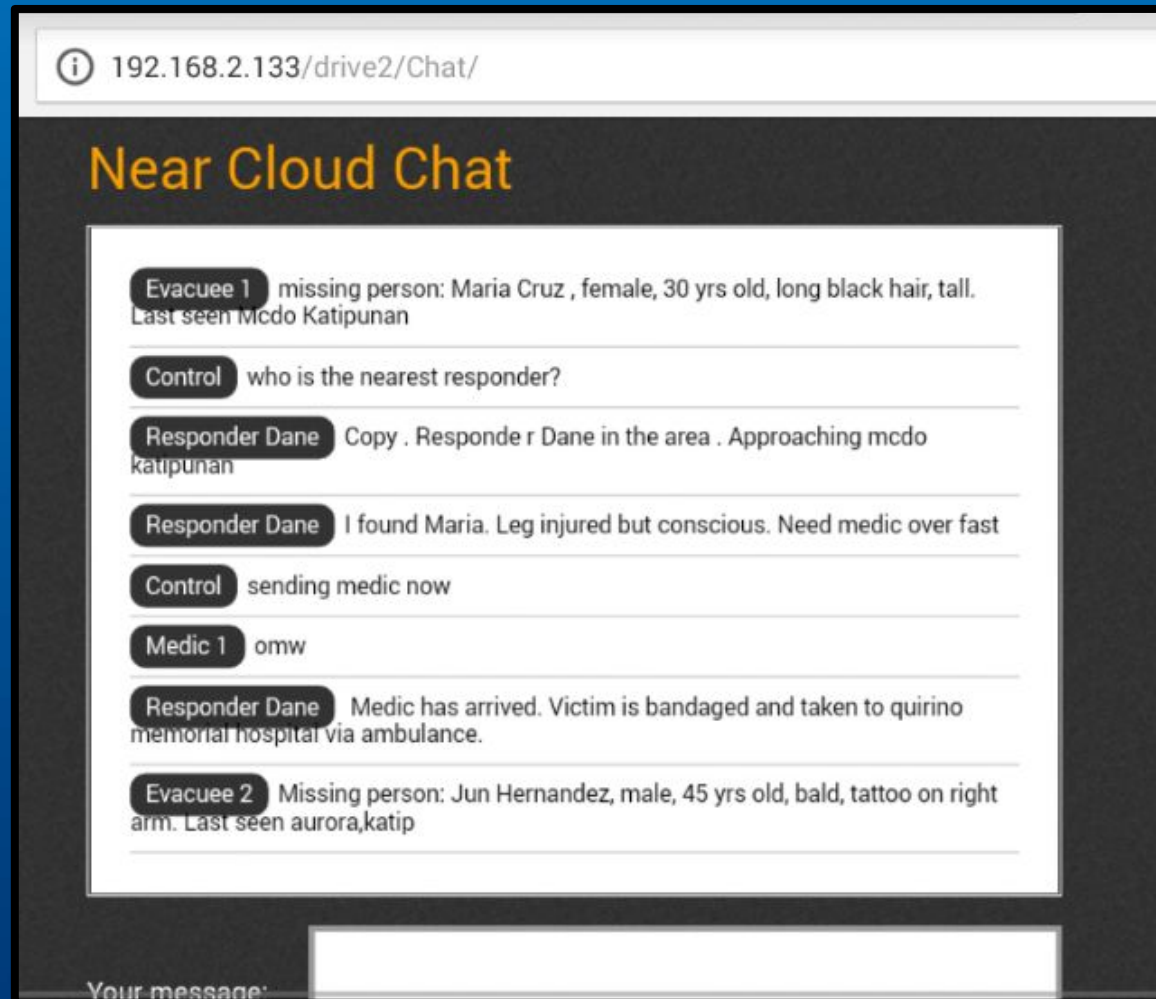
1. Each phone connects to the wireless network.
2. One phone opens the live message board.
3. Another phone opens the on-premise file sharing app.
4. The last phone streams a video.

Application 4: Raspberry Pi Near Cloud



1. Each phone connects to the wireless network.
2. One phone opens the live message board.
3. Another phone opens the on-premise file sharing app.
4. The last phone streams a video.

Application 4.1 Live Message Board



The screenshot displays a web browser window with the address bar showing "192.168.2.133/drive2/Chat/". The main content area is titled "Near Cloud Chat" in orange text. Below the title is a white chat window containing several messages from different roles: Evacuee 1, Control, Responder Dane, and Medic 1. The messages describe a missing person, Maria Cruz, and the subsequent actions taken by responders. At the bottom of the chat window, there is a text input field labeled "Your message:".

192.168.2.133/drive2/Chat/

Near Cloud Chat

Evacuee 1 missing person: Maria Cruz , female, 30 yrs old, long black hair, tall. Last seen Mcdo Katipunan

Control who is the nearest responder?

Responder Dane Copy . Responder Dane in the area . Approaching mcdo katipunan

Responder Dane I found Maria. Leg injured but conscious. Need medic over fast

Control sending medic now

Medic 1 omw

Responder Dane Medic has arrived. Victim is bandaged and taken to quirino memorial hospital via ambulance.

Evacuee 2 Missing person: Jun Hernandez, male, 45 yrs old, bald, tattoo on right arm. Last seen aurora,katip

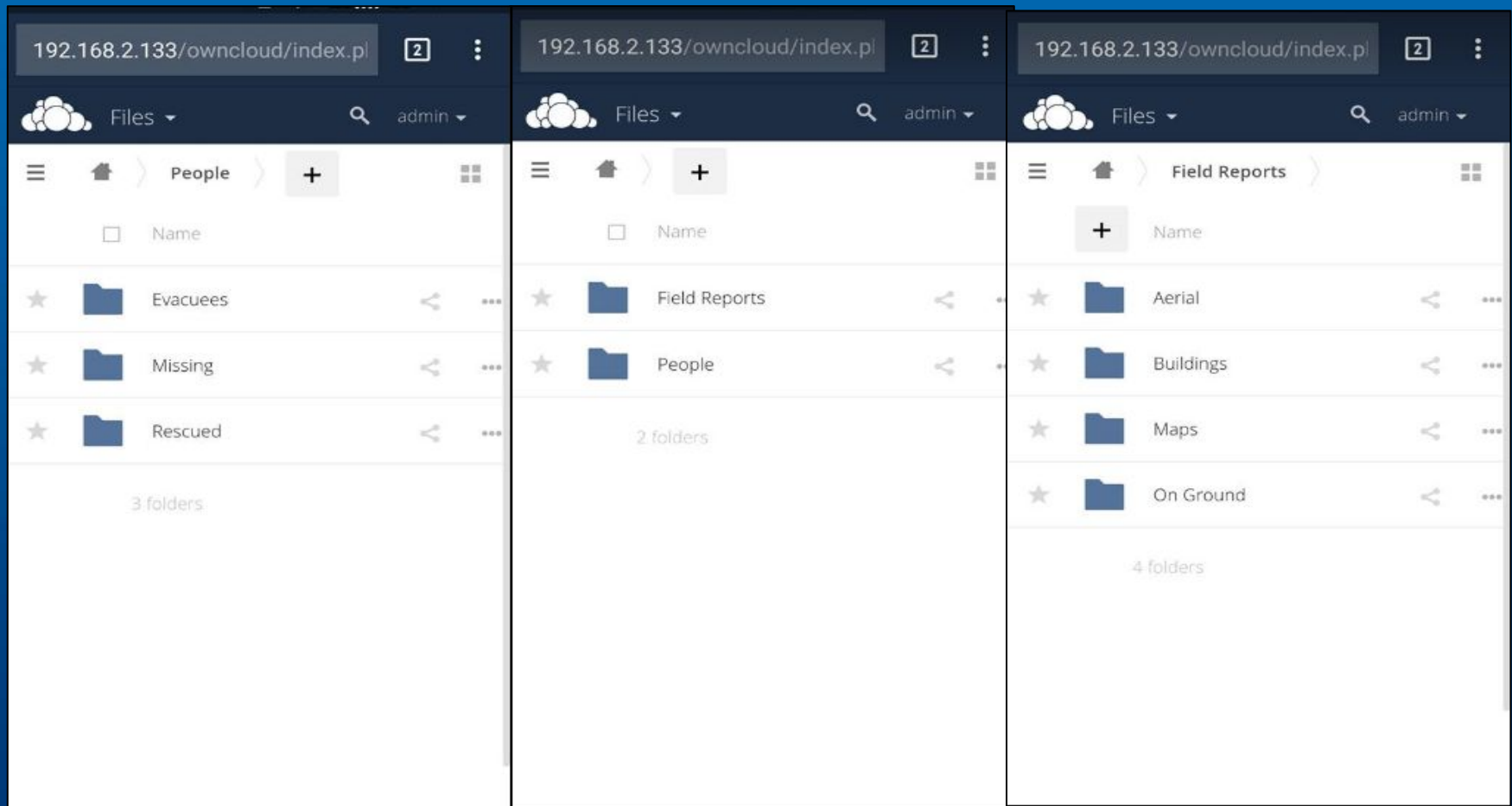
Your message:

Application 4.1 Live Message Board (video)



1. First user enters the message board and posts a message.
2. The message appears live on the message board.
3. Second user enters the message board and posts a message.
4. The message appears live on the message board.

Application 4.2: On Premise File Sharing



Related Work and Significance of Study

3. Conferences related to Disaster Response

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IGARSS 2015 - 2015 IEEE International Geoscience and Remote Sensing Symposium

The Geoscience and Remote Sensing Society (GRSS) seeks to advance science and technology in geoscience, remote sensing and related fields using conferences, education and other resources. Its fields of interest are the theory, concepts and techniques of science and engineering as they apply to the remote sensing of the earth, oceans, atmosphere, and space, as well as the processing, interpretation and dissemination of this information.

2014 IEEE International Conference on Systems, Man and Cybernetics - SMC

SMC2014 targets advances in Systems Science and Engineering, Human-Machine Systems, and Cybernetics involving state-of-art technologies interacting with humans to provide an enriching experience and thereby improving the quality of lives including theories, methodologies, and emerging applications.

2013 21st International Conference on Geoinformatics

GIS in Regional Economic Development and Environmental Protection under Globalization

2013 IEEE International Conference on Intelligence and Security Informatics (ISI)

Intelligence and Security Informatics (ISI) research is an interdisciplinary research field involving academic researchers in information technologies, computer science, public policy, bioinformatics, and social and behavior studies as well as local, state, and federal law enforcement and intelligence experts, and information technology industry consultants and practitioners to support counterterrorism and homeland security missions of anticipation, interdiction, prevention, preparedness and response to terrorist acts. The annual IEEE International ISI Conference series was started in 2003. In 2013, the main conference themes are: Big Data, Emergent Threats and Decision-Making in Security Informatics. ISI 2013 will be organized in three main streams focusing on: Big Data in Security Informatics, Emergent Threats, Decision-Making in Security Informatics.

2011 5th International Conference on Recent Advances in Space Technologies (RAST) [🔗](#)

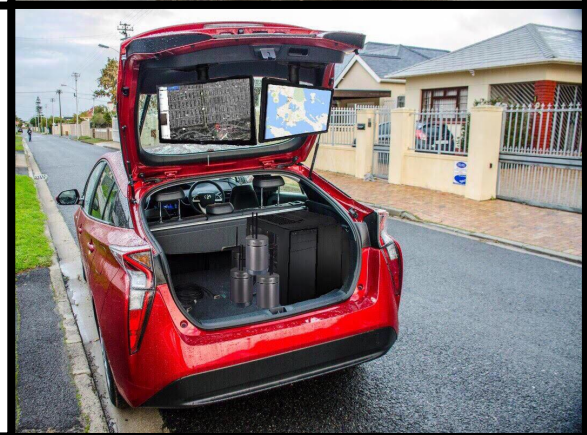
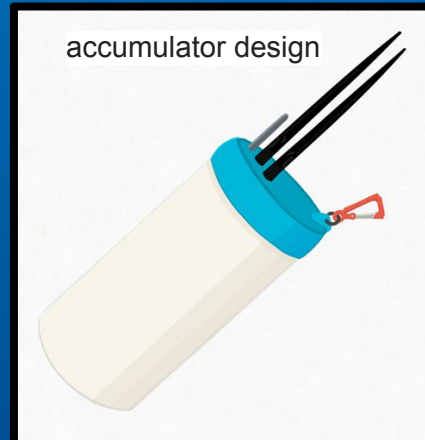
RAST 2011 has the general objective of providing a forum for the presentation of recent developments in space technologies. Furthermore and in particular, the organizers wish to make RAST 2011 a special event for looking into the future of space technology developments.

[More Conferences](#)

- J.P. Talusan, Design, Development and Demonstration of a Highly Interactive Near Cloud Architecture for Institutions over Wireless Connectivity, Unpublished, Quezon City, pp. 30-90, March 2015
- L. Koa and B. Sevilla, Internet Protocol Television (IPTV) as an Interactive Application for Disaster Management and Education, Unpublished, Quezon City, March 2014 .
- S.K. Cortez, R. De los Reyes and M. G. Gacusan, Developing Interactive Content Deployments and Extending the Near Cloud Capabilities of the Convergent Platforms and Network Media Testbed, Unpublished, Quezon city pp.7-15 March 2015.
- Asia-Pacific Telecommunity Standardization Program, "Requirements of Information and Communication System Using Vehicle During Disaster," 2016.
- Telecommunication Standardization Sector of ITU, "Requirements for Disaster Relief System" May 2014.
- Mushtaq, N. U. (2016, October 23). Network Attached Storage CCTV Institute CCTV Surveillance Smarthome. Retrieved March 15, 2017, from <http://cctvinstitute.co.uk/network-attached-storage/>

Accomplishments

- Design post-disaster information system based on near cloud nodes
- Develop use cases for field-deployable kiosks and command and control post-disaster environments
- Develop a near cloud-based multi-interfaced enabling platform for future use cases



Mobile kiosk design by Mr. Eduardo Bellido

Thank You



**If you want a copy of our thesis
you can do the following**

- 1. connect to RPi3 thesis**
- 2. open your browser type
192.168.2.133**



References

- [1] J.P. Talusan, Design, Development and Demonstration of a Highly Interactive Near Cloud Architecture for Institutions over Wireless Connectivity, Unpublished, Quezon City, pp. 30-90, March 2015
- [2] L. Koa and B. Sevilla, Internet Protocol Television (IPTV) as an Interactive Application for Disaster Management and Education, Unpublished, Quezon City, March 2014 .
- [3] S.K. Cortez, R. De los Reyes and M. G. Gacusan, Developing Interactive Content Deployments and Extending the Near Cloud Capabilities of the Convergent Platforms and Network Media Testbed, Unpublished, Quezon city pp.7-15 March 2015.
- [4] Asia-Pacific Telecommunity Standardization Program, "Requirements of Information and Communication System Using Vehicle During Disaster," 2016.
- [5] Telecommunication Standardization Sector of ITU, "Requirements for Disaster Relief System" May 2014.
- [6] Raspberry Pi 3 Model B. (n.d.). Retrieved January 29, 2017, from <https://www.raspberrypi.org/products/raspberrypi-3-model-b/>
- [7] RFD900 Modem. (n.d.). Retrieved March 15, 2017, from <http://store.rfdesign.com.au/rfd-900p-modem/>
- [8] Download Raspbian for Raspberry Pi. (n.d.). Retrieved March 15, 2017, from <https://www.raspberrypi.org/downloads/raspbian/>
- [9] Learn about Windows 10 IoT Core. (n.d.). Retrieved March 15, 2017, from <https://developer.microsoft.com/en-us/windows/iot/Explore/IoTCore>
- [10] What is PHP? (n.d.). Retrieved March 15, 2017, from <http://php.net/manual/en/intro-what-is.php>
- [11] About MySQL. (n.d.). Retrieved March 15, 2017, from <https://www.mysql.com/about/>
- [12] IBR-DTN (n.d.). Retrieved March 15, 2017, from <https://github.com/ibrdtm/ibrdtm/>
- [13] Mushtaq, N. U. (2016, October 23). Network Attached Storage CCTV Institute CCTV Surveillance Smarthome. Retrieved March 15, 2017, from <http://cctvinstitute.co.uk/network-attached-storage/>

