



The DUMBONET Experience

Internet Education and Research Lab
Asian Institute of Technology
25 March 2011

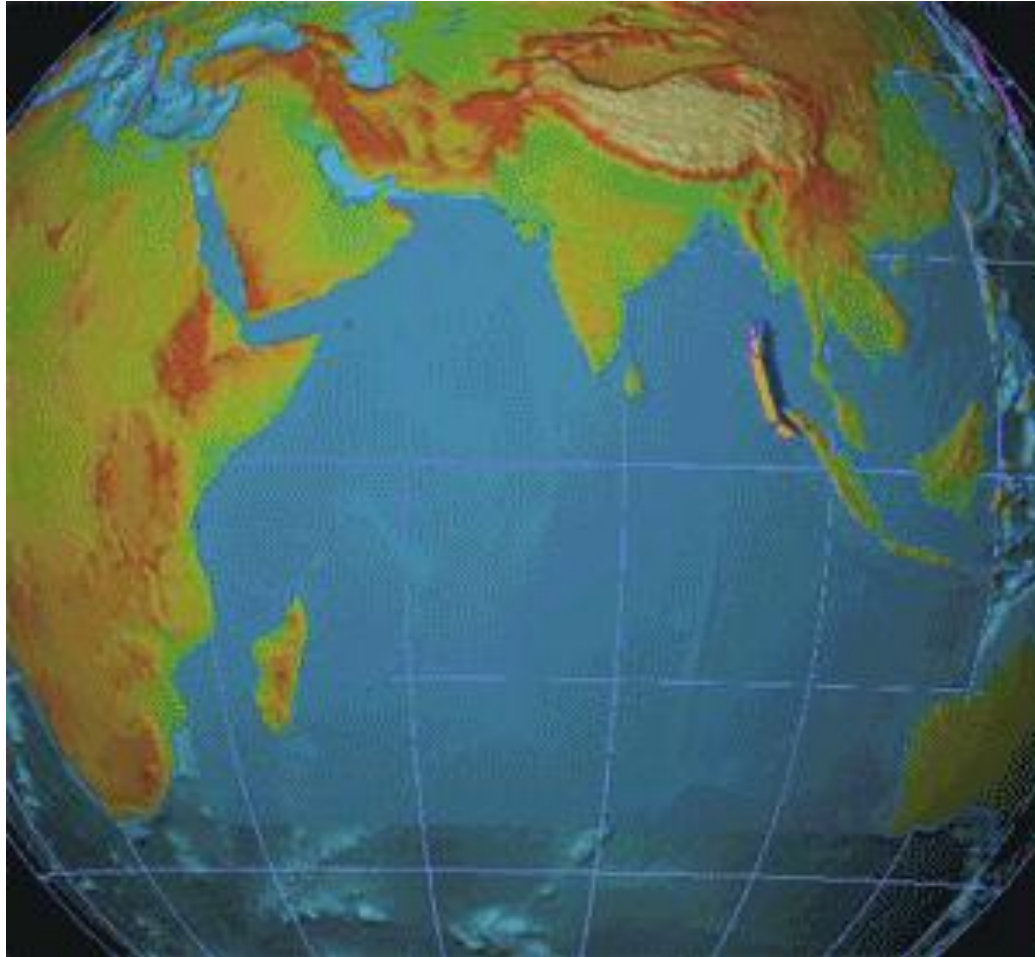
For further information please contact:

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Apinun Tunpan, Ph.D. (atunpan@ait.asia)

Why have we pursued this ?

- Because we have seen disasters beyond our imagination.

The Tsunami of 2004



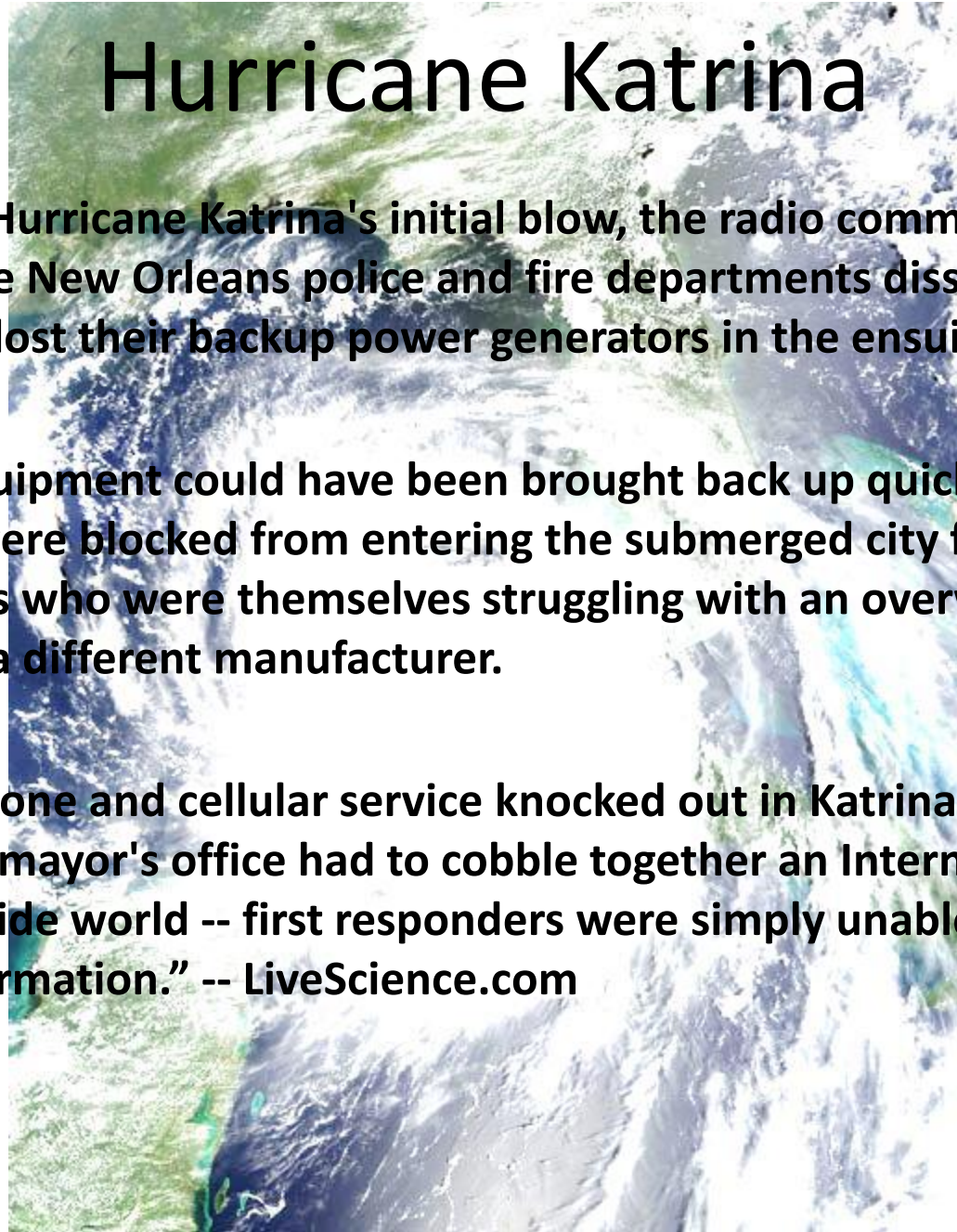
Source: NOAA video, retrieved from Wikipedia

Hurricane Katrina

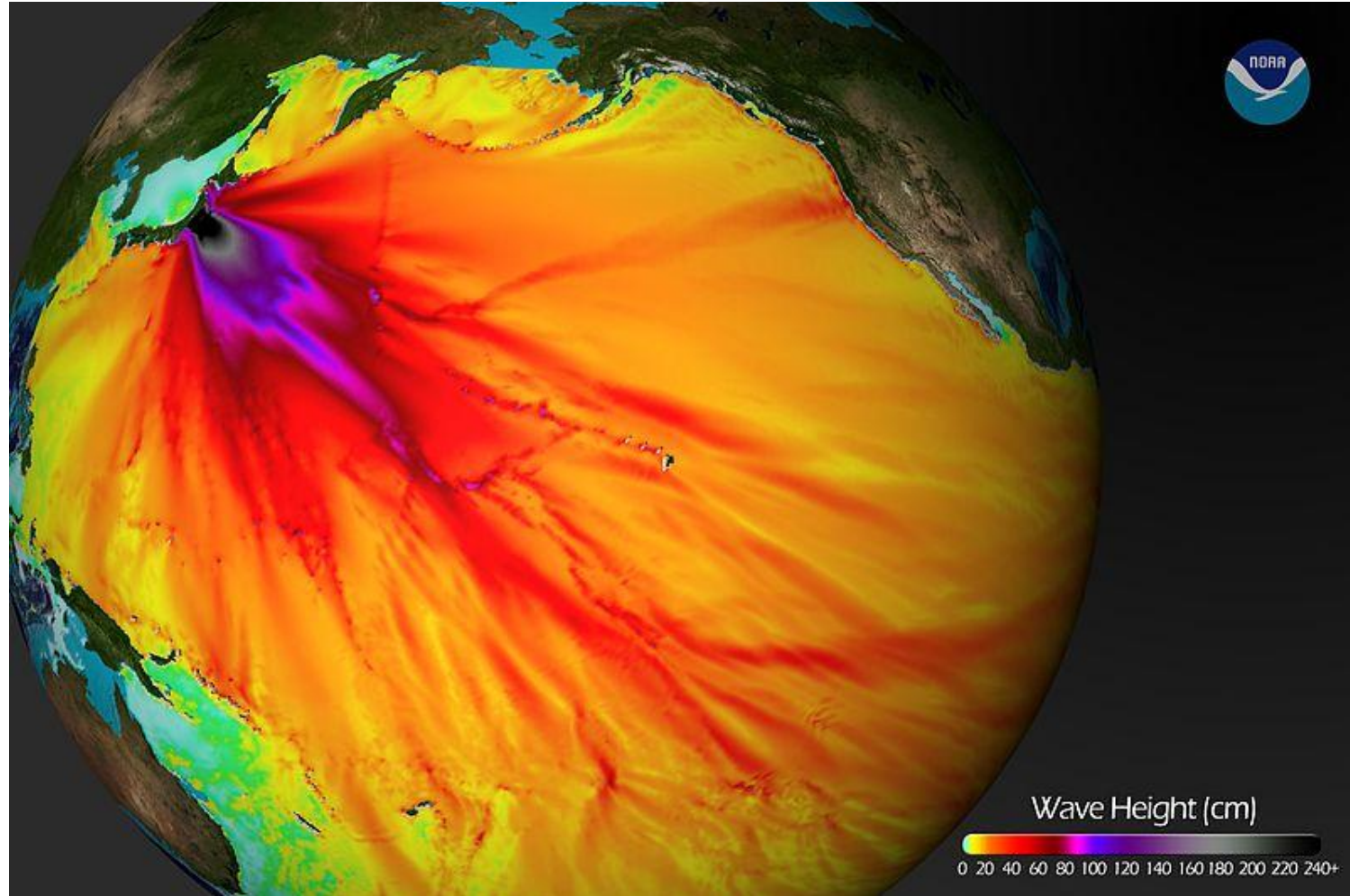
“After surviving Hurricane Katrina's initial blow, the radio communications system for the New Orleans police and fire departments dissolved as its radio towers lost their backup power generators in the ensuing flood.”

“Some of the equipment could have been brought back up quickly, except that technicians were blocked from entering the submerged city for three days by state troopers who were themselves struggling with an overwhelmed radio system from a different manufacturer.

“With regular phone and cellular service knocked out in Katrina's wake -- the New Orleans mayor's office had to cobble together an Internet phone link with the outside world -- first responders were simply unable to share essential information.” -- LiveScience.com



The Tsunami of 2011



Source: NOAA, retrieved from Wikipedia

Sendai Airport Damaged by Tsunami



Source: US Air Force, retrieved from Wikipedia

Will the communication infrastructure survive ?



A collapsed bridge can cut down fiber optics --
cutting communication to the whole region

Will the communication infrastructure survive ?



Flood damages also affect electricity supply..
No power = No communication

What is DUMBONET ?

Digital Ubiquitous Mobile Broadband OLSR Network

The project aims to demonstrate the use of mobile ad hoc networks in an environment where fixed network infrastructure is not available, such as in the case of natural disaster.

Operations of heterogeneous networks in emergency conditions will be explored.

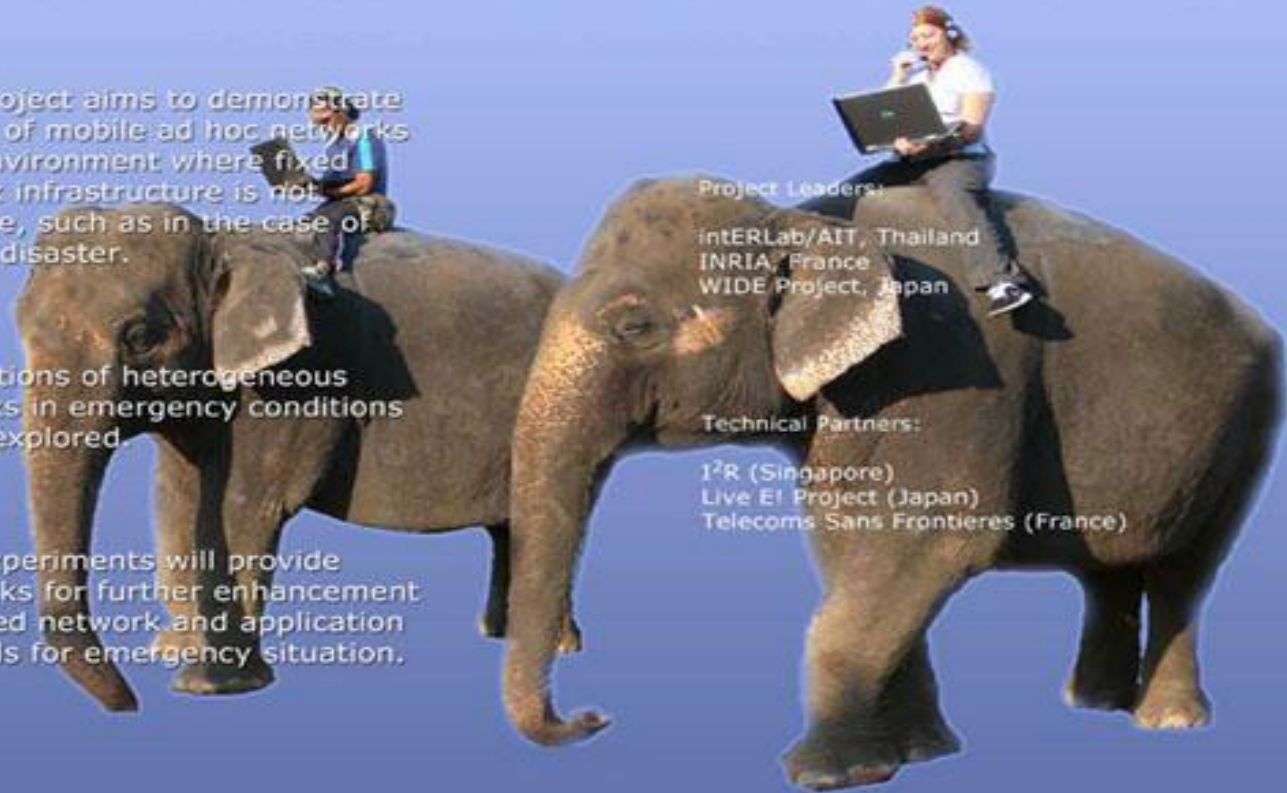
The experiments will provide feedbacks for further enhancement of related network and application protocols for emergency situation.

Project Leaders:

intERLab/AIT, Thailand
INRIA, France
WIDE Project, Japan

Technical Partners:

I²R (Singapore)
Live E! Project (Japan)
Telecoms Sans Frontieres (France)



DUMBONET Objectives

- DUMBONET aims to
 - produce a collection of post-disaster emergency communication tools
 - which can be quickly and reasonably deployed for rescuer activities.
 - enable multimedia communications
 - Photos, videos, texts, audios

DUMBONET Principle #1

- Use of commodity devices as user terminals



In the past:
Notebooks



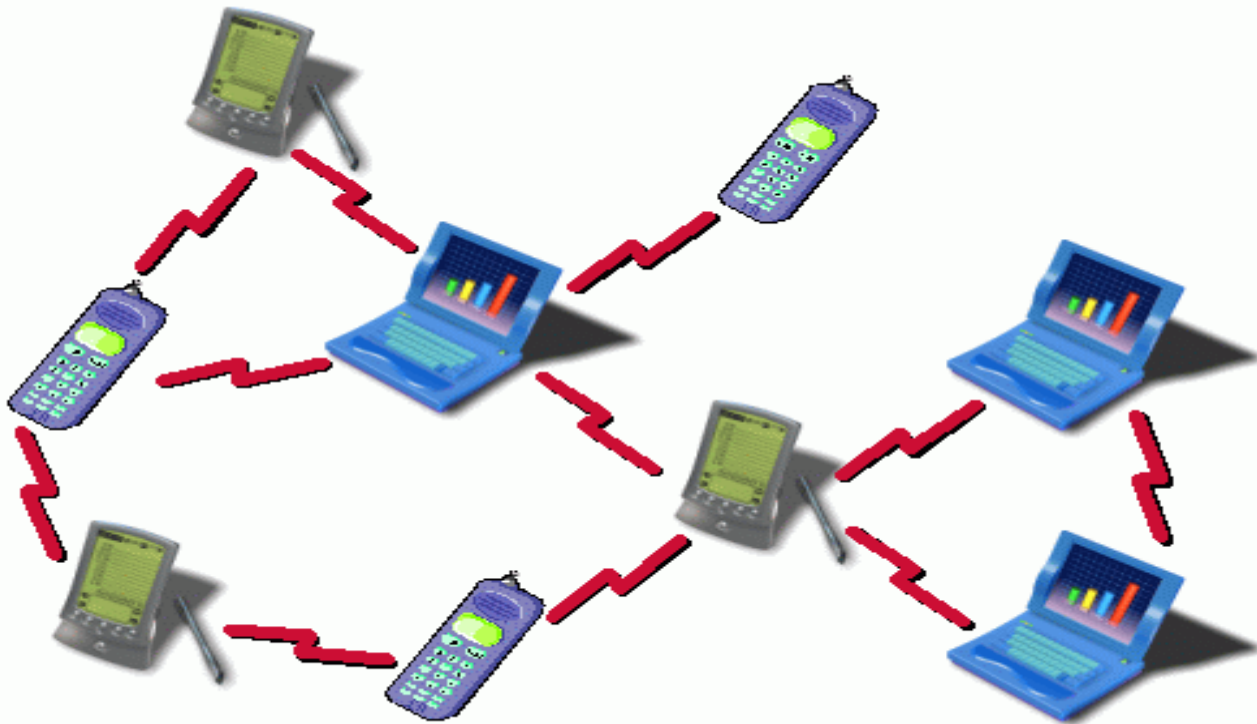
Current :
Netbooks &
Mobile phone



Near Future:
Tablets &
Embedded systems

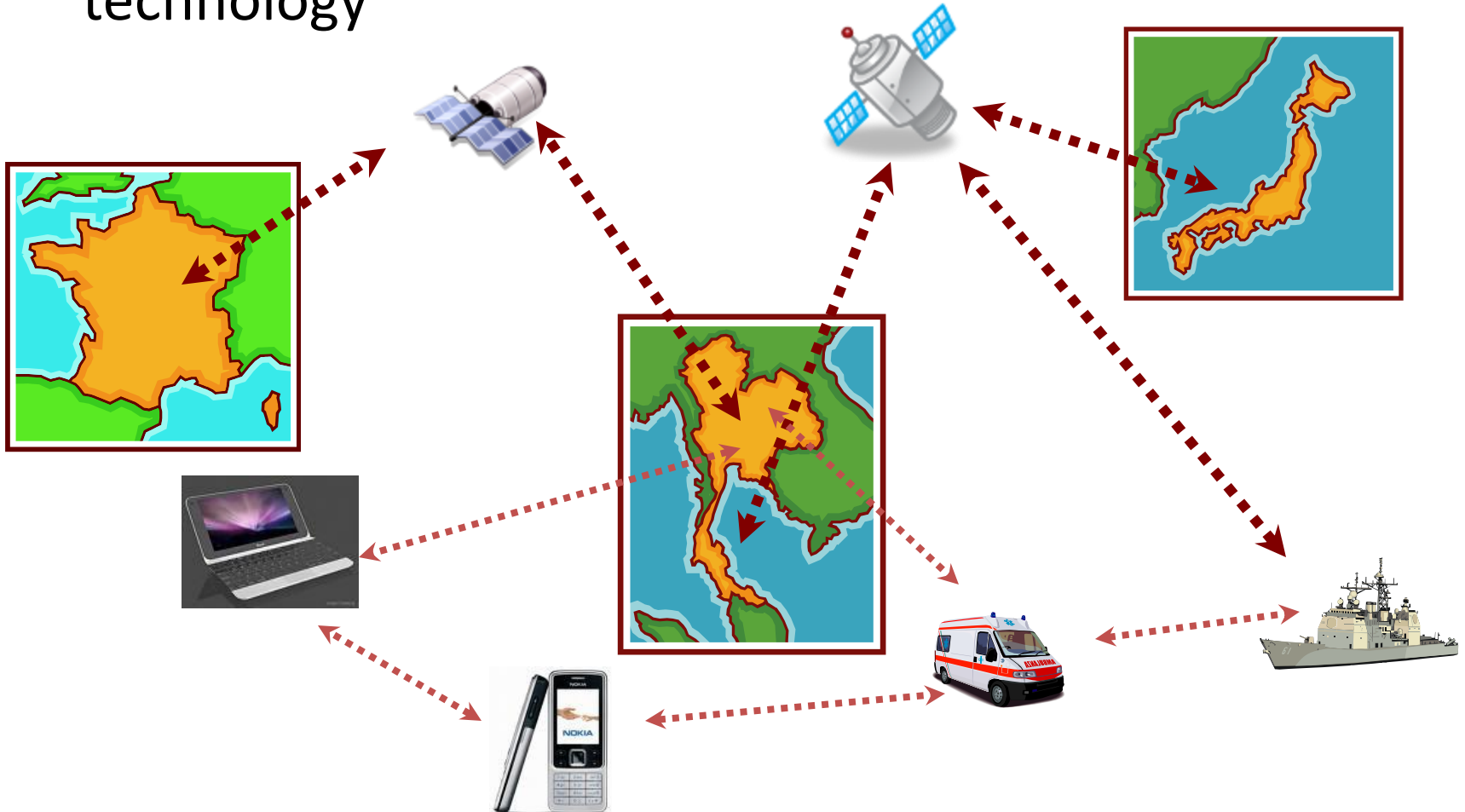
DUMBONET Principle #2

- Infrastructureless or relying less on infrastructure



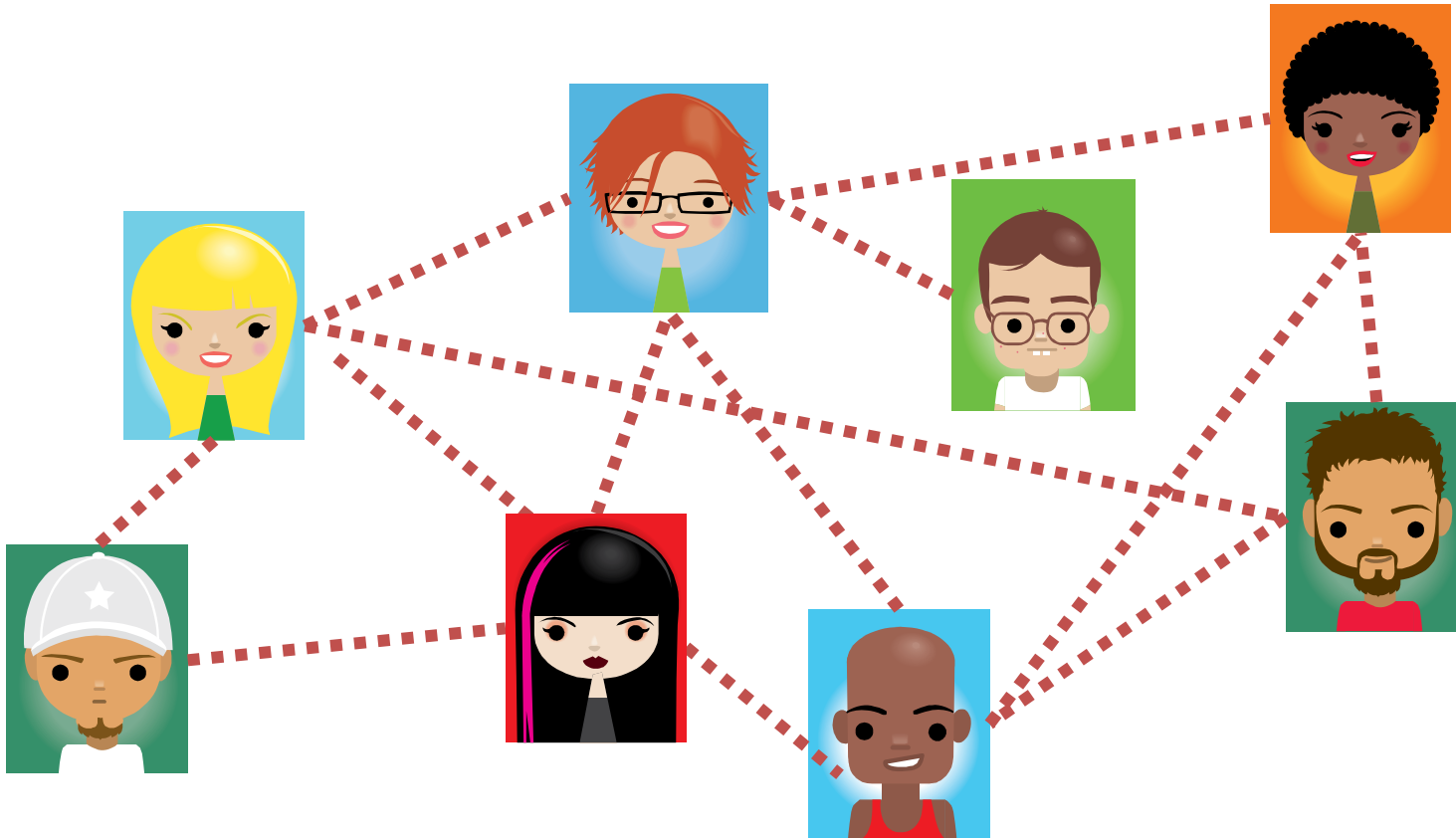
DUMBONET Principle #3

- Integration of heterogeneous communication technology



DUMBONET Principle #4

- Scenario-specific Applications
 - Fault-tolerance (e.g. self-configuring, self-healing)
 - Peer-to-peer



DUMBONET Principle #5

- To deliver practical systems that work in the real world
 - Not just a theoretical model or simulation



Our current equipment and tools

As of March 2011

Asus EEE PCs

Asus EEE PC 1002 HA

- Power: 12VDC 3A (36W)
- Built-in 802.11n chipset, however when we operate this in Ad hoc mode, it may have some compatibility problems esp. in joining other Ad hoc nodes using different WiFi chipsets.
- Our workaround is to use a common model of external Linksys 802.11g WiFi dongle (as shown) for compatibility with other nodes
- Using a USB extension cord is recommended so that you can put and rearrange the antenna in a better position (having a LOS with other nodes).



Asus EEE PCs



Asus EEE PC 901

- Power: 12VDC 3A (36W)
- Built-in 802.11g.
- However, we typically use an external Linksys 802.11g WiFi dongle (as shown) for compatibility with other nodes
- Using a USB extension cord is recommended so that you can put and rearrange the antenna in a better position (having a LOS with other nodes).

Notes on Asus EEE PC

- In general, any model would do. But you may want to look for the following:
 - It should have 12V rating, so that you can charge it directly from any 12VDC supply (e.g. a car battery) – you will need to make a battery connector (not too difficult.)
 - It may have a built-in 802.11 chipset, whether it be 802.11g or 802.11n. If they are of different WiFi chipsets, You may find them incompatible to operate in Ad-Hoc mode – using a common model of external USB WiFi dongle is recommended
 - It should have Bluetooth (some cheap EEE PCs don't have Bluetooth). This allow file exchanges with mobile phones that support Bluetooth

External WiFi Dongle 1/2



Linksys WiFi dongle

- Mode: WUSB54GC
- FCC ID: Q87-WUSB54GC
- 802.11g
- Outdoor range is approximately 120 – 130 meters



Using it in a horizontal position
yields a shorter distance between nodes

Using it in a vertical (either up or down) position
is recommended
(this is why we should have a USB extension chord)

External WiFi Dongle 2/2

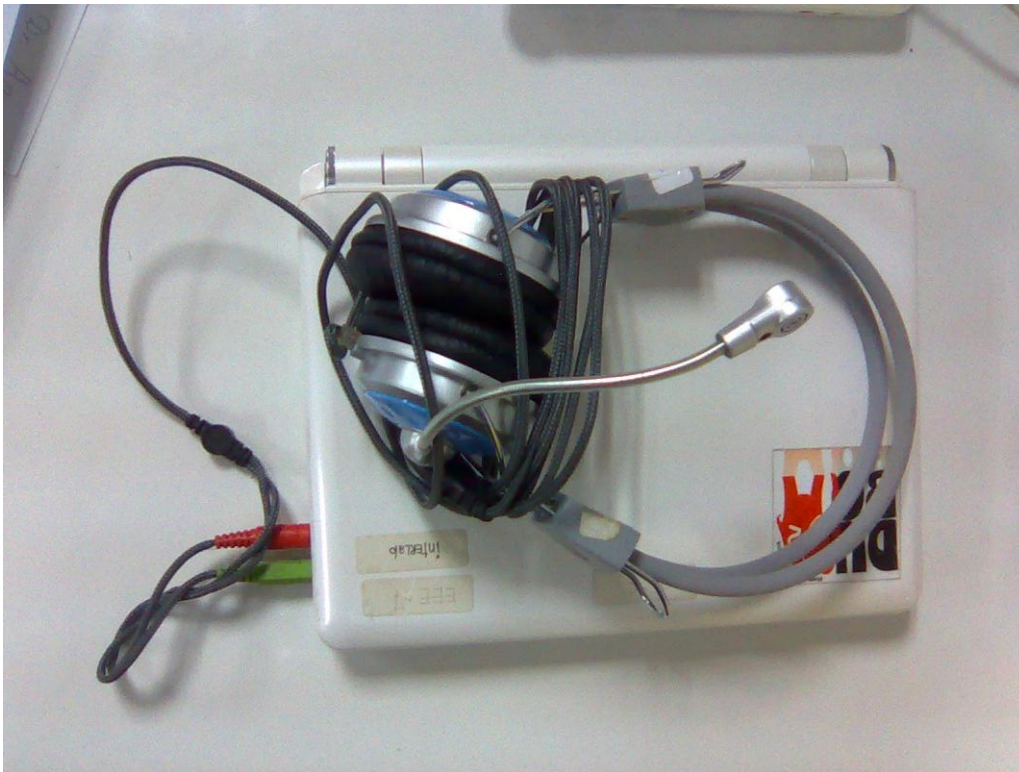


Another Linksys WiFi dongle which is also good

- Mode: WUSB54G ver. 4
- FCC ID: Q87-WUSB54GV4
- Same chipset as that of WUSB54GC – compatible in Ad-hoc mode
- 802.11g
- Outdoor range is also approximately 120 to 130 meters
- Try to have the antenna arranged in a vertical position for best result



Headset and microphone



Any good headset with
microphone would be good

Some Asus may support Bluetooth,
But we haven't tried Bluetooth
headsets yet.

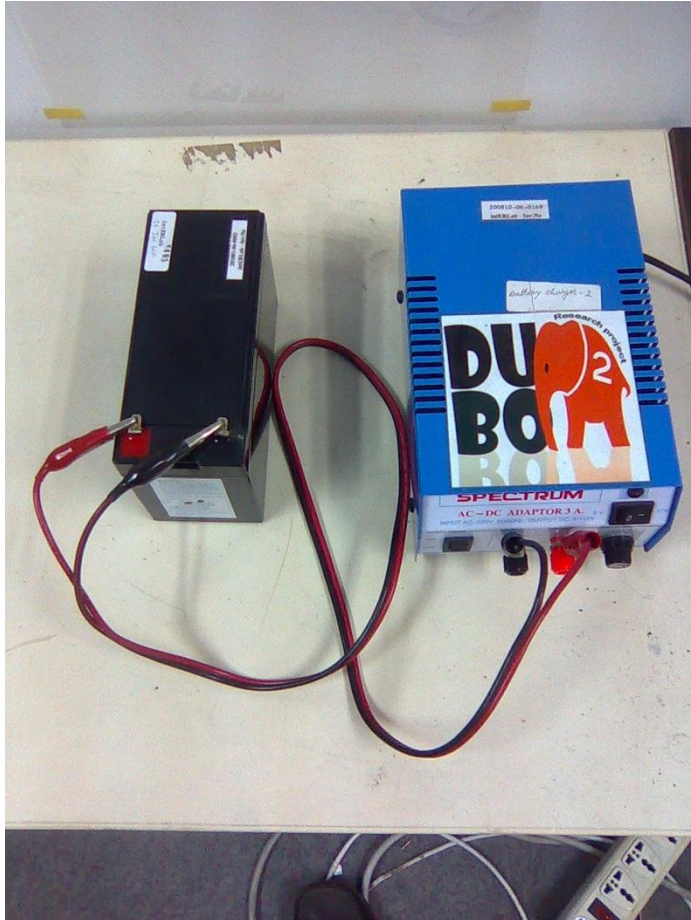
Spare Battery

Any cheap 12VDC sealed lead-acid battery would be equally good.

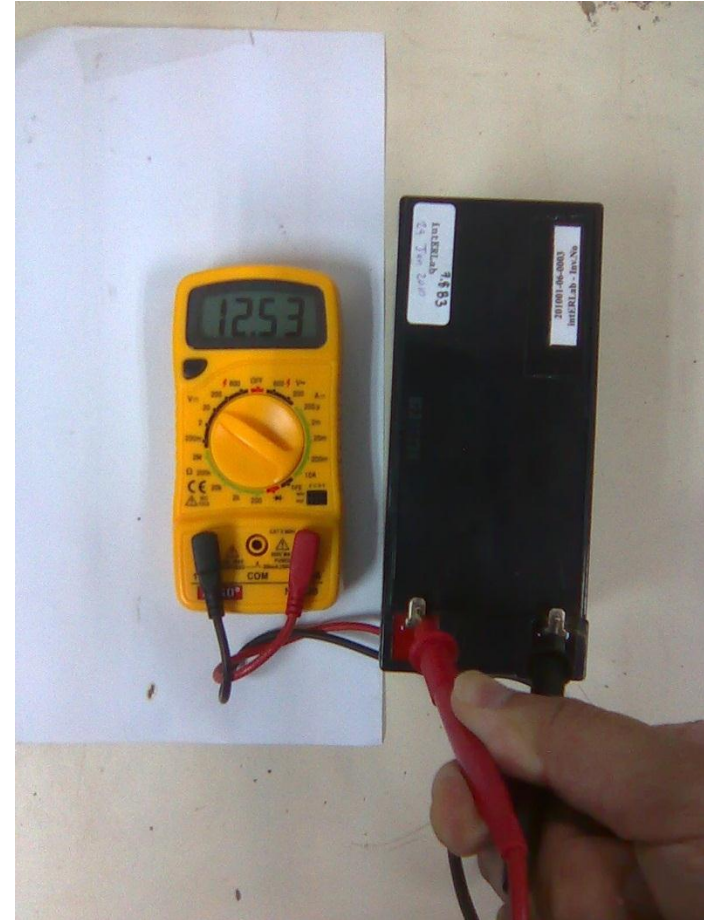
The difference would be in the Amp-Hour (AH) rating. The more AH rating the better, but that also means it's heavier !!



Battery Charger



A typical 12VDC charging station



Voltage reading (should be > 12 V)

Recharging the netbook & operating from an external 12V battery

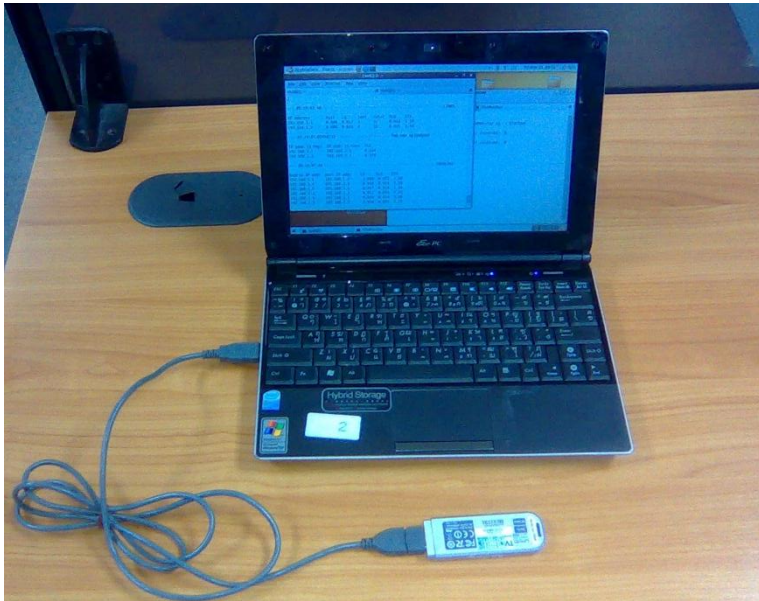


The nicest thing of having all-12V systems is now revealed.

You can recharge and/or operate the 12V netbook from an external battery directly !!

You will need to make a batter power connector. It is not too difficult. You need to find a jack that fits and to observe the polarity (+/-)

Inside the hood (as of March 2011)

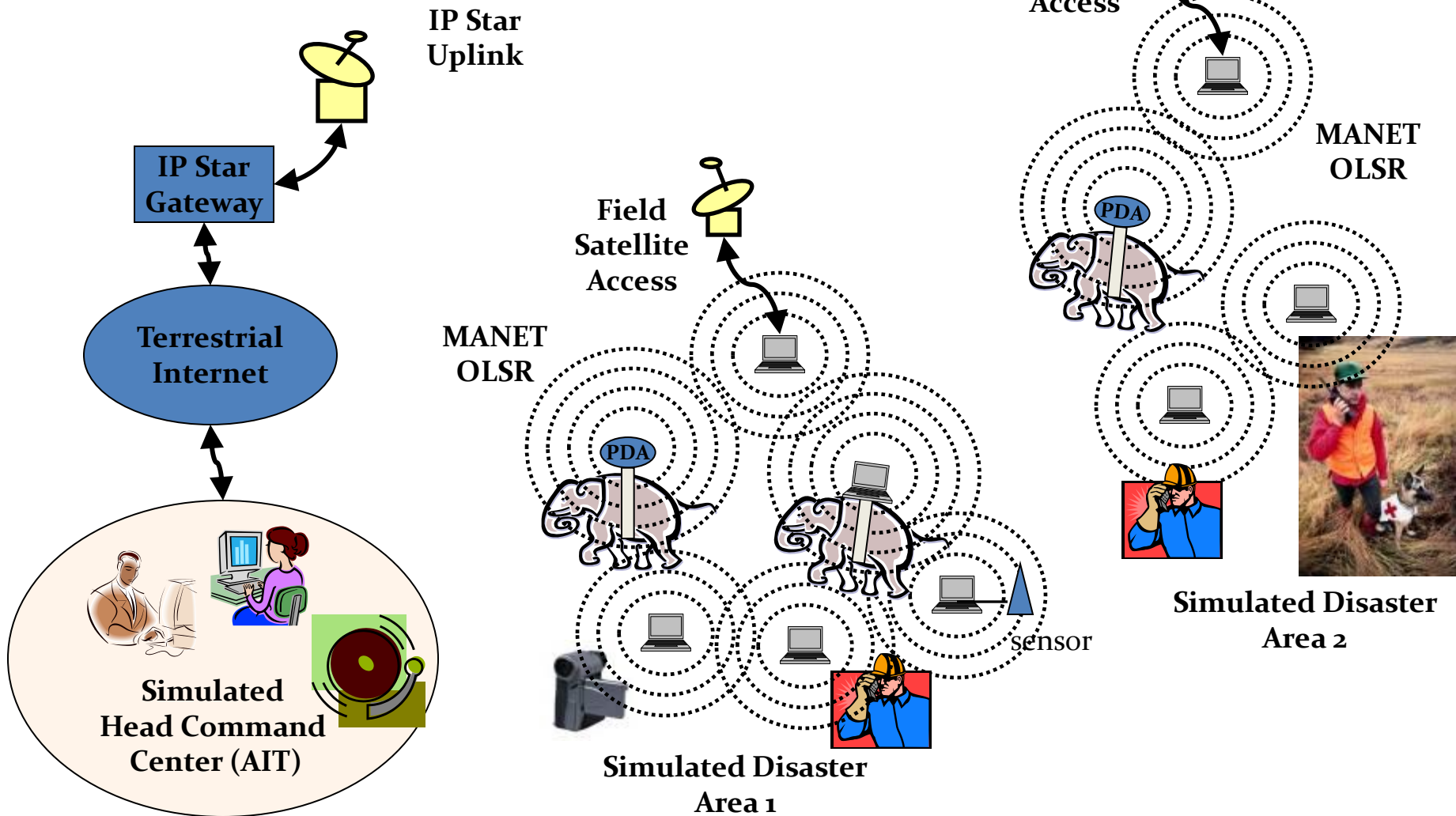


- Linux, with a slightly modified kernel to boost up the maximum WiFi tx/rx power
- OLSR routing daemon
- EasyDC – Interactive multimedia communication – chat, voip, video
- Bluetooth GPS module – to report position
- SMON, Structured Mesh Overlay Network – we have an overlay on top of OLSR MANET
- DTS-OLSR, interERLab's version of Disruption Tolerance Network (DTN) on OLSR , utilizing SMON and DTN2 reference implementation



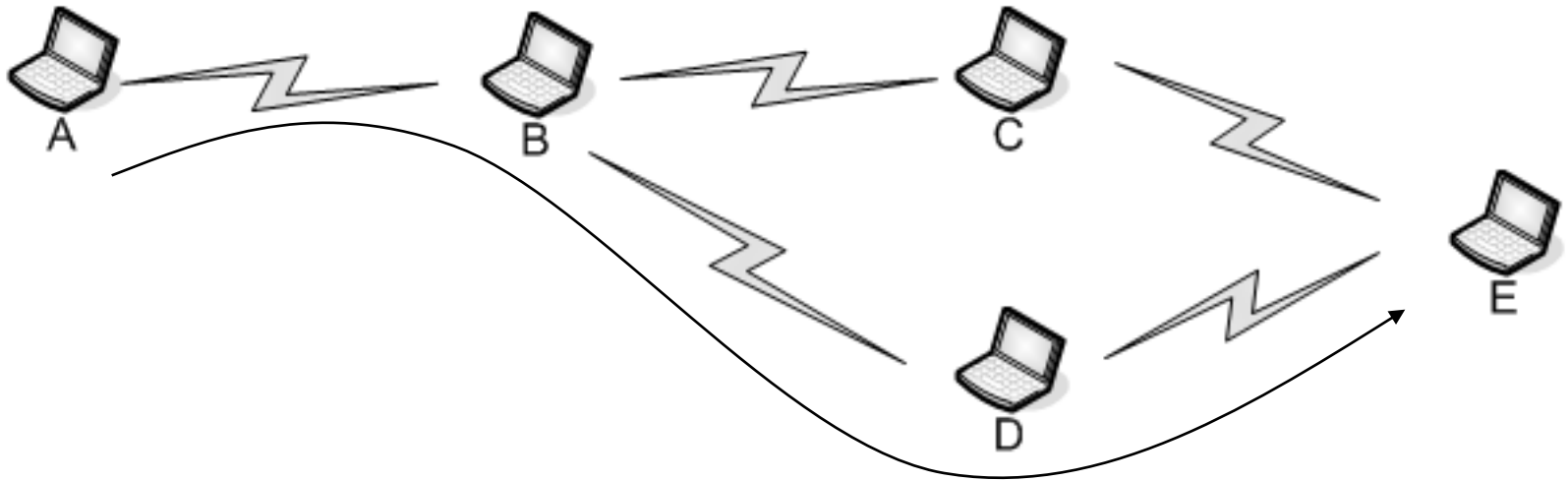
Our Experience

DUMBONET I (December 2006)

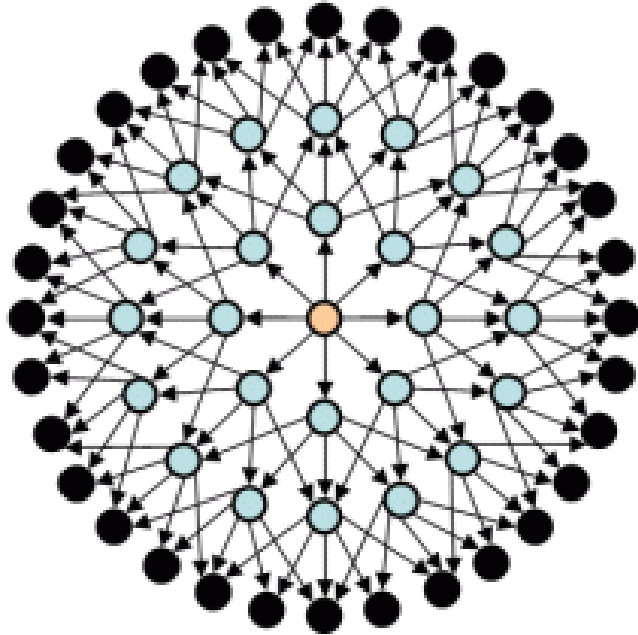


Mobile Ad Hoc Network (MANET)

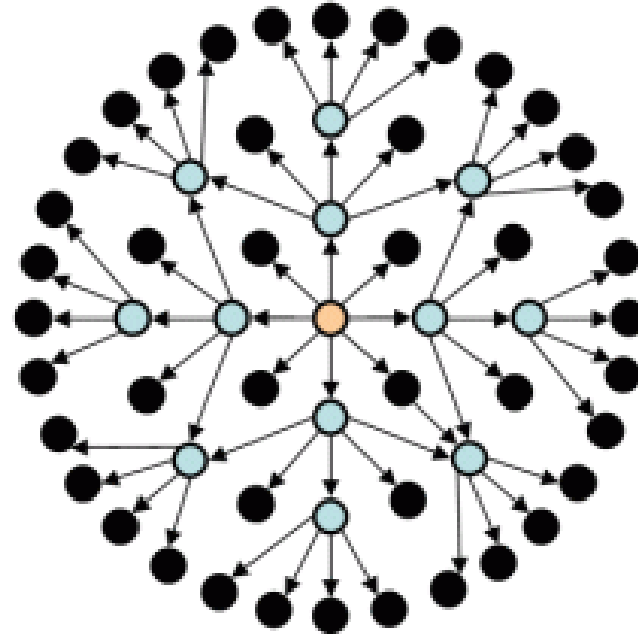
- B and D as intermediate nodes forward a packet to E
- Infrastructure-less
- Multi-hop network



The OLSR Routing Protocol (for MANET)

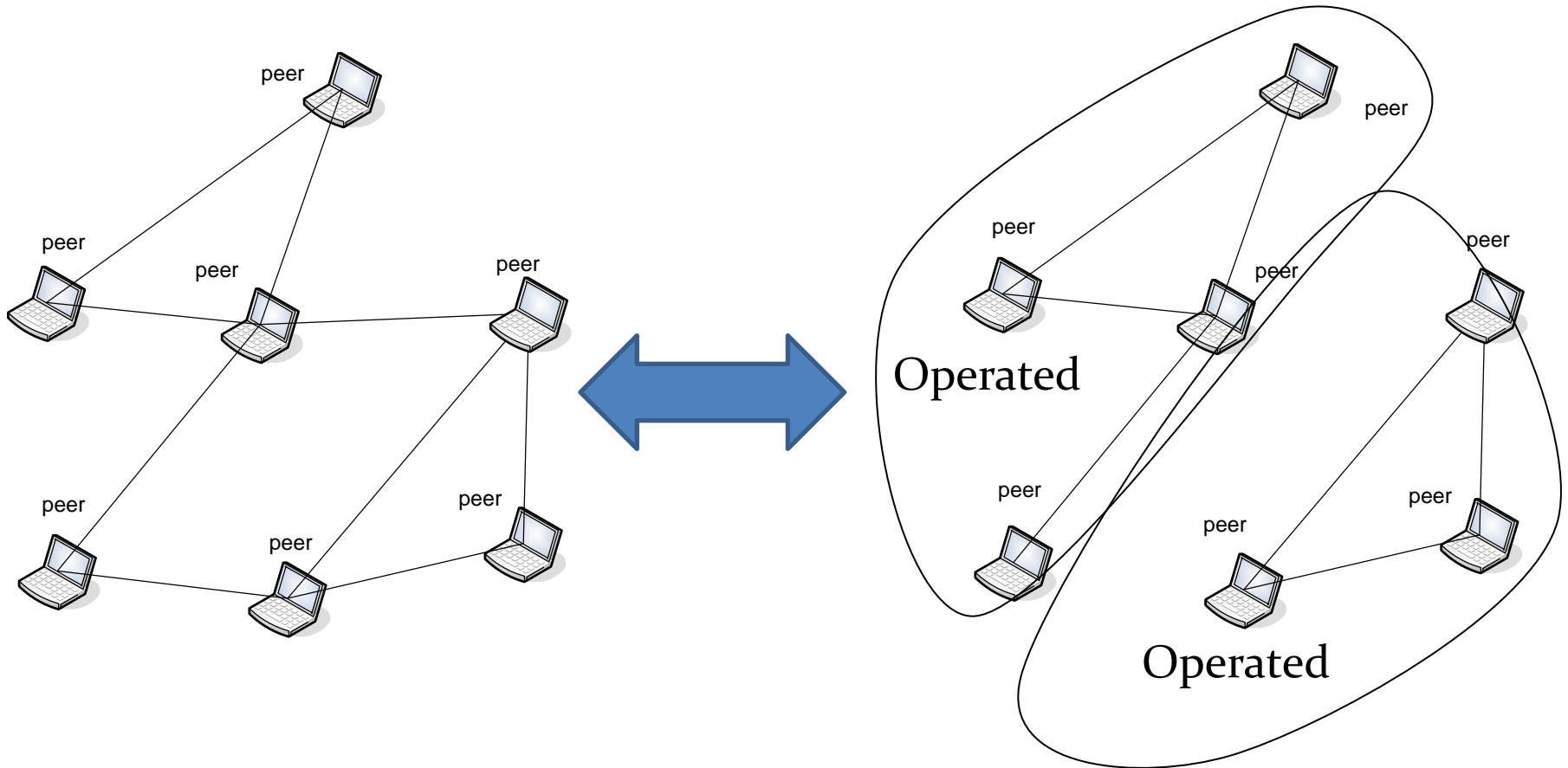


Flooding:
Inefficient & waste of energy



Multipoint Relay:
Only few selected nodes relay
the information

Peer-to-Peer Self-Configuring & Self-Healing



Multimedia Communications for Disaster Emergency Responses

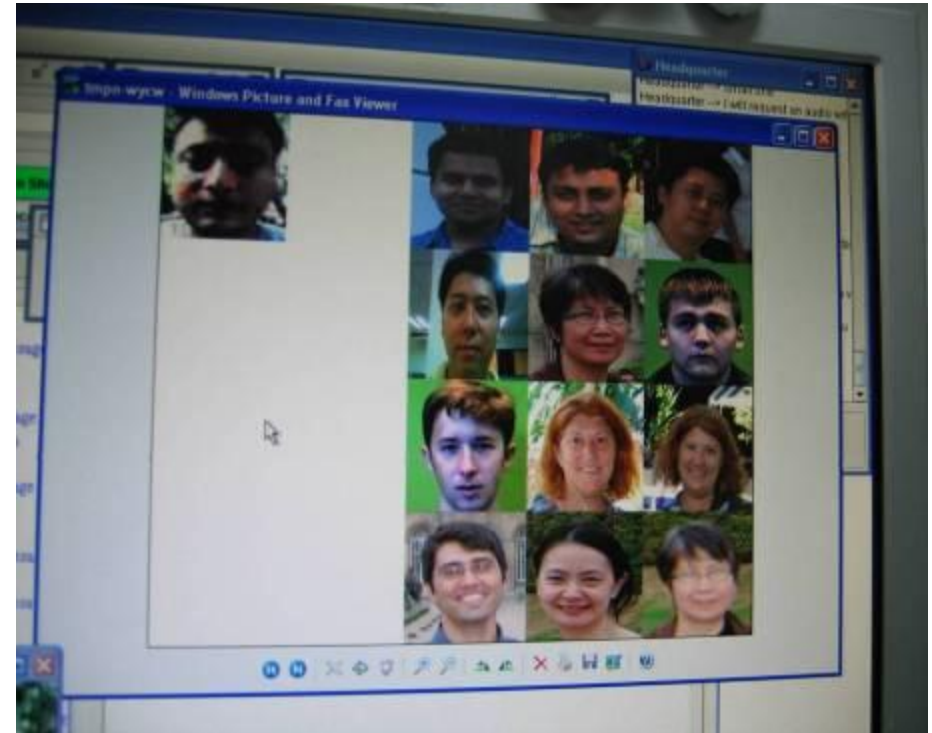
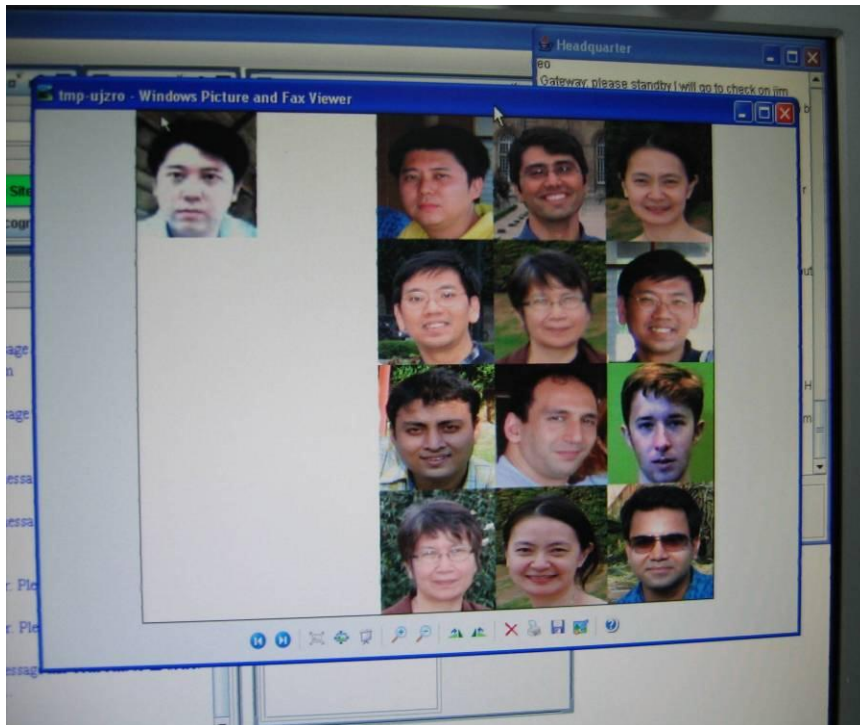
- Interactive Video, Voice, and Instant Messaging
 - very important for situational awareness
- Peer-to-Peer Paradigm (**no centralized server ****)



A Test Deployment in 2006



Facial Recognition System (optional)



Face Recognition : to search and identify people

DUMBONET II (2008)

The project aims to demonstrate the use of mobile ad hoc networks in an emergency situation where fixed network infrastructure has been destroyed by natural disaster.

DUMBO2 is the second phase of the project where we assume that partial recovery of the fixed infrastructure has been successful. The focus of this phase is on how to automatically connect the mobile ad hoc networks to the fixed infrastructure in order to attach the networks set up for emergency scenario with the normal Internet.

Mobile nodes and routers are placed on small boats moving in the sea moving vehicles like motor bikes, tuk tuk and cars on the shore forming Vehicle-to-Vehicle (V2V) MANET. Fixed network access points placed within the proximity of the V2V network are the point of attachment to the normal Internet.

Multimedia communications among field workers using V2V network is the main target of this demonstration. The experiment will provide feedbacks for further enhancement for related network and application protocols for emergency situation.

Project Leaders:

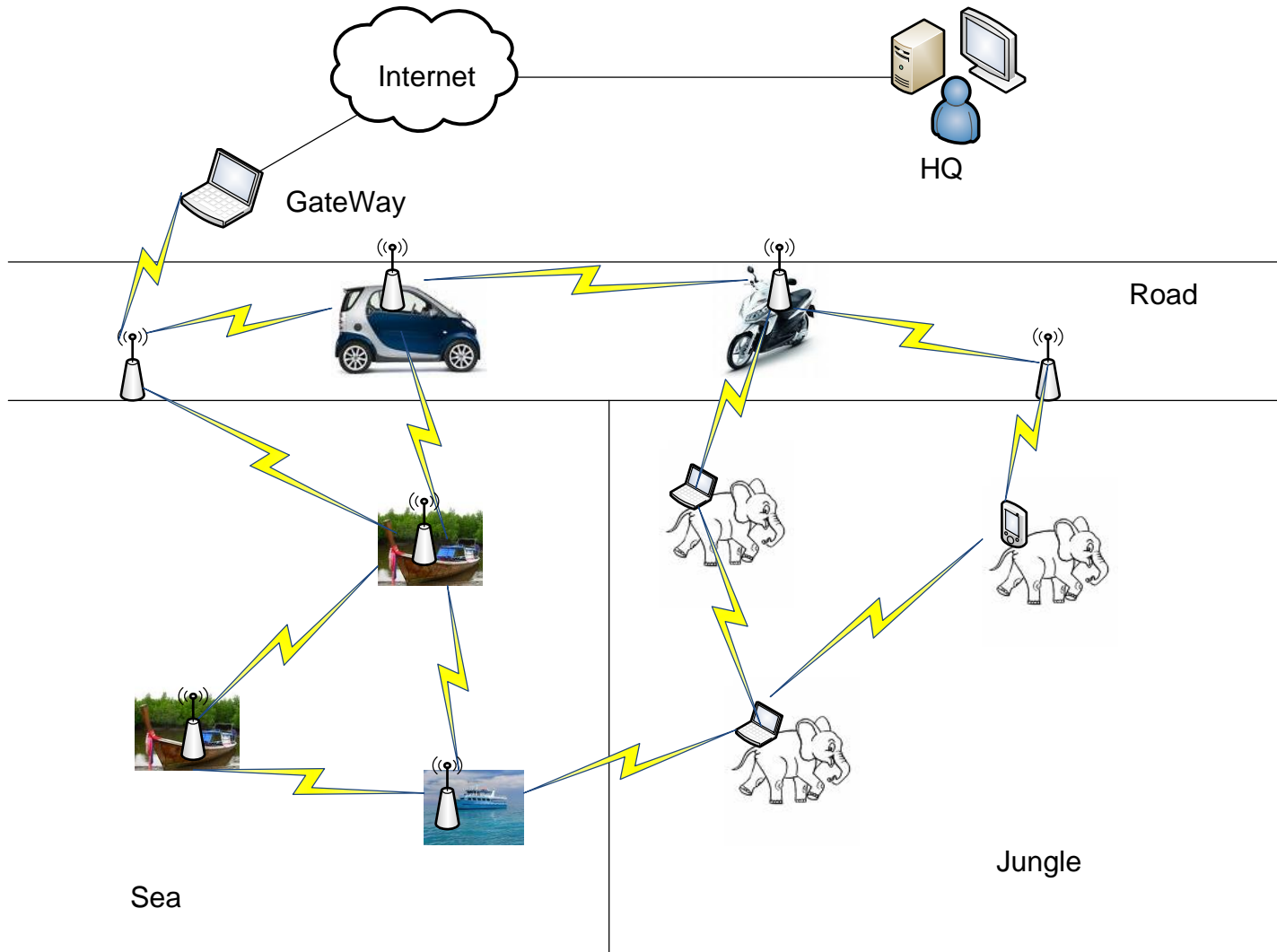
- *intERLab/AIT, Thailand*
- *Hipercom/INRIA and LOR/Telecom SudParis, France*
- *WIDE Project, Japan*

Tech Partners and Sponsors:

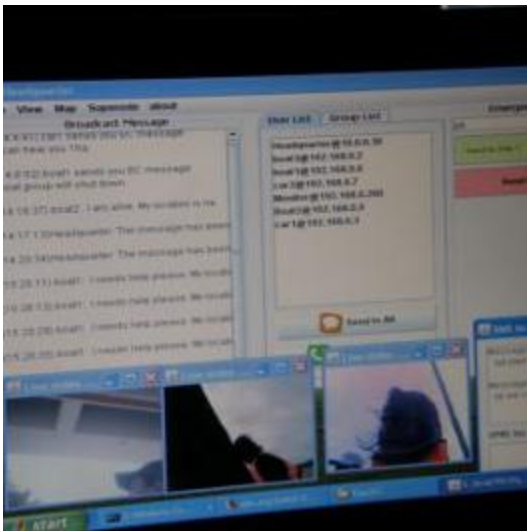
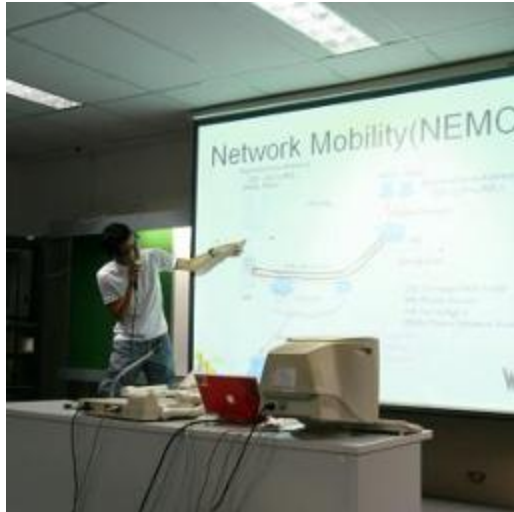
- *NECTEC, Thailand*
- *UniNet, Thailand*
- *French Regional Cooperation, France*



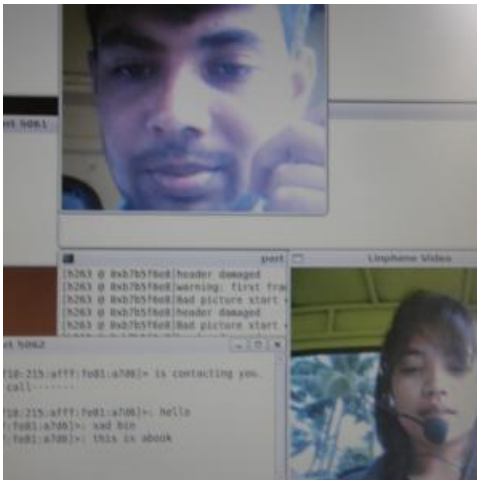
Vehicular Ad Hoc Network (VANET)



DUMBONET II (2008)

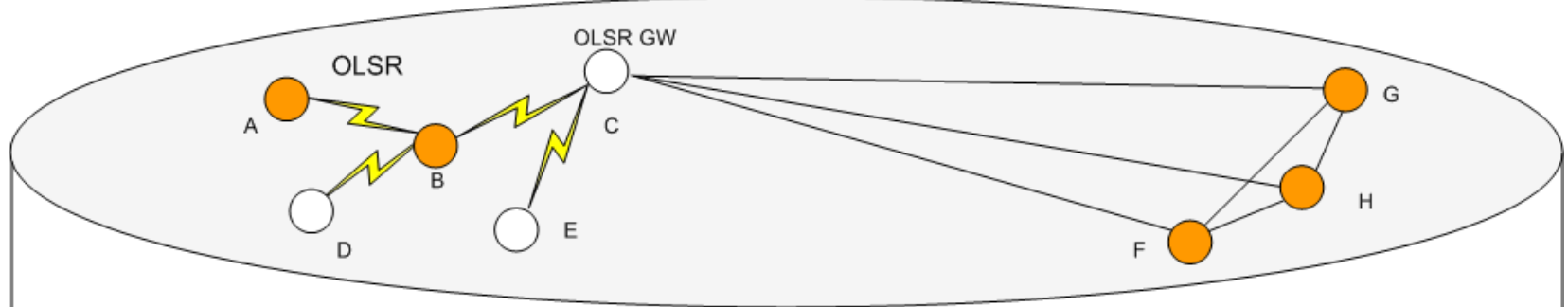


DUMBONET II (2008)

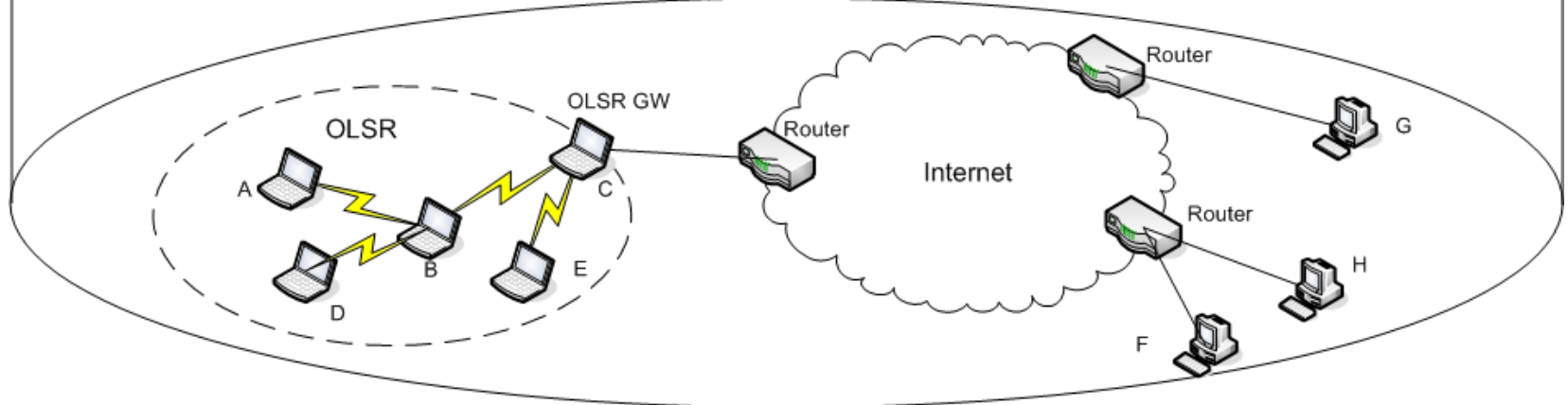


OLSR Overlay Network

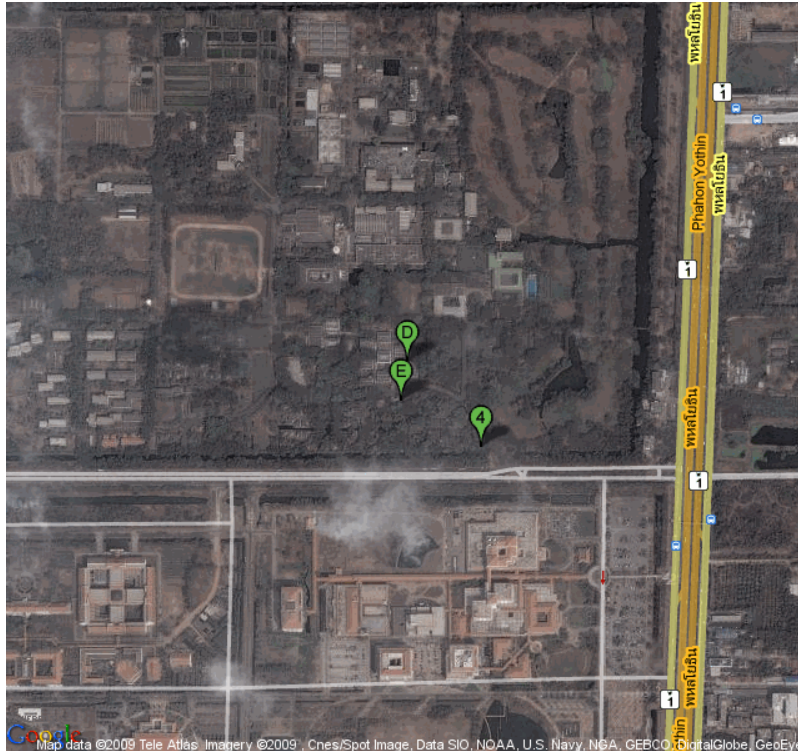
Overlay 1: OLSR overlay network



Physical network



GPS Location Service



We have an optional GEO-tagging capability
Each node can report its present lat/lon if it has a GPS

In 2008, After Cyclone Nargis struck Myanmar



IntERLab's staff members trained Myanmar engineers and NGOs for the deployment of DUMBONET in Myanmar

In 2008, After Cyclone Nargis struck Myanmar



and there, DUMBONET was deployed to help the Myanmar people.

DUMBONET III (March 2010)



Khao-Yai (~Grand Mountains) National Park, Thailand

- Trail in a dense tropical rainforest (~ 3 KM)
- Highly 'challenged' environment:
 - Trees and terrain disrupt our WiFi, CB, and GSM signals
 - Even GPS signal oftentimes cannot get through dense tree leaves

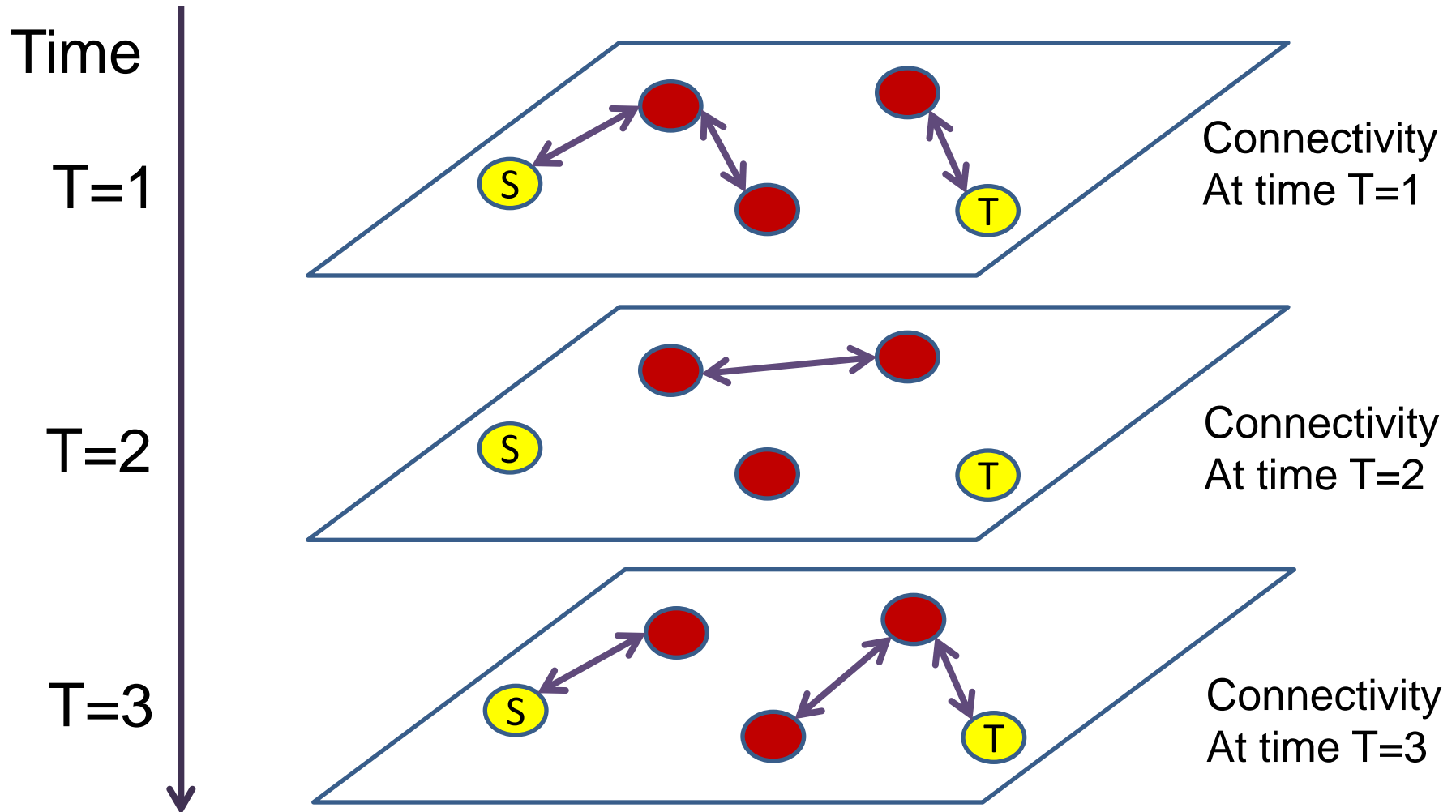
How to enable *multimedia* emergency communication in the highly challenged environments?



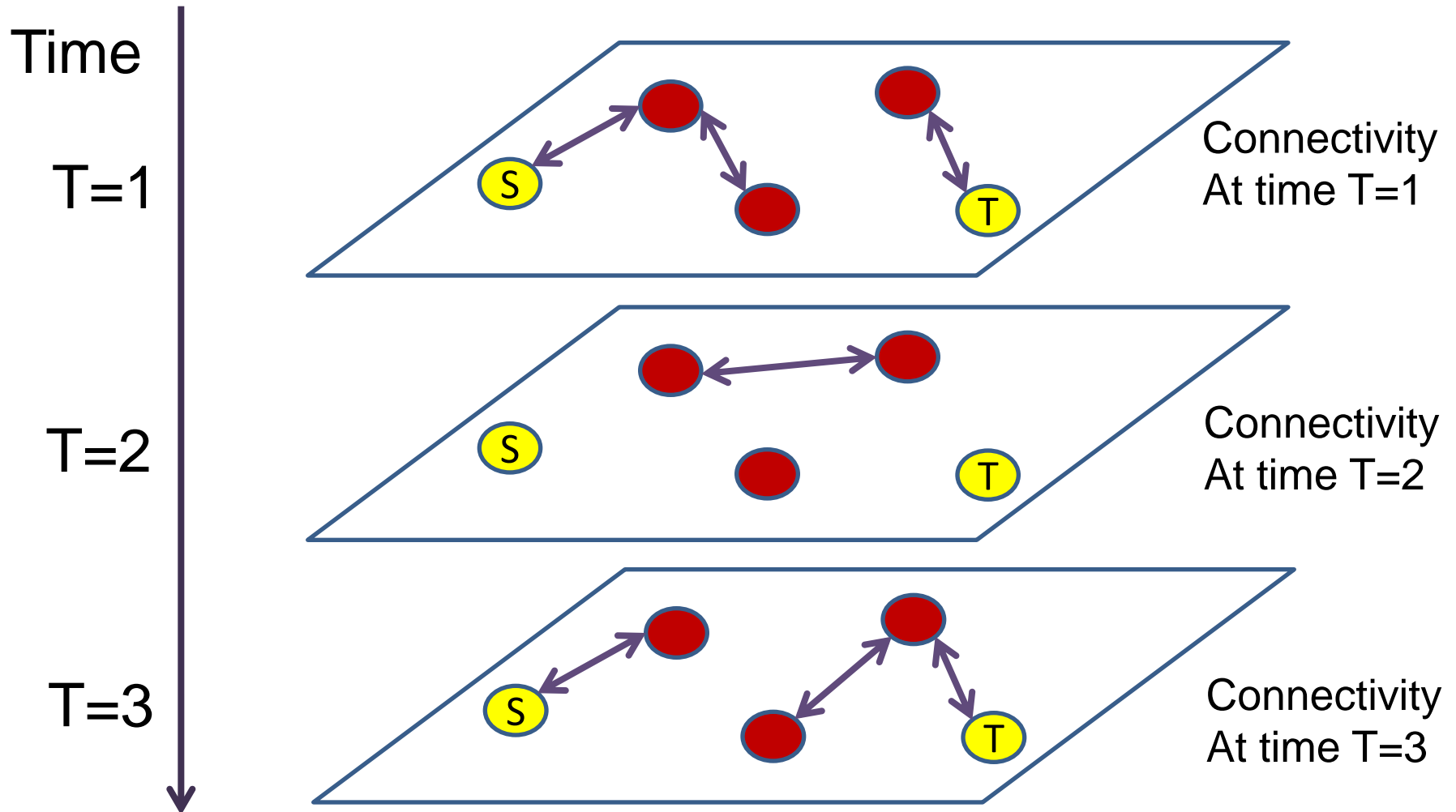
DTN : Disruption Tolerance Networking

- Also known as Delay Tolerance Networking
- DTN Research Group
 - <http://www.dtnrg.org/>

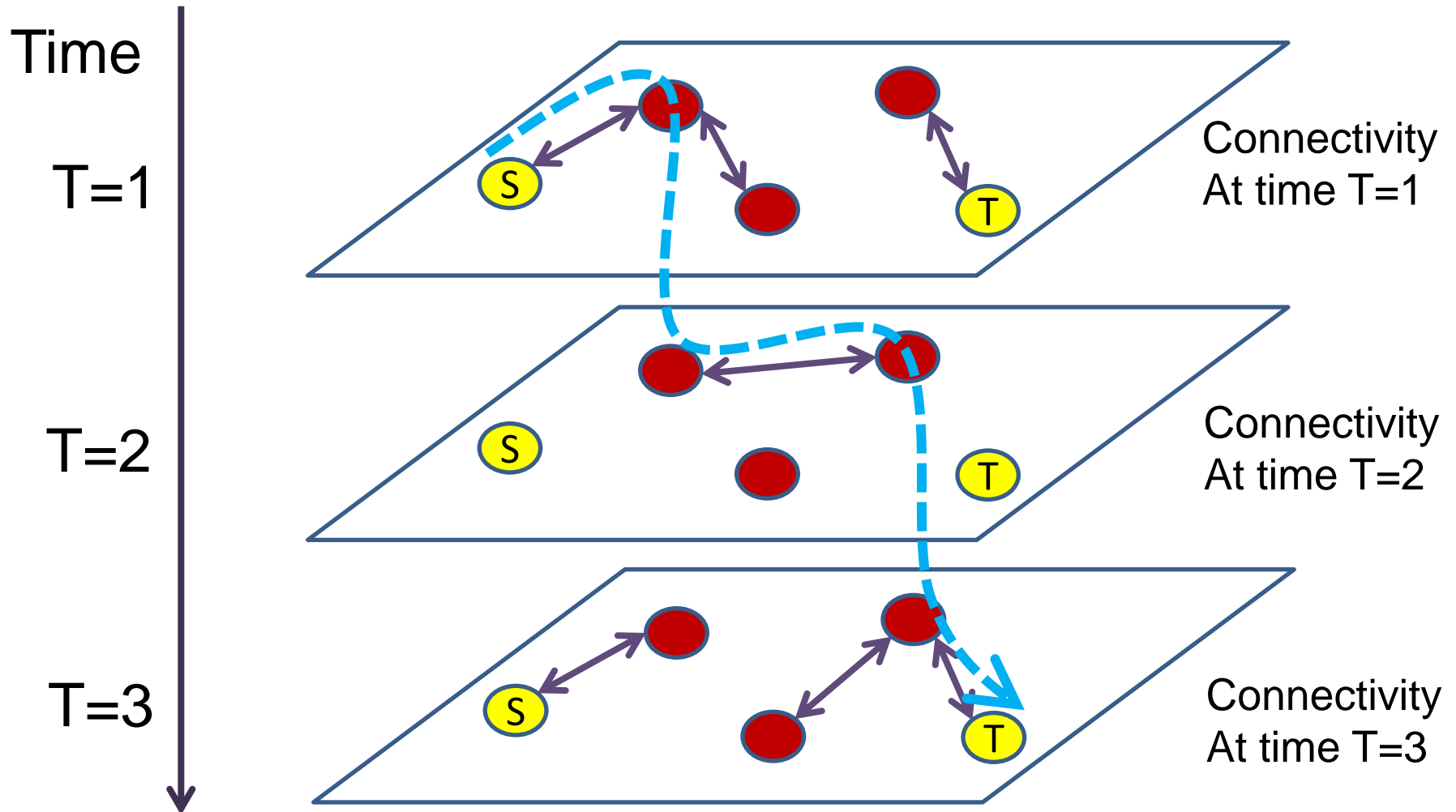
When You have a “Not-Always-On” Network: Space and time perspectives



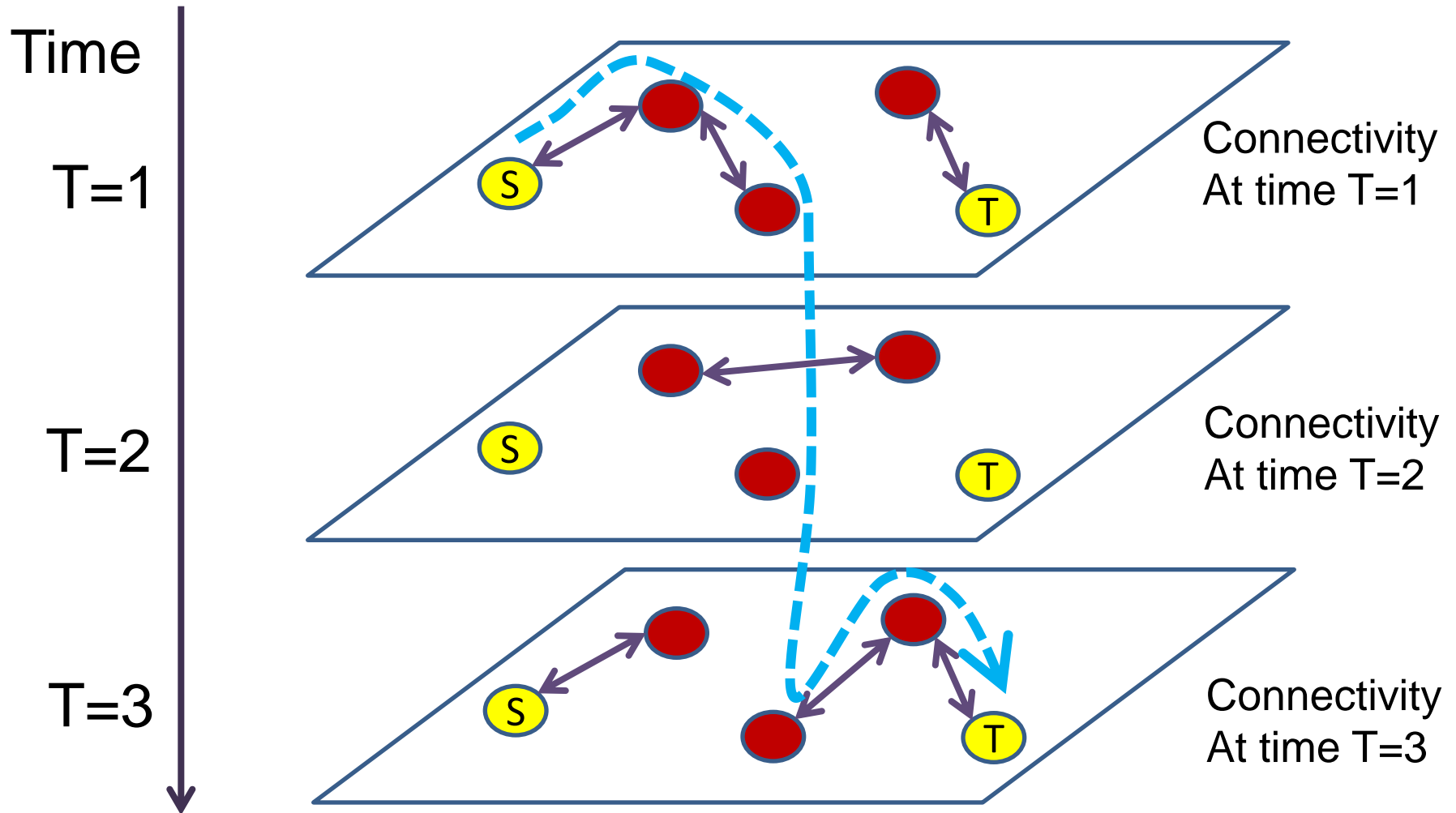
Q: Is there a space-time path from S to T ?



A1: Yes, this is one possible path



A2: Yes, this is another possible path



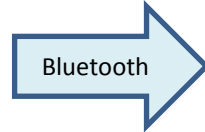
Example use : DTN file transfer in a disruptive MANET



1. Take a picture or a video with your ordinary mobile phone

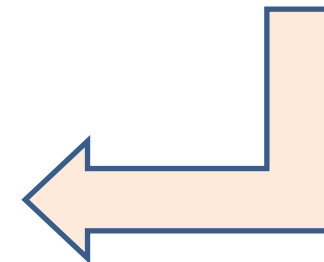
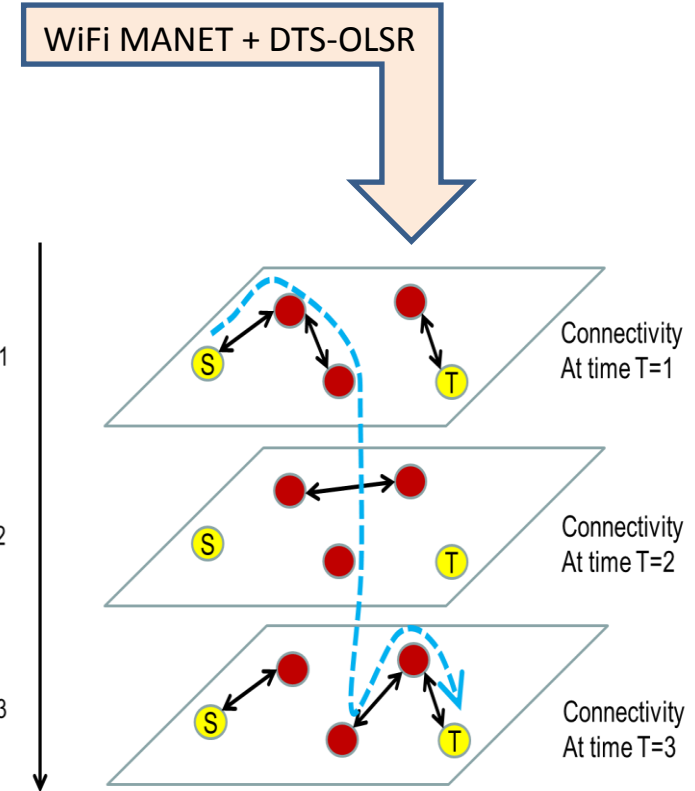
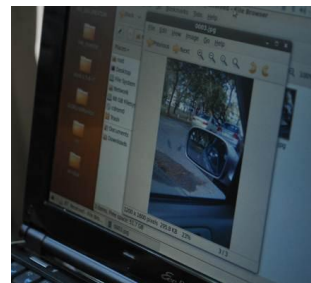


2. Send via Bluetooth to one of EEE PCs

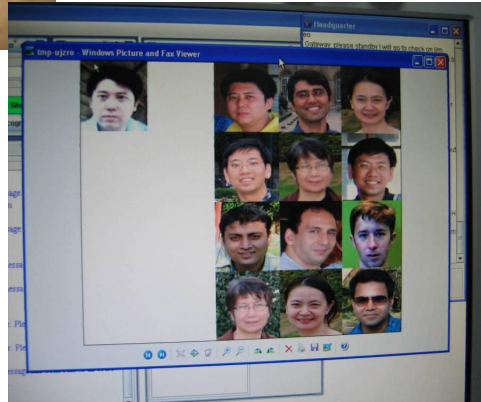
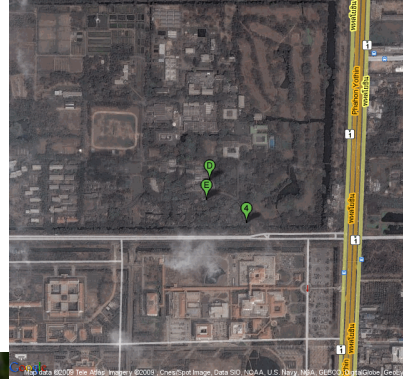


3. The netbook receives the file, makes it a DTN bundle, and forwards the DTN bundle in a disruptive MANET

4. The DTN file bundle arrives at its destination EEE PC (e.g. a command headquarter, or other members of the rescue team)

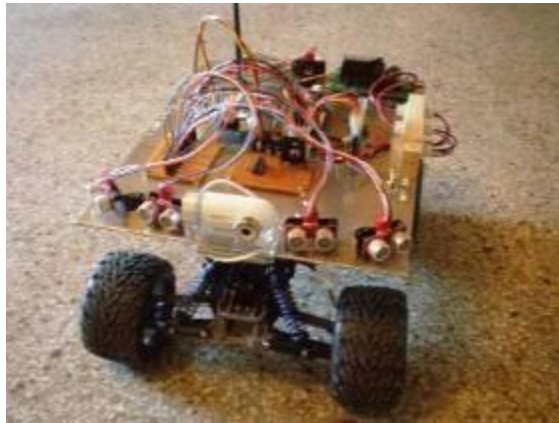


Challenges in Emergency Response Communication



- Dealing with mobility
- Dealing with special situations
- Intelligent information processing
- Cross-layered approach
- Multi-mode Information delivery: streaming, store-and-forward, feeds

Integration of Different Technologies?



“Anything that can go wrong will go wrong” – Murphy’s Law

Special Thanks to

- The French ICT-ASIA program
- The French Regional Cooperation
- The Ministry of ICT, Thailand
- National Science and Technology Development Agency (NSTDA)
- INRIA, France
- UPMC/LIP6, France
- WIDE Project, Japan
- I2R, Singapore
- LOR/Telecom SudParis, France
- Asia Broadband (Japan)
- IIJ (Japan)
- NECTEC, Thailand
- Shin Satellite (IPStar), Thailand
- TOT PLC.
- CAT Telecom PLC.
- and more who have helped in many ways to realize DUMBONET