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To: Florida Department of Education, via Florida A&M University
From: Dr. Lei Wei, Associate Professor
Subject: Final Report on Study and Demonstration of Emergency Communication Systems for Florida University and Community College Campuses

The attached report is transmitted to document the conclusions and recommendations of a best practices study on how to improve emergency communications on Florida college campuses. The study was funded in part by funds provided by the US Department of Homeland Security, Office of Domestic Preparedness to the state of Florida. The Higher Education Subcommittee of the State Working Group on Domestic Preparedness recommended funding of the study and has provided oversight of the project as it proceeded. The funds were approved by the Florida Legislature for FY2005-2006 through the Florida State Homeland Security Grant program, administered by the Florida Department of Education for this study.

As the study proceeded, it was determined that a demonstration of alternative alert and communication approaches and equipment was essential in order for the study to provide the guidance necessary for campuses to identify equipment that would meet their needs. The funding of equipment purchases for the demonstration was provided via a separate grant from Prepare Florida Part I funds under FL DOE project # 376-56000-6CER1, which enabled experimental data to be obtained to validate the conclusions of the best practices study.

The initial study and demonstration tests have been completed, with recommendations on approaches to significantly improve alerts and communication on a campus in the event of an emergency situation. The attached report presents the findings of the study team, including the results of the demonstration. The next phases of the program will include the following tasks: (1) determine via a Request for Proposal (RFP) process to all 39 Florida universities and community colleges how to allocate the grant project funds budgeted for hardware procurement at the campuses; (2) allocate equipment funds in the FL DOE grant to the institutions based on evaluation of the proposals by the Higher Education Subcommittee; (3) conduct follow-up studies to evaluate the effectiveness of the hardware purchased, and to build the best-practices database for future improvements.

On behalf of the study team, I want to express our sincere appreciation to the Florida Department of Education, to the Higher Education Subcommittee of the Florida State Working Group on Domestic Security, and to the UCF Office of Research and Commercialization for their support of this project, which is providing information and financial resources vital to the security of all of our state university and community college campuses.

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Final Report of Emergency Communication Systems for Florida University and Community College Campuses

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Special thanks to Mr. Douglas Backman, Mr. Bill Edmonds, Mr. Andy Hulsey, Mr. Joel Hartman, Mrs. Kim, Mr. Peter Olson, Mrs. Qi, Mr. Richard Turkiewicz, Mrs. Wang, Mr. James Uhlir Jr, Mr. Yang, Mr. David Zambri, Mr. Michael Zelanes, and many other people from UCF, FAMU, UWF and MDC, and also to the equipment hardware vendors who participated in the on-campus demonstration for their efforts and support to this project.

Special acknowledgement: Ms Leatricia Williams, Florida Department of Education; Ms. Tanya Robinson, FAMU.

Funds Background

A UCF research program was selected by the Higher Education Subcommittee of the Florida State Working Group on Domestic Security to study Intra-Campus Emergency Communications within the Florida state community colleges and universities. The UCF team is led by Dr. Lei Wei, Assoc. Professor in the Department of Electrical and Computer Engineering [(407) 823-5098, leiwei@mail.ucf.edu] and supported by Dr. Jim Pearson, Special Asst. to the VP for Research and UCF coordinator for homeland security programs [(407-823-6858, jpearson@mail.ucf.edu]. Funding for the research is from the US Department of Homeland Security FY05-06 funds, provided through the Florida Department of Education as part of the Florida State Homeland Security Grant Program. In addition, some match funds were provided by the UCF Office of Research & Commercialization. Additional funds have been provided by Prepare Florida Part I funds from Florida Department of Education, Project # 376-56000-6CER1. The project lead the Florida A&M University, Component 3 – Purchase of Alert/Notification Equipment to Conduct Test and Evaluation for Three Identified Scenarios at University Campuses. Initial study recommendations led to a demonstration of selected equipment in an operational university campus environment on the UCF campus on Feb 6, 2006. Oversight of the study and subsequent related activities is provided by the Higher Education Subcommittee of the Florida State Working Group on Domestic Security.

Project Background

Although the majority of K-12 schools in Florida have intercom or PA systems in place that would be used to alert students and faculty of an emergency situation and notify them of specific action to take, most higher education institutions have no equivalent system. Universities and Colleges require systems and procedures to rapidly pass critical information in emergency situations to all buildings classrooms, laboratories, and offices to alert students, faculty and staff regarding emergency situations such as a terrorist event, active shooter, bomb threat, hazmat release, or natural event such as tornado. Three important criteria are relevant to campus alert/notification systems: (1) provide an alert to the campus population as quickly as possible; (2) alert and inform the campus population in multiple areas with different instructions that could change rapidly; (3) provide at least a means of basic communications under extreme situations such as a power outage and/or downed telephone service. These criteria must also consider the limitations of the disabled.

The State Homeland Security Grant Program funding will be applied to this project in two ways. First, a "Best Practice/Technology Assessment" study will be undertaken to provide options and recommendations of alert/notification systems and methods for use by Universities and Colleges before equipment or systems are to be procured. This shall include as a minimum, both research on current practices at a variety of university/college campuses, and the test and evaluation of candidate alert/notification equipment & systems. These systems and methods must meet the specific needs of a diversity of campuses, and also be compatible and comply with local, state, and federal emergency management requirements. This study is to be completed by the end of February, 2006 and will then be distributed to all SUS-FL schools and Community Colleges. This document contains the final report of this study.

Following completion of the study, a Request for Proposal (RFP) will be issued to all State University System of Florida institutions and Community Colleges to solicit funding proposals of alert/notification equipment required to meet their particular campus security needs. The proposals will be evaluated by the Florida State Working Group for Domestic Security, Sub-Committee on Higher Education and subject matter experts based on stated evaluation criteria. The funding will be distributed based on the evaluations and recommendations of the Sub-Committee on Higher Education and the subject matter experts.

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I. Executive Summary

Funded initially by UCF, and later by the Florida Department of Education, the study began in May 2005. We selected three campuses out of 39 Florida public universities and colleges to perform an initial study of the requirements for an all-hazards emergency communication system. The key results are outlined in the following paragraphs.

(1) *Three key requirements for an alert system:*

a. Alert as many people and as quickly as possible in a normal condition
b. Alert as many people and as quickly as possible without power and phone service
c. Constantly deliver alerts to specific groups of people in different locations.

(2) *None of the three campuses selected for study have the capability to meet all requirements listed in (1).* Only one campus meets a partial requirement of (a).

(3) *It is very difficult to have a single design for an all-hazard alert system on a dynamic campus environment.*

a. *A variety of buildings on one campus*: Most of the buildings have been built over the last fifty or more years with a vast variety of infrastructure installed, renovated, operated, and maintained by many users, and based on many building design codes. Several buildings are shielded from any radio signal; thus even FM radio could not penetrate the building walls.

b. *A variety of facilities*: For example, at the UCF main campus, fifty percent of the buildings do not have a fire alarm intercom system, which can be used to announce an alert message to all residents in the building. Many lecture theaters do not have a telephone set. In those with a telephone set, almost no one in the department knows their phone numbers. Fifty percent of the buildings have TV sets in their hallways.

c. *A variety of buildings and campus settings across different campuses*: Building types and campus settings vary significantly from one campus to another. Some of them have many high-rise buildings squeezed in one small area. Others have one-story or two-story buildings spread over a wide, woody, and hilly site.

d. *Widely spread campuses and study centers*: Each college or university has multiple campuses and large study centers spread over a wide area and that often blend into the nearby community. These physical limitations make it very difficult (almost impossible) to rely on one system design to perform emergency alert for all hazards and all environments.

(4) *It is difficult to have an all-hazard alert system that will cope with all dynamic behaviors on campus.*

We highlight a few survey results here and discuss their consequences.

a. 50% of students and faculty will not immediately pick up a ringing phone.
This indicates that a reverse 911 type of service will have limited effectiveness for notifying students and faculty.

b. 95% of those surveyed prefer to be notified by mobile phones.
This shows the importance of collecting a mobile phone database, however cell phone reception could be limited in lecture rooms and in buildings that block radio signals due to their construction. Furthermore, before starting the lecture, faculty often ask students to turn off their cell phones.

c. *95% of survey respondents do not know the difference in meaning between an alternating steady siren and wail siren tones.*
This indicates that a siren may be good for general alert, but not effective to carry a precise message. It is thus important not to rely on a siren alone, but rather combine it with other alert methods.

d. *Most of the students frequently check email, but faculty do not.*
This shows that email is a good way to alert students, but not faculty.

(5) *It is difficult to have an all-hazard alert system with limited funds.*
A cost effective solution is critical and essential for colleges and universities.

(6) *Key recommendations*
Assuming limited funds, we issue the following recommendations.

a. Carefully examine a siren/audio system for main campuses, combined with campus FM to establish a basic alert system for requirements (1) a and (1) b. The FM system should be utilized even if the siren is not chosen for installation.
b. Implement a high-speed reverse 911 system to provide very basic service to all 39 universities and colleges for requirement (1) c.
c. Endorse a host-based emergency notification service and encourage students, faculty, and staff to sign up on a voluntary basis. This will enhance our capability to meet all requirements.
d. Each campus should develop or enhance other means of notification such as bulk email, phone hotline, website, campus TV, campus WLAN, etc. Most of these will use existing facilities and thus be low cost. Education and promotion is essential to improve the effectiveness of any notification systems. These efforts will enhance our capability to perform mass notification for a wide range of emergency events.

Note: *During the demonstration on the UCf campus, sirens had very poor voice coverage and a very limited coverage in tone as well. However, it is still the best solution on the market for a wdie-are and wide-coverage outdoor alert. Multiple sirens and speakers may be needed to cover all of a campus. Also NWR/FM receivers in each building need to be located at offices that have a good reception of the signal.*

(7) *Technologies used in recommended system*

Technologies	Scenarios	Provider type	Cost
Audio alert	1 and 2	Siren	$15K-50K per campus
telephone	3	R911/911 broadcast	$35K per small system
	3	Host based	$2-10 per user per year
Mobile phone	3	R911/911 broadcast	
		Host based	
Short message	1,3	Host based	
FM radio	1,2		No cost
NWR	1,2	Multiple vendors	$20-$100 per receiver

Potential candidates

Satellite phone		Immarsat, Vsat	~$3000 per transceiver
Indoor Audio		Tyco	TBD
Dedicated wireless		Cohda	
FM/TV subcarrier		TBD	TBD

II. Introduction

In the wake of 9/11, U.S. colleges and universities are potential terrorist targets because they feature a high concentration of young people and valuable infrastructure protected by minimal security. Bombings in 2002 at Hebrew University in Israel underscored the vulnerability of college campuses [**1**]. College and university campuses are essentially open environments and very few security measures can be implemented. The lack of environmental restraint makes universities and college campuses valued targets. Campuses are easily accessible and convenient places for terrorists to hide because they can blend in with students. Campuses also contain many hazard materials in their advanced research labs. A recent investigation by ABC News has found that nuclear reactors on 25 U.S. college campuses lack security [**2**].

The recent Asian tsunami and hurricane Katrina made people aware of the importance of adequate warning of impending natural disasters. Natural disasters such as floods, earthquakes, fires, and tornadoes can strike a community or a campus with little or no warning. Some natural disasters such as hurricanes and winter storms could cause widespread damage to facilities and infrastructures, such as a power outage, disrupted telephone service (land line and/or wireless), and disrupted Internet service.

There is a strong interest in the U.S. in ensuring the safety of students, faculty, and staff in our colleges and universities. In Florida alone, on any given weekday, more than half a million students attend 39 public colleges and universities where hundreds of thousands faculty and staff work. Additionally, universities and colleges are resources for their communities. Many campuses are used as shelters, command centers, or meeting places in times of crisis.

Although the majority of K-12 schools in Florida have intercom or PA systems in place that would be used to alert students and faculty of an emergency situation and notify them of specific action to take, most higher education institutions have no equivalent system. Universities and Colleges need systems and procedures to rapidly pass critical information to all building classrooms and offices to alert students, faculty and staff regarding emergency situations such as a terrorist event, active shooter, bomb threat, hazmat release, or natural event such as tornado.

A reliable telecommunication facility is a key component to mitigate the effects of crises. An effective and reliable emergency mass notification system should be at the heart of a university/college telecom facility, and could save lives in the event of an emergency. For example, could we inform 95% of students, faculty, and staff at campuses near the beach front of the Florida east coast to move to high ground or upper levels of high-rise buildings within 10 minutes of a tsunami strike? Could we inform people in several buildings to move from one side to another 5 minutes after a strange van was reported to be parked at an area next to these buildings? Could we override a fire alarm alert in several nearby buildings and ask people to stay inside if a strange carry-bag or strange smoke was spotted at a common exit area given those fire alarms may be deliberately set off by terrorists?

In this study, we examine several types of notification systems for the open university and college environments. In the end, we develop metrics for evaluating each system that will help university authorities and related agencies such as the Florida Department of Law Enforcement (FDLE) or the Department of Emergency Management (DEM) determine how to improve the safety of campuses in Florida Public Universities and Community Colleges in the event of emergency.

III.Goals & Objectives of Study

The goals of this project are (1) to develop best practices on how to communicate within the individual campuses of the Florida community colleges and universities in a time of crisis, and (2) to provide the needed benchmarks and recommend the best system(s) to install in a community college or university to provide the needed alert and notifications in a time of natural or man-initiated crisis. We have conducted a national review, and examination of three campuses in Florida, to gain insights on current practices of emergency communications for buildings and individuals on college and university campuses.

The specific study tasks included:

1. Review and examine the types of possible attacks and nature disasters that a campus must consider. Prioritize and select the three most important themes (or chain of events) in which communication systems/procedures are required. Design a survey or interview question set. Review existing practices to handle these themes in campuses across the U.S.
2. Identify the best possible ways/systems and procedures to react to these themes on campus environments. Examine the best possible communication tools (type and capability) for these needs. These will be set as reference points for interview /survey efforts in the study.
3. Identify common communication tools used in higher education institutions and examine their advantages and disadvantages or limitations. Examine their capability and limitation to handle these themes.
4. Explore the existing alarm system(s) used on campus, the IT infrastructure, and broadcasting tools. Review the emergency handling procedure and study how to maximize the benefits of existing tools and infrastructure in emergent themes.
5. Extend the study to other themes and identify needed future study activities.
6. Develop a test plan and Statement of Work for procurement of test equipment to be used on one or more Florida campuses to test and demonstrate capability of the identified communication systems. Develop estimated costs for demonstration(s).
7. Execute an approved on-campus demonstration

IV. Methodology of Study

In this section, we first identify general hazards to consider in Florida, and key criteria, including an overview of existing practices on campuses across the U.S. We then examine the best possible systems and best existing practices on the market. We finally outline the work completed on each of three campuses.

IV.1. Identification of Hazards and Key Criteria

In this subsection, we first examine possible man-initiated attacks and nature disasters typically seen in Florida. From these attacks, we summarize three typical scenarios that have the most severe requirements on campus telecommunication tools and define the criteria for the emergency alert systems. We further select three campuses from 39 Universities and Colleges in the Florida Public High Education System to conduct this initial study.

In order to understand the existing practices at these three campuses, we survey students / staffs/faculty, department and college administrators and their secretaries, and university law enforcement officers and emergency management administrators. From the survey feedback, we are able to paint a clear picture on existing practices and tools, and their efficiencies. A

demonstration was organized at the end of study. Manufacturers showed their equipment and performed a live-demo at one of the selected campuses. Hundreds of observers were distributed across the campus to evaluate the efficiency of each equipment. The final results will be used to determine the future application of the system.

Finally, in this subsection, we overview the existing practices through internet surveys on the methods and equipments used in emergency notification on campuses across the U.S.

A Hazards

We study three classes of crises: man-initiated crisis due to terrorism, man-initiated crisis under normal situation, and nature disasters. It can be difficult to distinguish between the first two classes. For example, the event of school shooting could be the act of terrorists or underage students. Nevertheless, our goal is to find the typical scenarios that must be handled by the mass emergency notification system.

Most materials used in this part are from: (1) Primer to Design Safe School Projects in Case of Terrorist Attacks [4]; (2) A Governors Guide to Emergency Management [3]; and (3) School Crisis Prevention and Response [5]. Many other websites have also been used in the study. We will focus primarily on the typical procedures used to deal with an event, since these actions determine the requirements of notification tools.

i. Man-initiated crisis due to terrorism

(a) Bombing or explosion by an Improvised Explosive Device (IED).

If a suspected car bomb or truck bomb is discovered on a campus, we must inform all people surrounding the explosive materials to initiate their established evacuation as quickly as possible. Since it is possible that more explosive devices may be on a campus, a systematical and well-organized evacuation of the entire campus, and its surrounding communities, may be activated. If a suspicious vehicle is approaching one side of a building on campus, then people inside the building must be immediately notified to move to the other side of the building or, if possible, evacuate outside the building via safe exits. If a bomb has detonated, then aid should be provided to those immediately impacted along with an initial search and rescue of the blast area, and an evacuation of the surrounding buildings. In addition, the situation must be closely monitored to avoid any follow-up attacks, with people notified as soon as the situation changes.

(b) Unauthorized Entry

This type of attack could be as small as a building intrusion on campus during the night and the destroying or vandalizing of facilities; or as dramatic as a campus intrusion involving hostages or mass murder. In such a situation, we need to evacuate those areas/buildings surrounding the attack as well as the attack site itself, if safe exits can be identified.

(c) Chemical, Biological, Radiological, Nuclear or Explosive (CBRNE) Terrorism

If a CBRNE attack happens, then typical actions needed include: (1) Detecting CBRNE agents and examining contamination. (2) Evacuating people in surrounding classrooms and offices to safe places. (3) Instructing people in contaminated areas to find a safe temporary shelter. (4) Isolating contaminated personnel to avoid further spreading of agent (particularly the bio-agent). (5) Allocating personal protective equipment including respirators, protective hoods and suits and building protective equipment such as air filtration and pressurization. (6) Launching a search and rescue mission.

(d) Agro-terrorism, including food and water contamination

Some campuses have their own water processing facility. If contamination is found, then the supply must be cut off and affected persons must be treated. Massive notification is needed to inform all possible consumers to stop drinking the water.

(e) Cyber-terrorism

Cyber-terrorism itself may not cause injury on campus. However, if it happens in conjunction with CBRNE terrorism, then it can be severe. For example, if either one or a combination of several communication means (such as campus internet, telephone system, public broadcast system, fire alarm system) have been attacked during the bomb or CBRNE crisis, then our ability to exchange critical information could be severely limited.

ii. Man-initiated crisis under normal situation (often called "technological hazards").

(a) Medical problem, accident on campus, and infectious disease control [8]

This type of crisis includes (1) a serious traffic accident or bus accident, (2) an incident involving death or homicide, (3) an illicit drug overdose, (4) verbal or written threats of suicide, and (5) food or water poisoning. Typical actions to this type of crisis include (1) informing university authority, police and medics (2) performing temporary emergency actions including first aid and to calm students down, and (3) protecting the accident senses, and controlling the crowd and traffic.

(b) Violence & crime

Common forms of violence and crime on campus include an armed student or hostage situation, sexual assault, intruders, riot or racial/gang altercation, vandalism or graffiti, illicit drug selling or use, substance abuse-alcohol or tobacco, or drive-by shooting.

(c) Facility emergencies

These include fire, a hazardous material spill, utility failure such as gas leakage and downed power-lines, and asbestos release from aged buildings.

iii. Nature Crisis (often called "Natural Hazards")

(a) Hurricane

A hurricane is a typical large-scale event in Florida, which can cause huge destruction over a large area. The effected area, however, can be well-prepared and the university can often be vacated before the storm hits the campus. Some campus buildings have also been used as shelters for people in the surrounding areas. However, the aftermath could cause large areas of power outages and many conventional means of telecommunications could be temporarily out of service. This makes emergency communications very difficult using the conventional communication tools.

It is very important to maintain good communication in this situation. For example, in 2004 during the hurricane season, the roof of a shelter was blown away and occupants had to be evacuated to a safe place in the middle of the storm. It is critical to maintain a good communication between different parties to coordinate such an evacuation. In the last two hurricane seasons, many communities in Florida experienced long-term power failure (up to a month in some areas) and downed telephone service. Fire alarm systems often rely on wired infrastructure and telephone service. If the telephone service is down, then the fire alarm message cannot reach to fire brigade on time. So, quickly restoring the telephone system is one of most important recovery efforts. Nevertheless, in the last two years, many colleges and

universities in Florida have experienced no telephone service for weeks after a hurricane. It will be our priority to provide a temporary phone link between campuses and the nearby fire brigade. An important challenge is to maintain good quality emergency communications during a long-term power failure and downed telephone service.

(b) Tornado or severe storm

Severe storms happen very often in Florida and it can cause temporary disruption of power and telecom systems. Tornados and lightening are often part of severe storms that can strike a campus with very little warning. Under these conditions, the residents are often advised to seek shelter protection or move to interior hallway on the ground floor of the building that are NOT parallel to the tornado's path, and to watch or listen to the storm track programs constantly through TV and Radio.

(c) Flood and Tsunami

Flood has often resulted from a hurricane and a severe storm in Florida. If a flood happens, it is necessary to cease using all electrical equipment and turn off the power in the buildings or campus to avoid further accidents.

A tsunami is a rare event, but it could cause catastrophic loss of life and property damage. Many campuses in Florida are near an oceanfront. If a tsunami strikes, then students and staff members need to be notified immediately to evacuate to high land or to high floors of safe buildings. The tsunami warning is broadcast via NOAA Weather Radio.

(d) Forest fires or wildfires

In dry seasons, forest fires or wildfires could cause sudden and severe threats on campuses. Wildfires could start from a cigarette butt, a piece of broken glass, or lightening. Wildfires can spread very quickly. Those campuses near forests must have a way to inform and evacuate a large population in a short period.

(e) Avalanches / Earthquake / Landslides / Winter-storm /Extreme cold

These are not major concerns in Florida.

In summary, the most likely man-made threads include (a) an Improvised Explosive Device, (b) Chemical, Biological, Radiological, Nuclear or Explosive (CBRNE) Terrorism, or (c) school shooting incident. On many campuses, chemical, biological and radioactive materials are often stored and used for research and education purposes. Thus, it is also important to consider the threats of CBRNE accidents. Such a threat may also come from a spill from a storage facility or manufacture facility near campus. The important nature disasters are (a) hurricanes, (b) severe storm and tornado, (c) flood, and (d) wildfire. One rare but extreme catastrophic event is a tsunami.

B Criteria

The following three important scenarios have the most stringent demands on campus communication tools.

(1) To reach and inform a large population of students and teachers across the campus and surrounding area, in a short period.

(2) To reach and instruct people in multiple areas with different instructions that could change rapidly.

(3) To provide very basic communication under extreme situations, such as a power outage and downed telephone service.

It will be difficult to find one piece of telecommunication equipment that can meet all these requirements, particularly with a limited budget. However putting different types of existing equipment together may achieve the desired result.

Scenario 1: In many cases, such as wildfires or chemical/biological attacks near a campus, we need to reach and evacuate a large population of students and staff members in a short period, particularly on a windy day.

Action**:** Inform as many people as possible, as quickly as possible, to evacuate the campus via safe paths.

Scenario 2: In cases of isolated biological agent spills or chains of bomb explosions, we need to reach several groups of people simultaneously, but each group may have different instructions. For example, if the biological agent spills near exits of a building, the safest approach for those trapped in the building may be to remain inside the building, and for those in the surrounding buildings, to evacuate. We need to advise those in the building to shut down air conditioners and seal the doors. These instructions could also change quickly. If a new threat appears, or a new safe path is discovered, then the best approach may be to evacuate the occupants.

Action**:** Constantly deliver different live voice messages and text messages to different buildings or areas.

Scenario 3: After a major hurricane goes through the campus, a campus typically experiences power outage and downed telephone service. In many cases, the mobile phone service or TV/radio program could be out for a day or two. This may not be severe since before the hurricane hits, most campuses on the hurricane path have been evacuated. Some special cases, however, need to be considered. These cases include: (a) parts of campus buildings are used as shelters during the hurricane (in which FEMA or Red Cross typically has their own emergency radio communication tools); (b) wildfires destroy the power supply and telephone service before posting a sudden threat to the campus; (c) terrorists launch simultaneous attacks on a campus power and telephone facilities; and (d) a building collapses and the telephone service and power supply to the building are broken. Although these cases may be rare, it is essential to provide very basic communication under extreme conditions.

Action**:** Without power and telephone service, our communication ability is very limited. Some dedicated wireless tools may be considered for these situations. Siren and FM with power backup may be the best solution.

All equipment units must check their ability to serve disabled persons (such as deaf, blind, wheelchair bound). The final chosen solution for a campus must meet the needs of these persons.

In the next part, we select three campuses to conduct the initial study. We limited the study to three campuses largely due to limited funds for this study.

C Choice of campuses and rationale

We first surveyed 39 universities and colleges in Florida Public University and Community College System. We then selected three typical campuses for the initial study.

The choice of campuses depends on many factors such as the enrollments, the main campus sizes, the number of buildings on the campuses, and the type of campus environments, etc. In Appendix A, we list the campus information. Head count is from http://www.fldcu.org/factbook/quickfacts.asp#population and other data are mainly from websites of each university. Head count for community colleges for year 2003-2004 is from http://www.firn.edu/doe/arm/cctcmis/pubs/factbook/fb2005/factbk05.pdf .

We selected the following three sites for the study:

1) **UCF**: University of Central Florida is located in a metro area. Its main campus occupies 1700 acres and has 117 buildings. More than 44,000 students are enrolled (ranked 8th in U.S. in student population). It is surrounded by a corporate research park and residential areas. Four universities (UF, USF, UCF, and UWF) have a similar campus size and five universities (UF, USF, UCF, FIU and FSU) have a similar student population. Furthermore, the study PIs are on this campus, so it is convenient for the study with limited funds.

2) **UWF**: University of West Florida is located in a rural area. Although it has a small student population, its 70 buildings spread over a wide woody area (1600 acres of land). In a woody and rural area, there may be additional demands on an emergency alert system. Furthermore, it has been reported that it does not have adequate telecommunication facilities as other metropolitan universities/colleges do.

3) **Miami Dade College**: Most community colleges have multiple campuses spread over a wide area. Each campus typically has many buildings. Miami Dade College is the largest community college in the U.S., with a total of more than 150,000 students. It has eight campuses. Two of them have more than 50,000 students each.

D Overview existing practices on campuses across USA

From internet resources, we find that many universities have introduced new emergency notification systems on campuses after Sept 11, 2001. In this section, we review these practices.

Loyola College in Maryland introduced siren based systems [14]. Cornell University utilizes four different methods of disseminating information to the campus community: Message Blaster, bulk mail, Univ-Closing-l, and the Special Conditions web page [15]. Four primary tools are email, webpage, TV, Radio.

The University of Minnesota at Morris primarily depends on emergency alert radio. This alert radio will sound an alarm tone in the event of a county/city wide alert at about 20 different locations [16]. Many other ways are used to assist the radio alert system. They include Posts on the front and back of each door to each entry/exit of each building on campus, email to inform students and faculty groups, Fax and telephone for notifying the departments/divisions, and TV/Radio for broadcasting information to all campus areas and surrounding areas. In the event that there is no technology (phone/fax) available, and there is time, a notice will be delivered in person.

Southern Illinois University uses 150 handhold radios preset to receive information via Department of Public Safety systems. A tone alert, followed by a message, will be heard in the event of emergencies where the campus is affected. On the information page [17], it mentions that it took 2 years to get FCC approval to use an unused frequency. The radios must also be inventoried annually.

The telephone is the primary means of emergency notification at Tennessee State University [18]. During an emergency, campus telephones must be restricted to official University business ONLY. In the absence of telephone service, the Campus Police may provide runners for emergency notification (contingent on available personnel). The outdoor warning system may be used to convey both siren and voice messages. The outdoor warning system consists of two speaker stacks with controls in the department of Campus Police. The two speakers are capable of emitting both siren signals and voice messages. The system will be activated to receive voice messages for non-weather related messages when the National Weather Service issues a weather related warning for the campus area and/or at the direction of the President..

Johnson State College has a telephone-based system similar to that at Tennessee State University. During an emergency, campus phones must be restricted to official notification only. In the absence of phone service, the runners will carry out the job [19].

On the UC Berkeley campus, the notification consists of a warning siren [20], followed by a voice announcement on an outdoor public address system. Four sirens are located around the campus. They are activated from the campus Police Dispatch Communications Center. The siren system is radio-operated using the campus 800-megahertz radio system. It is computer-controlled, using digital technology with a manual system back-up. During an emergency, all four siren(s) may be activated or only sirens in a particular area. The Office of Emergency Preparedness also has the ability to operate the system. UC Berkeley also utilizes emergency website, emergency phone number, and campus FM radio.

Many campuses use surveillance systems to improve the campus security. They include Tennessee State University [21], John Hopkins University [22], Penn. State University [23], and the University of California at Santa Barbara [24]. Although the surveillance system cannot notify the residents about the emergency, it can help police and university authorities make better decisions. For example, if a fire alarm of several near-by buildings simultaneously sets off, it is better to check the exits via video surveillance before announcing an evacuation. The worst case is that terrorists leave explosives at the exits, then set up false alarms in the building to drive a crowd of people to the exits. Surveillance systems are powerful tools to fight conventional crimes as well. It significantly reduces the need for foot patrols in some hot spots on campus and the record can be used as evidence to fight against crimes.

It is very challenging to cover the third scenario, so we expanded our search beyond the campus environment. In the following paragraphs, we summarize our findings.

Massive power outage, often caused by hurricanes or other incidents, challenges newly developed communication tools since these tools are more likely dependent on infrastructures such as internet connections, wireless links, GPS, etc. The most reliable communications in this situation are older technologies such as conventional telephone and FM broadcast, because cell phones, cell phone towers, radio repeaters, and Internet connections fail due to the loss of electrical power and have limited backup capabilities [25] and [26]. VOIP phones have more power backup issues than the telephone [27]. It is even more challenging for disabled persons. [28].

Many other universities like MIT, Stanford, and Princeton are relying on traditional ways to communicate emergency messages (Web, phone, radio and TV). Most of them have an established emergency preparedness taskforce to coordinate the effort.

In summary, a siren is one of the most common forms of emergency notification systems in campuses across U.S. Most universities rely on using existing facilities such as Email, Web, Phone, Radio, and TV to disseminate the emergency information. In the absence of the above

existing services, runners have been selected as the last resource. Siren is good for Scenario 1 and 3, but it has very limited capability to disseminate specific information to a small area, or different messages to different areas. One campus will introduce alert (weather) radio systems.

IV.2. Best Possible Systems and Best Existing Systems on the Market

The best alert systems (1) cover both outdoor and indoor; (2) have the shortest activation time, are easy to set up, and have voice message capability; (3) are easy to maintain and manage; (4) have a manual system backup; (5) have a battery backup; (6) are cost-effective; and (7) able to accommodate disabled persons. Common ways to cover outdoors are Siren or horn, message board, FM or weather radio, handhold TV, satellite or cellular mobile phones, PDA, and wireless notebook. For indoor, many ways to inform the residents, include telephone, TV in hallway and FM or weather radio, fire alarm intercom system, mobile phones, email, internet, etc.

Many public safety technologies have been built by exploring the common communication infrastructures, including indoor mass notification system based on fire alarm intercom, public broadcast system, siren system, reverse 911 or 911 broadcast telephone service, code3 emergency radio phone, NOAA weather radio, public safety system based on wireless LAN, host-based all hazard alert service, and long range, high power and stand-alone cordless phone, satellite phones, email, internet, etc. In the following sectons we review each technology and examine its advantages and disadvantages for campus application.

Fire Alarm: A fire alarm with an intercom system is the standard emergency notification system for each individual building. When the alarm is tricked, the prerecorded evacuation message is broadcast in the building. Simultaneously, a message is dialed to a central station automatically, and then the central station calls the fire station and the fire truck is dispatched to the building. Typically, a fireman uses the intercom system to deliver some specific message to residents inside the building. There are several drawbacks to current fire alarm systems: (a) It is isolated and only the prerecorded evacuation message can be broadcast throughout the building. No other specific information can be passed to residents. (b) It relies on wired infrastructure and telephone service. If the telephone service is down, then the fire alarm message cannot reach to fire brigade on time. (c) To operate the intercom system, a person must be physically in the building.

One of major fire alarm companies, Simplex Grinnell, is currently offering massive notification systems. It has been found that it is not an easy task to use fire alarm to play the dual roles of fire alarm and notification alarm. During the notification period, the system still needs to operate fire sensors. If a fire is detected during the notification period, it is not clear how to coordinate them. Furthermore, not all buildings have intercom systems. Consequently, substantial modification may be needed to update fire alarm systems in all buildings to perform mass notification tasks.

Ideal case: A fire alarm and its intercom system provides basic infrastructure in each building. The above disadvantages can be eliminated by introducing a system that can connect the intercom system in each building to one or two central command centers. A simple broadcast system or a wireless system can fulfill the task as the bridge. Typically, a wireless system or a free-air broadcast system cannot guarantee a good wireless connection at each and every indoor location. But, if we can find two or three spots in each building that have a good reception quality, then reliable wireless communication to each building can be established. The key requirement is that the wireless system can automatically activate the fire-alarm intercom system.

It is difficult to estimate cost of modifying a fire alarm intercom system to gain massive notification capability. It depends on the quality of existing alarm system in building, which may vary significantly from one building to another. A rough estimation has shown that it requires about $500,000 to $1 million to introduce this feature to all of UCF's 117 buildings. About half of the buildings do not have intercom systems and many fire alarm systems in old buildings need to be upgraded. If all buildings were built to comply to the basic requirement of this feature, then the cost of upgrading the traditional fire alarm systems would be substantially reduced.

Broadcast announcement: Broadcast announcements are good tools for distributing general information to a wide coverage area, but they are not well-suited for delivering specific information to distinct segments. It is good for the first scenario, not the second. In general, it is not good for the third either since most of these systems depend on power supply. But if the system, such as an on campus FM program, has a power backup (either UPS or it own generator), then it could be a good choice for the third scenario. To be effective, it is essential for the intended audience to tune in to a regional radio or television channel. Radio or TV is often on in most department secretary offices during the office hour. It is, however, ineffective if the emergency event occurs in the middle of the night when most residents in on-campus residential quarters are asleep. An alternative way is to use siren to alert people first, then they can tune in to an FM or TV broadcast.

Ideal case: The ideal broadcast technology for campus security would provide consumer television and radio monitors that turn themselves on when an emergency alert is broadcast and automatically turn on other alert systems in the building such as fire alarm. FM radio and TV are existing activities on campus. It requires no additional cost to broadcast an emergency message. But, a procedure needs to be in place to ensure the safety, security, and efficiency of using the system.

Sirens: Sirens can be effective in their ability to alert people within hearing distance that a crisis or emergency situation may exist. Outdoor warning sirens/public address systems are ideal for densely-populated campus areas. Sirens are intended to alert the public to implement some pre-determined action (i.e., tune to radio and television for specific information on an impending hazard). However, the public generally has no awareness of the need to do so and often will ignore sirens. The meaning of sounded alarms can be open to wide interpretation and most people, in fact, do not know what a siren alert means. It is essential to have voice messages immediately after the siren to explain the nature of the crisis. However, in many cases the voice message can only reach a radius of 1500 foot, which is much smaller than the siren tones. Moreover, outdoor warning sirens/public address systems were never intended to be loud enough to be heard inside buildings. Thus, it is important to use it with multiple and complementary systems designed to overcome such limitation. In many areas of the country, sirens are used only for specific emergencies, such as floods or tornadoes, and are of little use in helping public safety and law enforcement personnel alert residents to other events/crises, such as a suspect at large, or other event with descriptive information.

Ideal cases: The siren is an ideal tool to alert campus to draw attention to specified messages from other means such as broadcast or internet. It is also an ideal tool to inform people to take immediate actions such as an emergency evacuation and to seek shelter. Although only a few people may know the actual meaning of siren, voice message could overcome this shortage. In a crowded campus, the message relayed from one person to another could reach a much larger area. Interruptions due to power outages can be easily avoided using a battery power supplier or a small generator.

Cost of a single siren is about $50,000. A good system with 4 siren zones costs about $200,000 to $300,000. Sirens at UC Berkeley carry one message: “seek shelter as quickly as possible and then listen to FM, or dial to a phone hotline, or check internet webpage for further activities.”

Reverse 911 or 911 broadcast system: Reverse 911 or 911 broadcast, using the telephone system as the media, can carry out emergency notification [11] [12] [13]. Many counties and companies such as Microsoft, AT&T Wireless, USPS, etc. selected this system. Typical emergency phone dialers cost from $5,995 up. For 2,000 calls per 5 minutes, the equipment and hardware costs around $300,000. It is a very good choice for sparsely populated residential areas, but for a densely populated campus, its effectiveness may be questionable. For example, most classrooms in our engineering building do not have a telephone. Many faculty members may prefer answering machines and voice messages instead of picking up a ringing phone. However, telephones in a department office can often be answered promptly. Thus, a good application of reverse 911 or 911 broadcast on campus may be established between department offices and the police department. It relies on T1-telephone lines, which are costly to maintain. On the campus environment, it may be connected to Internet via on campus backbone. Today, many companies are starting to offer a host-based reverse 911 option, very similar to *E2campus* and *Send Word Now* systems.

Ideal cases: An ideal reverse 911 or 911 broadcast system will automatically activate the speaker and broadcast the voice announcement regardless of whether or not the receiver picks up the phone. A telephone would be installed in each classroom and in each room. In the case of downed telephone service, the system can switch to wireless or other ways to broadcast the message. Linking to the building fire alarm intercom system is essential.

There are two ways to use this system. The first one is to build up a centralized call center to serve all university and college campuses. A center, costing $300,000 for equipment and software, $150,000 in personnel to build and maintain the database in the first two years, will be able to make 2,000 calls per 5 minutes. If we place 2 calls per building, then it should be able to alert several campuses simultaneously. Our target is to be able to inform several campuses simultaneously within five minutes of a tsunami or widespread CBR spread over one side of coast.

The second one is made of 41 less powerful reverse 911 or 911 broadcast equipment sets; arranging them in a tree structure. Two will be located at a center and will only need to call remaining 39 reverse 911 or 911 broadcast sets, each located at each university. In this setting, each set would be able to make around 100 to 200 calls per 5 minutes with each costing between $25,000 to $50,000. Also, each university and college will need to establish and maintain their own database and software.

Host-based all-hazard alert service: It may be too costly to own reverse 911 or 911 broadcast speed dialer equipment and software. Today, many companies provide customer-based emergency alert service. Each customer can sign up for the service and pay an annual service fee. Fee structures vary from one provider to another. During the emergency, the service provider will broadcast emergency messages via telephone, mobile phone, SMS, email, Fax, Pager, PDA, Blackberry device, etc. Here we list a few companies that provide such a service: (1) Send Word Now [30], (2) E2campus [29], (3) 3N system (National Notification Network) [31], (4) Emergency email service [32], and (5) Twenty First Century Communication Inc. Website: www.tfcci.com.

These systems enable a non-technical administrator to communicate emergency information to the campus community via all available communication medias such as Mobile phone (via

SMS), Email, Web page, Blackberry device, Pager, or PDA (Personal digital assistant) with wireless connection. They can be used in the emergency situation or ordinary event such as informing students about the room changes at the last minute. They ensure that all the communications -- emergency information, updates, or everyday notices -- can be transmitted to students and staff quickly, easily, and accurately, within a single department or across multiple campuses. Contacts can be organized into any logical group: engineering faculty, art history students, even students in individual classes. The message can be sent to ten or tens of thousands of people within minutes, and receive a real time confirmation report of who received the message and who has yet to be contacted. The message can be initiated from anywhere via web or phone, and can be sent in voice and text format simultaneously. They are an ASP (application service provider) solution, which means that there is no hardware or software for administrators to purchase, implement, and maintain. The system is administered via a standard web browser with Internet connectivity or via a mobile device with Internet connectivity. Recipients can manage their account via a web browser and make updates to their device or contact information. Some provide a free email alert of county-wide emergency information to individuals. Many companies (including Bank of New York, USPS) have chosen this type of service.

The disadvantages of the system are (a) it requires receptors to register in the system; (b) it will not work in the event of downed internet service and downed phone services; (c) it requires recurrent investment unless individuals pay for themselves; (d) although it has capability of sending tens of thousands of calls in minutes, its calling capacity may be limited by local phone switch centers. For dense population campuses, this limitation needs to be considered in the system design. (e) It needs a system to establish and maintain the database.

Ideal case: Compared to a reverse 911 or 911 broadcast system, it integrates almost all communication tools commonly used on campus, including telephone. It does not require maintaining software and purchasing hardware. If it can integrate siren and stand-alone industry phone systems, and provide each campus a manual backup database, then it will be an ideal candidate for campus emergency notification. That is, when we have a downed power supply and downed internet service, we will still be able to launch emergency notification via phones and siren using UPS power backup systems.

Cost of *E2campus* system is $2.50 per registered user per year. Multi-year discounts and bundle discounts are possible. Cost of SWN for a group of 20,000 users is roughly $165K per year.

First hand experience on SWN: SWN is backed by Quest Communications, Inc. and has high priority over normal telephone, mobile, and internet users. During the crisis, as long as one of three ways -- Internet, telephone, or wireless -- is available, the administrators can send out mass notification to all or sub-groups of receptors via either web, 1800 numbers, or wireless blackberry device. The university only needs to provide initial contacts of receptors to the company and the company will take care of data management, registration, and software/hardware. Every three months, the company will email/call receptors to get their information updated. Each receptor will have 10 contact numbers, so students would be able to input their parents' number as well. During the emergency, the administrator just needs to pull out the web device, type in the short message and press send. The administrator can issue requests of return message. The receptor only needs to press one button to indicate their status. Those statuses can be monitored on-line and forwarded to relevant parties such as student parents or rescuers. For a group of 50,000 users, the price is $7 per user per year and for a group of 5,000 users the price is about $13 per user per year. Although it is slightly more expensive, it can be used during a normal situation such as a notification to a particular class or grade. The saving on

massive calls on normal notification could offset a portion of the user cost. If the university assumes only part of the cost (for example 10-20%), then there is no additional burden on the university. Around $10 per year is very affordable for individual students and staff members.

Weather Alert Radio/FAST Radio: The National Oceanographic and Atmospheric Administration (NOAA) operates NOAA Weather Radio (NWR). Traditionally, NWR broadcasts warnings about severe weather conditions to the U.S. population. However, in response to the terrorist attacks of 9/11, in 2002 the Federal Communications Commission (FCC) mandated the addition of 21 civil warning messages on the NOAA system. An agreement between NOAA and the Department of Homeland Security was signed in June of 2004 providing DHS access to the network. NOAA broadcasts are received on seven weather band channels by special emergency-alerting radios, which automatically alert with siren, voice and text. These are pre-defined, non-customizable messages. Recipient groups are high-level geographic aggregates i.e. counties; it can't alert a small region like a campus.

The Fast Accurate Strategic Transmission, or FAST radio for short, is conceived to quickly alert the public and/or private population of a location-relevant emergency, enabling the delivery of accurate text and voice information selectively, to the people who need to act or take precautions. FAST radio technology creates the novel ability to focus on a target audience as large as a state or small as a city block, or even an individual radio. Radios can be programmed to specific demographics for civil emergency warnings. FAST technology can provide local, county and state emergency service agencies or private industry with the ability to send custom warnings or instructions instantaneously to any sized area. Unlike alerts from NOAA or EAS, this technology does not require notification of a major portion of a county, interruption of commercial radio or TV broadcasts, or standardized message menus.

FAST radio requires the end-users to buy the specific receiver (very cheap at $30-50 per unit) registered to the agency that operates it. It requires the university authority to purchase the transmitter and maintain the system. It requires only one investment and can be battery operated. However, at the time of this report we have not obtained any price information on FAST radio.

Most weather radio receivers are built-in FM receivers. So, by providing two receivers per building, it will establish the capability of receiving notification information via on-campus FM radio broadcast or via NWR.

Ideal case: It is a good candidate for university authority to alert each building or each department office. It only requires each department to install one receiver unit at its office. The alert can be activated even if the radio is not on. It will be ideal if it can automatically activate a fire-alarm voice system to inform all remaining residences in the building to take proper action. Alternatively, department officers may activate it manually. If manual-only, then the system will not be effective when the office is empty either during lunch hours or after-office hours.

Special wireless mobile systems: Satellite mobile systems or dedicated wireless systems are ideal to use as backup systems. However, the price is beyond current budget limitations. For example, a pair of satellite mobile transceivers costs around $4,000, plus the monthly service fee or $69 per transceiver.

Surveillance systems: The surveillance system has been one of most effective tools to reduce crime rate on campus. It is not only a useful tool for conventional crime, but also an important tool to identify suspicious activities of terrorists. With surveillance systems, the police can check for suspicious activities before making an action decision on an emergency. A range of surveillance systems can be found in [34] [35] [36] [37].

Ideal case: Top range surveillance systems require a substantial investment. But, given the existing internet infrastructure and cheap PC video camera, it may be feasible to install several PC cameras per building and link to a centralized computer server with very little cost. In the case of emergency, the record of activities can be relayed to the police department to assist in making better decisions. This capability must be further explored.

Other systems: There are many communication devices available that may be able to receive emergency notifications such as fax machines, pagers, PDAs and cell phones. However, as with Weather Alert Radio, their level of penetration throughout the population is too low to ensure effective message delivery. Selecting distinct population segments based on geography with such devices is also highly problematic: no proven technology exists today to do so.

With regard to wireless communications, a few companies are experimenting with "pushing" emergency notification messages to a targeted area's cellular/wireless phones/devices served by a single or combination of area cellular towers. NENA encourages the work in this area and looks forward to its widespread implementation and incorporation into standard ETNS level of services.

Email and internet are common infrastructure which can be use for broadcasting emergency messages. In fact, almost all campuses are using these tools to communicate with students and faculty. However, their efficiency and time prompt needs to be evaluated in campus environments.

Summary of findings

Systems	Scenario			Others	Costs
	1	2	3		
Siren	yes	No	yes	Its meaning is hard to understand. Voice message is needed. Voice covers much smaller area than tones.	$50K per siren, plus installation
Fire alarm	yes	Yes	yes	Good for indoor; need to modify existing fire alarm system; many buildings do not have intercom.	TBD
Campus FM	yes	No	yes	Most people do not carry FM; Most cars have FM. Many buildings block out FM and mobile phone signals.	Free; cheap FM receiver
r911	maybe	Yes	maybe	Powerful r911 system is needed to be effective for Scenario 1. It relies on mobile phone, desktop phone, email, etc. Need to buy equipment and maintain software and database. Many counties use this system.	Expensive, depending on capability

Host based notification	maybe	maybe	maybe	Exactly r 911 functions without buying software and hardware. Using all possible ways to reach as many registered people as possible and get confirmation. It can be used in non-emergency application.	Expensive, unless users will pay for themselves. 50,000 users: $7-$10 per user per year 5,000 users: $13-$15 per user per year
Special wireless system	no	Yes	yes	Install one transmitter to serve 100 nodes located in 100 buildings.	TBD
Weather radio	Yes	No	Yes		$50-$60 per receiver, the transmitter TBD.
WLAN	no	No	no	Cannot guarantee 99% coverage without a significant investment.	

IV.3. Description of study activities accomplished for each campus

During the last 3 months, we did an extensive web search on emergency alert procedure and systems in three campuses. We did several site interviews including Florida and California. We attended the conference of 7th Annual Technologies for Critical Incident Preparedness from October 31 to November 02, 2005 at San Diego. We also set up two survey forms and sent out more than 500 survey forms to each campus. Although the response rate was low, we were still able to paint a picture on existing activities at each campus.

At UCF, we further interviewed the following persons: UCF police representative, UCF FM manager, UCF TV studio manager, UCF emergency planning manager, UCF wireless LAN engineer, and UCF indoor safety engineer. At UCF, we established an emergency alert demonstration management team to supervise the demonstration activities. The team is comprised of Dr. Wei, Dr. Pearson, UCF police, UCF emergency management and public safety officer, UCF telecommunication and computer service, UCF news, UCF physical plant, and UCF traffic and parking officer. We drafted the demonstration procedure and evaluation forms. We have been coordinating with vendors, UCF authority, Florida Homeland Security Institute, and Florida High Education Incident Preparedness committee for demonstration equipment purchasing and demonstration activities. Furthermore, we are working on recruiting and training demonstration observers and on finalizing the demonstration procedure and evaluation form. The demonstration procedure has now been approved by UCF authority.

At UWF, we interviewed: FM radio station engineer, TV station manager, Siren purchasing manager, and UWF wireless LAN engineer. We contacted several public safety management team members, but there has been no response from them. Nearly 500 survey forms have been mailed to the campus.

At the MDC, we interviewed the public safety management team leader and discussed with public safety officers on both North and Kendall campuses. We conducted an onsite survey and evaluation. We called MDC police several times and got no response so far, largely due to communication difficulties after hurricane Wilma. Near 500 survey forms have been mailed to two campuses.

V. Study Findings

In this section we first list the existing common communication infrastructure on the three campuses. The observations and data are largely from survey, onsite evaluation, and interview.

We then evaluate the possible improvement over existing infrastructures for emergency notification. Lastly, we evaluate the needs of new infrastructures and estimate cost.

V.1. Existing common communication infrastructure on three campuses and Highlight of survey and interview results for three campuses

UCF: Currently UCF can handle an evacuation notice via the following methods: (1) bulk email, (2) posting the note on the webpage, (3) making calls one after another to specific departments or buildings, (4) driving to the building and making a voice announcement via fire alarm intercom system, or (5) FM station [38]. Currently, the UCF TV station does not have capability to deliver live mass notification information. To secure this capability, it requires $20,000 to establish link via optic fiber to the studio located at Coca Beach. Currently, UCF has limited WLAN coverage and has not established any capability for mass notification. Recently, UCF has introduced a small tornado siren covering classrooms in several trailers and a horn for tennis court and outdoor swimming pool.

There is no method to warn all campus communities within 5 minutes, no method to deliver specific information to part of communities in 5 minutes, except making a list of calls one after another, and no method to deliver a basic emergency message during a power outage or downed telephone service except for FM broadcasting.

In the following tables, we list the common facilities at UCF. The percentage data comes from survey. The other information mainly comes from interviews.

Facilities	Operation under normal condition	Power outage	Downed phone
Plain telephone	Yes	Yes	No
Mobile phone	Yes	No, downed mobile TX	No downed mobile TX
Email	Yes	---	---
TVs in hallways	Yes in 50% buildings	No	Yes
On campus TV channel	TV station is located in coca beach. Currently no capability of broadcast live emergency message from campus, $20k needs to install optic link between campus and TV studio to gain this capability. DTV-62-4, Cable 19, Tel: 33280, Fax 32109 http://pegasus.cc.ucf.edu/~ucfchann/home.html	Yes, power backup	Yes
On campus FM Radio	Emergency plan is in place. If needed, they can broadcast emergency announcement at any time. 89.9, WUCF-FM, http://www.wucf.ucf.edu/aboutwucf.htm	Yes, power backup	Unless phone, mobile, fax, email, all downed.
Fire alarm	Yes in all buildings	Yes	No
Fire alarm/intercom	Yes in 50% percentage buildings	Yes	No
WWW	Yes	---	Yes
WLAN	Yes, but only part of campus. No emergency plan and will not be able to broadcast emergency message at current stage. http://www.noc.ucf.edu/Wireless/default.htm	No	No
Outdoor siren	Not for entire campus, just for trailer classrooms	No	No
Weather radio	Some in trailers, for emergency transportation	Yes	Yes
Others			

Summary of major findings in UCF survey sets 1 and 2: A total of 500 survey sets were sent out, with 61 returned. A total of 50 survey set II have been mailed out; 12 of them returned.

(a) Fire alarm and Intercom (A3, set II): Around 30 % of buildings do not have an intercom system in the fire alarm systems.

(b) Mobile phones (A2, set I and II): 95% of students, faculty, and staff members have mobile phones with them all day long. 50% of students and 20% of staff members believed that the mobile phone is the best way to notify them.

(c) Conventional Phone: 50% of the students and faculty members surveyed may ignore a ringing phone. 80% of staff members will answer phones immediately.

(d) PDA: 5% of people in the survey indicated they have PDAs.

(e) FM radio/Weather radio (Q1, Q9, Set I, Q8, Set II): 60% of surveyees knew the Campus FM radio, but less than 1/3 of staff members and students knew the frequency. None of them knew weather radio. 95% of them do not carry FM receiver on campus. 1/3 of staff members have a radio receiver in their office, but at most of times, neither TV nor the radio is on.

(f) WLAN/Email: Most of students frequently check emails.

(g) Siren (Q1, Q6, and Q17): There is no outdoor siren system has been activated on this campus (Q1), but 40% of them believed that they heard siren outside the buildings on campus. 95% does not know the different meanings between

alterative steady siren and wail siren tones. Furthermore, about 75% of people who answered Q6 (Set I) believed that they cannot quickly find out the meaning of a siren on the campus safety website.

(h) Campus TV and TV on building hallways: 50% of buildings have TV on hallways.

(i) Safety website (Q3-Q5): About 50% of students and 60% of faculty and staff do not know safety website. About 95% of people who answered this question rarely visit this website (once every three months or less). Most of them believed that they can find this website very quickly if needed.

(j) Emergency phone number (Q6-Q8, Set I): 50% of people do not know the emergency phone number, but 75% of them believe they can find it on the website quickly.

(k) Emergency officer in department (Q9, Set I, Q5-Q6, Set II): 80% of them do not know emergency officer in their department. 80% of departments have emergency evacuation procedures and 80% of staff members knew the procedures.

(l) Best ways of notifications nominated by surveyees (A2): Mobile (about 50%), Email (about 40%), Office phones (20% students/faculty, 50% staff members), Fire Alarm (10%), TV(3%), Radio (3%), Person door knock (5%).

Comments: Question A2 in set I and II is an open question which asks the surveyees to tell the best ways that they can think about. Some of them put two methods. None of them mentioned siren since UCF does not have outdoor siren system, UCF has several sirens on trailers.

Best ways to notify the whole department from staff members (Q7, set II): Email and fire alarm.

(m)The way of knowing last emergency situations (Q13, set I): Police siren and Fire alarm (50%), TV (28%), Radio (15%), phones (5%), email (5%).

(n) Hurricane and Power outage effect (Q2): Hurricane and power outage will affect email and WWW the most (10%), mobile phone (7%) and telephone (4%).

(o) Others

i. 30% of students and 50% of staff and faculty members are willing to pay $7-$14 for host based emergency alert service.

ii. (Q19 Set I, Q17 Set II) 75% of students and 90% of staff members noted the blue safety stations around the campus.

iii. (Q20 Set I, Q18 Set II) 99% of them believed that there are no sensors for CRB agents on campus.

iv. (Q21 Set I; Q19 Set II) 75% of students and faculty and 40% of staff members believed that there is no way to communicate with the outside if power and telephone are down.

v. (Q22 Set I; Q20 Set II) 65% of students and faculty and 50% of staff members believed that we do not have capability of notifying the whole campus within 5 minutes.

(Q23 Set I; Q21 Set II) Best way to notify people to evacuate half of a building is Siren/fire alarm with voice message (50% of students, 75% of staff members), Email (26%), phone call (37%), FM (8%), door to door knock (25%), website (8%). Some people selected multiple answers.

UWF: UWF is located in a woody and hillside area of 1600 acres. There is a public FM station on campus, which does not belong to UWF. If an emergency happens, the FM station will be able to broadcast the emergency message. UWF has a public TV broadcast station on campus. The UWF TV station cannot include emergency notification message directly in TV program. Once an emergency event occurs, the county emergency management center will take over the campus TV channel and broadcast the emergency message. If an emergency event happens on campus, then the incident will be directed to the county emergency management center. UWF has an ATI outdoor siren system, mainly used for warning chemical spill from a nearby chemical facility. The coverage of outdoor siren system is limited, so in the next six months UWF will install another siren to cover woody areas. UWF has telephone systems internally as well as through Bell South to link outside. It can switch to internal operation mode if the service from Bell South is down. It can make communication internally, but not to the outside.

The UWF has clear, defined emergency procedures and organization published on their website : http://uwf.edu/envhs/emprocedure/Reporting.cfm. Currently UWF can notify its campus via (1) siren, (2) bulk email, (3) website, (4) making call one after anther, or (5) FM broadcast.

In the following tables, we list the common facilities at UWF. The percentage data comes from survey. The other information mainly comes from interviews.

Facilities	Operation under normal condition	Power outage	Downed phone
Plain telephone	Yes	Yes	No
Mobile phone	Yes	No, downed mobile TX	No downed mobile TX
Email	Yes	---	---
TVs in hallways	Yes in 15% buildings	No	Yes
On campus TV channel	A public TV station is located on campus. If needed, it can broadcast county emergency message. (850) 473-7451 http://wuwf.tv/contact.htm	Yes, power backup	Yes
On campus FM Radio	This FM station is on campus, but it is a public radio station and does not belong to UWF. If emergency happens, the FM station will be able to broadcast the emergency message. 88.1, WUWF, http://www.wuwf.org/pledge/fx2k.htm	Yes, power backup	Unless phone, mobile, fax, email, all downed.
Fire alarm	Yes in all buildings	Yes	No
Fire alarm/intercom	Yes in 10% percentage buildings	Yes	No
WWW	Yes	---	Yes
WLAN	Argoair wireless only covers part of campus. No emergency plan and will not be able to broadcast emergency message at current stage. (850)474-2075 http://uwf.edu/computerlabs/sail/g_start.cfm	No	No
Outdoor siren	Single ATI siren; coverage is about 2/3 campus	No	No
Weather radio	Yes, some places	Yes	Yes
Others			

Summary of major findings in UWF survey sets 1 and 2: A total of 500 survey set I have been sent out; 46 have been returned. A total of 50 survey set II have been mailed out; 8 of them have come back. Italic items are very different from those at UCF.

(a) ***Fire alarm and Intercom (A3, set II*)**: Around 85 % of buildings do not have intercom system in the fire alarm systems.

(b) ***Mobile phones (A2, set I and II)****:* 70% of students, faculty, and staff members have mobile phones with them all day long. 25% of students and 13% of staff members believed that the mobile phone is the best way to notify them.

(c) ***Conventional Phone***: 35% of the students and faculty members surveyed may ignore a ringing phone. 90% of staff members will answer phones immediately.

(d) **PDA**: 0% of people in the survey indicated they have PDAs.

(e) ***FM radio/Weather radio (Q1, Q9, Set I, Q8, Set II)****:* 80% of surveyees knew the Campus FM radio, more than 70% of staff members and students knew the frequency. 95% of them do not carry FM receiver on campus. 50% of staff members have a radio receiver in their office, but at most times, neither TV nor the radio is on.

(f) **WLAN/Email**: Most of students frequently check emails.

(g) **Siren (Q1, Q6, and Q17)**: ATI siren was recently installed on UWF campus. 75% students and 60% staff do not know the different meanings between alterative steady siren and wail siren tones.

(h) ***Campus TV and TV on building hallways***: 15% of buildings have TV on hallways.

(i) **Safety website (Q3-Q5):** About 40% of students and 50% of faculty and staff do not know the safety website. About 90% of people who answered this question rarely visit this website (once every three months or less). Most of them believed that they can find this website very quickly if needed.

(j) **Emergency phone number (Q6-Q8, Set I):** 60% of people do not know the emergency phone number, but 75% of them believe they can find it on the website quickly.

(k) **Emergency officer in department (Q9, Set I, Q5-Q6, Set II):**70% of them do not know emergency officer in their department. 80% of departments have emergency evacuation procedures and 80% of staff members knew the procedures.

(l) ***Best ways of notifications nominated by surveyees (A2)*:** Mobile (about 28% students, 12% staff), Email (about 25% students, 60% staff), Office phones (32% students/faculty, 50% staff members), Fire Alarm (7%), TV(0%), Radio (7%), Person door knock (7%).

Best ways to notify the whole department from staff members (Q7, set II): Email, fire alarm, and door knock.

(m) **The way of knowing last emergency situations (Q13, set I)**: Police siren and Fire alarm (40%), TV (24%), Radio (27%), phones (35%), email (3%).

(n) ***Hurricane and Power outage effect (Q2)***: Hurricane and power outage will affect email and WWW the most (50%), mobile phone (12%) and telephone (50%).

(o) **Others**

vi. *10% of students* and 62% of staff and faculty members are willing to pay $7-$14 for host based emergency alert service.

vii. (Q20 Set I, Q18 Set II) 95% of them believed that there are no sensors for CRB agents on campus.

viii. (Q21 Set I; Q19 Set II) 50% of students and faculty and 25% of staff members believed that there is no way to communicate with the outside if power and telephone are down.

ix. (Q22 Set I; Q20 Set II) 80% of students and faculty and 60% of staff members believed that they do not have capability of notifying the whole campus within 5 minutes.

(Q23 Set I; Q21 Set II) Best way to notify people to evacuate half of a building is Siren/fire alarm with voice message (35% of students, 40% of staff members), Email (40%), phone call (60%), FM (12%), door to door knock (40%), website (12%). Some people selected multiple answers.

MDC: Miami Dade College is the largest community college in the U.S. with a total of more than 150,000 students. It has eight campuses. Two of them have more than 50,000 students each. There is no campus FM radio. It has a cable TV station, but it CANNOT broadcast live programs. The campuses had to be closed for a few weeks after the recent hurricane Wilma. During the week, there was no telephone service, very limited mobile phone service, and largely no power. Many buildings do not have fire alarm intercom system. There are no student quarters on campuses.

The setting of the two main campuses is very unique. Near 20 buildings surround a foreyard area, and then they are surrounded by campus parking and sport venues. Few TV sets are in hallways, depending on the campus. A message board in a foreyard or a small siren could make a big difference.

In the following tables, we list the common facilities at UWF. The percentage data comes from survey. The other information mainly comes from interviews.

Facilities	Operation under normal condition	Power outage	Downed phone
Plain telephone	Yes	Yes	No
Mobile phone	Yes	No	No
Email	Yes	---	---
TVs in hallways	Yes in 30% buildings	No	Yes
On campus TV channel	Cable TV, but no live casting capability	--	---
On campus FM Radio	No	No	No
Fire alarm	Yes in all buildings	Yes	No
Fire alarm/intercom	Yes in 10% percentage buildings	Yes	No
WWW	Yes	---	Yes
WLAN	No wireless access for private laptop	No	No
Outdoor siren	No	No	No
Weather radio	No	Yes	Yes
Others	Message-board displayer, NO		

Summary of major findings in MDC survey sets 1: A total of 500 survey set I have been sent out, 26 have been returned. A total of 50 survey set II have been mailed out, 1 has come back. This may reflect the lower staff to student ratio in community college. Italic items are very different from those at UCF.

(a) ***Fire alarm and Intercom (A3, set II*)**: Around 85 % of buildings do not have intercom system in the fire alarm systems.

(b) ***Mobile phones (A2, set I and II)****:* 65% of students / faculty have mobile phones with them all day long. 46% of students believed that the mobile phone is the best way to notify them.

(c) ***Conventional Phone***: 26% of the students and faculty members surveyed may ignore a ringing phone.

(d) **PDA**: 4% of people in the survey indicated they have PDAs.

(e) ***FM radio/Weather radio (Q1, Q9, Set I, Q8, Set II)****:* There is no Campus FM radio. 100% of them do not carry an FM receiver on campus.

(f) **WLAN/Email**: Most of the students (70%) frequently check emails.

(g) **Siren (Q1, Q6, and Q17)**: There are no outdoor sirens on campuses. 50% students heard a siren sound. Probably it is police siren. 88% students do not know the different meanings between alterative steady siren and wail siren tones.

(h) ***Campus TV and TV on building hallways***: 15% of buildings have TV on hallways.

(i) **Safety website (Q3-Q5):** About 43% of students do not know the safety website. About 76% of people who answered this question rarely visit this website (once every three months or less). Most of them believed that they can find this website very quickly if needed.

(j) ***Emergency phone number (Q6-Q8, Set I)*****:** 16% of people do not know the emergency phone number, but 67% of them believe they can find it on the website quickly.

(k) ***Emergency officer in department (Q9, Set I, Q5-Q6, Set II):***43% of students do not know emergency officer in their department.

(l) ***Best ways of notifications nominated by surveyees (A2)*****:** Mobile (about 46% students), Email (about 12% students), Office phones (15% students/faculty), Fire Alarm (4%), TV(4%), Radio (4%), Person door knock (8%).

Best ways to notify the whole department from staff members (Q7, set II): not known

(m) **The way of knowing last emergency situations (Q13, set I)**: Police siren and Fire alarm (61%), TV (8%), Radio (8%), phones (16%), email (0%).

(n) ***Hurricane and Power outage effect (Q2)***: Hurricane and power outage will affect email and WWW the most (27%), mobile phone (12%) and telephone (27%).

(o) **Others**

x. *25% of students* are willing to pay $7-$14 for host based emergency alert service.

xi. (Q20 Set I, Q18 Set II) 82% of them believed that there are no sensors for CRB agents on campus.

xii. (Q21 Set I; Q19 Set II) 57% of students and faculty believed that there is no way to communicate with the outside if power and telephone are down.

xiii. (Q22 Set I; Q20 Set II) 46% of students and faculty believed that they do not have capability of notifying the whole campus within 5 minutes.

(Q23 Set I; Q21 Set II) Best way to notify people to evacuate half of a building is Siren/fire alarm with voice message (54% of students), Email (27%), phone call (24%), FM (8%), door-to-door knock (24%), website (4%). Some people selected multiple answers.

V.2. Examine their capability and limitation to meet criteria

From the previous discussions, we know the common infrastructures in a university are: Email, WWW, telephone, mobile phone, Fire alarm, and TV. Many campuses have WLAN, but they only cover part of the campus. Most universities have on-campus FM radio. About 50% or more of buildings do not have Fire alarm intercom. All campuses also have a newsletter and a webpage dedicated to campus safety. Now let us examine the capability and limitation of these common facilities.

TV is a good way to broadcast emergency information to the campus. First, most people get emergency information through TV and it carries voice, text and video information. However, for TV systems, it is very difficult to insert a message over the all TV stations from on-campus police or university authority, unless a TV crew is right at the spot. If just inserting into one station, then the emergency notice will be ineffective unless the TV set is tuned to the station.

Newsletter/Fax/Email could not guarantee prompt and immediate attention from the receiver.

Desktop telephone is very robust unless it is downed. A speedy dialer and a host-based management tool are needed to set up a standalone system to constantly update telephone numbers or other contact information. In an emergency, the police department or university authority can issue truck calls directly. The cost depends on dial speed and call volume. Also, the dial speed depends on the capacity of the local switch center. Service providers may claim to reach tens of thousands of users in minutes but if these users are crowded in a small area like a campus, then its capacity may be limited by many other factors. An emergency manager needs to ensure critical information has been communicated to department offices first before activating the massive alert systems. An overloaded phone system may hamper the alert effort.

In the university environment, a conventional telephone system may not be a good choice since most faculty and students are away from their phones or too busy to pick up the phone. However, telephone is good for department offices that can often pick up promptly during the office hours. See survey results in the previous section for details.

One important issue worth mentioning here is the VOIP evolution. Today conventional telephones are being replaced by VOIP phones that depend on good Internet connection and power supply. With the constant evolution in internet and VOIP, the equipment purchased today may only have a limited life-span. Many companies offer host-based service that requires a due for each subscribed user, without the need to buy or update any hardware and software. The downside is that the user relies on good internet connection to issue alert. Several companies allow the user to issue alert using multiple medias.

Mobile phones: Most students and faculty carry their mobile phone all the time. It is a convenient tool for disseminating alert information. However, it requires the user to register in the network, and requires the user to update their contact address and pay a service fee. Currently, it is beyond our budget limitation.

Internet website is a good tool to broadcast the message, however, during an emergency many websites experience a huge surge of traffic. Lengthy delay from an overloaded website will significantly reduce the effectiveness of a website.

Phone hotline is commonly used to disseminate the emergency information. However, the location and volume capacity of the hotline needs to be designed carefully.

FM radio broadcast: On campus FM radio station is a good tool to broadcast the emergency information. The key limitations are (1) the user must tune to the radio station to receive the message; (2) poor quality in many indoor environments; and (3) most of offices do not have an

FM receiver. These limitations can be overcome if we can combine modified weather alert radio with FM radio.

Some universities have special equipment such as FM broadcast, Blue light emergency phone systems, and emergency pull stations (which are throughout the UCF and MDC campuses).

V.3. Possible improvement over existing infrastructures and cost estimation

FM: Both UCF and UWF have on-campus FM broadcast. Thus, it can be used to broadcast emergency alert. However, since most offices do not have FM receivers, it is desirable to equip two key offices per building with FM receivers. Toda, NOAA weather radio receivers can also receive FM broadcast. Thus, the best way is to equip the key offices with NWR that has Fm capability. FM and NWR receivers do not rely on power and telephone, so they are good candidates for scenarios 1 and 3. However, because most of people on a campus do not carry a FM receiver all the time and also very often the receiver is turned off or turned to other stations, another alert method must be co-operated with FM. Siren or horn or message board can often alert people first, and then they can turn to other ways such as FM, phone hotline, or webpage to get specific emergency information. NWR with FM capability costs about $50-$100 per unit. The total cost would be equal to the number of buildings per campus times the number of units per building times the unit cost.

Telephone and mobile phone: Both desktop phone and mobile phone are good tools for alert. Phones themselves do not need to improve, but the cost of a speed dialer and maintenance of phone number database could be costly. If one uses a host-based alert service, then an annual subscription fee is beyond the current budget limitation. However, this is the most cost-effective way to send alert messages for scenario 2.

Email, Webpage, Phone hotline: They do not need any additional cost, but a careful design is essential to ensure the efficiency and effectiveness of the systems. These can further enhance the alert capability.

Fire alarm intercom: Fire alarm intercom is one of the best ways to alert people inside a building. However, according to our survey, it will be too costly to update the fire alarm and introduce this type of service. For example, it could cost $500,000 or more for UCF alone to add this service to 117 buildings.

TV: Several campuses have investigated how to insert alert messages into TV systems. It is relatively easy to insert messages for all digital TV stations or to just insert the message into one analog channel through its station studio. But, it is very costly to insert message into all analog TV channels. Currently, most TV stations on campus are still analog. Thus, it may not be a cost effective solution at this stage. It costs $20,000 to ensure UCF has capability to insert live message in its campus TV channel. Furthermore, it requires each campus to substantially increase the TV sets in the building hallways, and provide adequate power backup.

Wireless LAN: Each campus has limited coverage, and, as shown in survey, very limited usage of PDAs and notebooks on campus. It may not be effective way to alert the campus at this stage.

V.4. Needs for new infrastructures and cost estimates

In this subsection, we examine how to cover the three scenarios with limited funds and cost-effective new infrastructures. We then rule out a few costly ideas and infrastructures.

The first task is how to alert people indoors and outdoors. For people outdoors, there are four ways to alert them: siren or horn, mobile phone or PDA, wireless LAN, and FM radio or NWR radio. Wireless LAN has limited coverage in all three campuses we evaluated. Very few students, faculty, and staff carry PDA devices or FM receivers. Thus, the best ways to alert people outdoors on campus are either siren/horn, or mobile phone using a host-based alert service.

Host-based alert service: It could be very difficult to reach tens of thousands of people on a campus within minutes using a mobile phone service due to limited capacity in local switch centers. Campuses are open environments and many people may visit them without registration to the emergency alert service via mobile phone. These people will be very difficult to alert during a campus emergency. Furthermore, less than 50% of students are willing to pay and register to this service. Thus, the effectiveness of this alert method is questionable. However, sending alert messages via mobile phones can be a very important compliment to any other alert system. Thus, we will recommend that the Florida Public University and Colleges (FPUC) adopt one service provider and students/faculty/staff who are willing to pay can sign up for the service on a voluntary basis. The cost for this type of service per person per year is between $7 to $14, depending on many factors. With more than one million students and tens of thousands of faculty and staff in the FPUC system, even if only 30% students and 40% staff sign up for the service, we can still negotiate a good price with a vendor. Furthermore, the universities and colleges may provide non-emergency mass call services, such as last minute class change messages, etc. All three campuses need this service. In the demonstration, we evaluate its capability of calling thousands of phones in 3-5 buildings.

Siren and horn: Siren is the only effective way to alert people outdoors on a dense, populated campus. For a community college campus, a message board in the central foreyard may also be a good choice. Siren costs from $10,000 to $50,000. Some campuses may require multiple sirens. Siren systems also have many drawbacks: testing issues, confusion for nearby communities, interference in daily activities, lack of understanding of its meaning (see survey results), etc. Some concerns can be overcome. For example, current vendors are provided a silent test feature, so it can reduce the interference in daily activities and nearby communities. Another example is to use siren for one situation, i.e., seeking shelter immediately in the case of tornado or CBRNE attacks. In the two campuses of MDC, car parking and sport venues provide a sufficient buffer zone to cushion the interference to the nearby communities, so that a small siren or horn could be the best solution to alert people on campus. UCF still needs to determine the impact of a campus-wide siren. It needs a way to send out campus wide alert. UWF needs to further improve its siren system. MDC needs two small sirens to cover its two densely populated campuses, particularly Kandrall campus since it has many classrooms in trailers.

Server based service: Reverse 911 or 911 broadcast speed dialer is the only way to cover the second scenario. Ideally, each university and each college shall have one to service its multiple campuses. However, the cost is too high. For example, one dialer per college with capability of 100 calls per 3 minutes would cost 39 times $35,000, or $1,365,000 total; not including the annual fee. One centralized r911 system with capability of 2000 calls per 5 minutes, which covers all colleges and universities, will only require $400,000 to $450,000. This includes a software engineer who sets up a telephone database uniformly across all colleges and universities. UCF and UWF need this service. It is also a cost-effective way to cover the remaining six campuses and many study centers at MDC.

Weather radio and FM receiver: Combining with siren, FM radio can cover both scenarios one and three. They are independent of telephone and power supply and they are cheap. Both UCF and UWF can use existing on-campus FM stations. MDC needs to make an arrangement

with some local stations that cover the campuses to establish an emergency alert procedure using these FM stations. The only costs would be to introduce a number of NWR/FM receivers in main offices for each building. In the future, we may see that MP3 players with NWR/FM/TV capability become popular.

The following items are too costly for now. In the future, with the development of technology, they may be feasible.

Satellite Phone: Each campus needs to have a telephone backup system to maintain communication capability between buildings and the fire station. The survey showed that UWF has the highest priority. Its phone and email have been interrupted for weeks after hurricanes. Without this backup system, all buildings are at risk for fire after the phone service is down. In the past two years, unusual hurricane activities make this risk too high to be ignored (an average of 2 weeks times two hurricanes per year). At this stage, it is too expensive to implement the satellite backup system to cover all buildings ($4,000 per transceiver pair plus $65 per month per transceiver). If the budget can accommodate it, then we would like to equip each college and each university a pair of transceivers, one at the campus police station, and the other at a nearby fire station.

Dedicated wireless phone service: Dedicated wireless phone systems such as 800MHz police trunk systems may also be good candidates for phone backup systems. But, they are expensive, often costing a few hundred, to a few thousand, dollars per handset.

Digital FM/Alert broadcast: Digital FM broadcast with emergency alert capability may be the best cost-effective solution for campuses. We simply set up a transmitter on campus, and two receivers per building. We can broadcast an FM program during the normal time. During the emergency, the transmitter can send a message to all or one specific receiver, and the receiver can automatically switch to emergency mode. This is the combination of FM and NWR concept. This is not an amateur FM transmitter which is sold on the market and does not need license to operate if its transmission power is below FCC regulation (typically tens or hundreds of feet). Unfortunately, we did not find any product we needed on the market.

VI. Recommendations

VI.1. Key recommendation

A System design criteria and design constraints

The key design criterion is: do not solely rely on one service. In the other words, cover each scenario with at least two systems or services; one basic and one supplementary. Several systems compliment each other to provide a good service. For example, siren plus FM is the basic tool to cover the first and third scenarios. Host-based alert service is supplementary to siren alert. Webpage and phone hotline are supplementary to FM radio. Reverse 911 or 911 broadcast speed dialer is the basic tool to cover the second scenario. Host-based service is the supplementary tool. Even in the case of a power outage, siren malfunction, downed internet and phone service, we can still provide two NWR radio receivers to receive county-wide alert information per building.

The main design constraint is the cost. We are dealing with a budget less than $2 per student. We also need to consider its impacts on nearby communities and daily activities. Another design constraint is the need to use equipment available on current market.

B Overall recommendations

We recommend two levels of systems. Level 1 is the essential and basic system. It includes an outdoor siren system, campus FM radio transmitter, weather radio with FM receivers, and centralized reverse 911 or 911 broadcast mass call capability. Level 2 is optional, including voluntarily assigned SWN or 3N capability, SMS, email, website, emergency information hotlines, campus TV, and WLAN broadcast.

Recommendation 1 (essential): *Each university or college needs to consider a mass notification system comprised of at least one outdoor siren or horn or message board, campus FM or local FM radio program, and two weather radio receivers with FM capability in every building.*

Further explanations: The system in this recommendation can effectively cover the first and the third scenarios. It is essential to have a siren or horn for a dense, populated campus, and it is a cheap way to notify most people outdoors on campus.

Local switch offices, directing a massive number of calls to a campus, could easily be overloaded. We expect a large portion of students will either not register or fail to update their phone numbers in calling systems. We also expect each day that many people will visit or bypass the campus and will have no chance to be informed through pre-registered calling systems. A wireless system can rarely cover more than 90% area effectively. High quality wireless systems often cost much more to set up and to maintain.

Since more than 50% of people may not know the meaning of siren tones and siren voice signals and can only cover a very small area, the FM system can act as a message broadcaster to provide specific information about the alert. *It is essential to establish a good coordination between the siren operator and FM manager*. Under the normal condition, people can get an FM message from their car radio, handhold receivers, or on the web. However, very few people have FM receivers in their offices. Local FM will broadcast selected NOAA alert messages. By providing two weather radio receivers per building, we not only give the capability of listening to local FM radio, but also in the worst case (i.e., power outage, internet down, and local FM down) the occupants can still tune to NOAA alert program directly. The places where weather radio receivers are located must be selected to ensure that (i) it can clearly receive the signal; (ii) the officers must know the responsibility of notifying the remaining occupants in the building. The siren must minimize the impacts on local communities and on daily activities. *A clear guideline and procedure for operation officers is needed.*

Note: *During the demo, sirens had very poor voice coverage and a very limited coverage in tone as well. However, it is still the best solution on the market for outdoor alert. It may need multiple sirens to cover a campus. Also NWR/FM receivers in each building need to be located at offices that have a good reception of the signal.*

Recommendation 2 (essential): *A centralized mass call center (mass dialers from reverse 911 or 911 broadcast) could be established to send notification to a single building, or several buildings on one campus, or many buildings on multiple campuses in Florida Public Universities and Colleges system.*

Further explanations: We believe the best way to cover scenario two is to use mass dialers smartly. With a capability of 2000 calls per 5 minutes and two officers per building, we can notify a maximum of 1000 buildings simultaneously. This could cover most campuses on one side of Florida coastlines in the events of Tsunami warning or a wide-area CBR release along the

coastline. We can also distribute 2000 calls to one building or several buildings in one campus. *In order to operate this system effectively, it is essential to establish a database of telephone numbers (including mobile numbers) based on buildings and location.*

Note: *During the demo, two server-based systems dialed to near 100 preset phone numbers. The overall performance is acceptable, but the capability is severely limited by its trunk capacity (24 simultaneous calls). Large campus can use this to communicate within emergency management team efficiently.*

Recommendation 3 (optional): *We need to endorse a host-base emergency notification service and encourage students and faculty/staff members to sign up for the service on a voluntary basis.*

Further explanations: Although more than 60% students reject the proposal that requires them to pay $7-$14 to use this type of service, there are sufficient numbers of students, staff and faculty members who are willing to do so. Given the size of student and staff population, we expect around 1/3 of a million people will sign up for the service. The final price per person shall be lower than the $7 dollar figure. The service can significantly enhance our basic systems. It will require users to register for the service and to provide their contact numbers (plain phone, mobile phone, email, PDA, etc). The data will arrange according to buildings and location. In the emergency, the authority can send short messages to those registered in the affected buildings or locations. During the emergency, mobile phone service is often limited to the emergency purpose only. People may have difficult to make a private call using their mobile phone, but the messages from SWN or NNN have high priority and can get through without any problem. Furthermore, the majority of people are reluctant to release their mobile numbers to the university or college authority, but they have no problem giving it to emergency service providers. One important requirement is to eliminate the junk call or emails and ensure the privacy of the mobile users.

Note: *During the demo, three host-based systems were tested over three cases: dial, short message, and bundle calls. The overall performances of two companies are acceptable. But the capability is typically limited by campus trunk capacity (near 500 simultaneous calls on the UCF campus).*

Recommendation 4: *Each campus shall enhance other means of notification such as bulk email, phone hotline, website, campus TV, campus WLAN, etc. Education and promotion is essential to improve the effectiveness of all notification systems. These efforts will enhance our capability to perform mass notification in emergency events.*

Further explanations: Most of these notification methods are free. These are existing facilities on campus. To effectively notify people in a particular building, we need to construct a database of location-based email addresses. Some campuses may need to improve the coverage of FM, TV and WLAN, and introduce emergency procedures for these systems.

Note: *With no one system being a 100% solution for all campuses, each university and community college needs to do its own "hazard analysis" to determine what technologies it should pursue. And each should pursue more than one, so communications will be more reliable. It also might be worth saying that all colleges and universities should investigate the strength and reliability of their electric power transmission system and their phone switching and transmission system. It should not be assumed that phone and power will always fail in emergencies. Many campuses can maintain their utilities if they are hardened and have redundancy built in.*

Considerations for special-needs personnel.

(a) Siren: Some siren manufacturers provide small tone alert receivers which can be installed in offices for the hearing impaired. Once the main siren is activated, it also activates the tone alert receiver, which then activates a strobe to alert the hearing impaired.

(b) Device to alert the deaf or hearing impaired on telephone emergency calls is included in two r911 systems.

(c) Some NWR (NOAA weather radio) receivers are equipped with special output connectors that activate alerting devices for the hearing impaired, such as vibrators, bed shakers, pillow vibrators, strobe lights and other alerting systems.

C Recommendations for each campus (or class of campus)

UCF: All four recommendations apply to UCF. UCF may need to further evaluate the impacts of introducing campus-wide siren. If a siren is not adopted, then a special way to alert people outdoors is needed to replace the siren. We did not find any other cost effective way at this stage.

UWF: All four recommendations apply to UWF. UWF needs to further enhance its siren system to ensure proper coverage of the entire campus. UWF also needs to identify a way to communicate between the campus and the outside world, if the power is out and both phone and internet services are down. 800MHz phone or a pair of satellite phones may be the solution.

MDC: All four recommendations apply to MDC. Multiple small sirens are needed, one for each major campus. MDC needs to make arrangements with local FM stations that cover campuses to ensure MDC can use these stations to broadcast emergency messages.

VI.2. Demonstration

A Demonstration equipment

Three siren vendors were invited. Two of them (McCord, and Federal Signal System) performed a demonstration. After the demo, one system will be purchased. Two speed dialers (database system and reverse 911) will be purchased and installed, and tested during demonstration. Three host-based service providers were invited to demonstrate their capability. They are SWN, 3N, and Emergency Wireless Network. After demo, one vendor will be selected to serve our system. Five types of NWR/FM receivers will be tested out during demonstration. Many other vendors such as satellite phones or dedicated wireless services may also be invited for demonstration.

B Demonstration procedure and set-up

This section shows how we tested and compared the systems. Under the different environmental settings, the results may be different.

Sirens: Federal Signal (FS) siren was operated at 115 dB and 30 feet height. McCord (MC) siren was operated at 119 dB and 35 feet height. The location of the siren is marked with a big red X at Appendix E. This is at northeast corner of the campus. Moreover between the siren and the center of the campus there are two five story buildings and forest with tall trees. The full functional siren will be operated at 128 dB and 60 feet height. The location shall be at the center of the university. So, the demo setting can be viewed as the worst case. The measurement includes (a) on site comparison by observers, (b) engineering measurement.

Server and hosted based systems: Two server-based systems (speed dialers) were purchased and installed at the UCF teledata service, which provides data and phone links between outside and inside the UCF. These two systems are database system and reverse 911 system. Two systems are identical in trunk capacity. Both of them use a T1 line that can place 24 simultaneous calls at a time. The full function system shall have at least 10 T1 lines and can place 240 simultaneous calls at a time, so that one system can inform around 2000 places within the five minutes. The system can place a maximum of 240 X 2 (two 30 second calls in one minute) X 5 minutes=2400 calls. Two tasks were given. One was to call all observers spread around the campus and another was to call sign-on-list and UCF COOP team. Each task had near 80 phone numbers.

Three host-based systems were tested. They were SWN, 3N and EmergencyEmail. Three tasks were given to them. The first one was to call observers, sign-on-list, and UCF COOP team. The second one was to send SMS to observers and the third one was to call 1097 phones in 5 buildings on the UCF campus. The test criteria include (a) call through rate, (b) capability of accommodating the trunk limitation, (c) how quickly the calls can be initiated and cancelled, etc.

To ensure fairness for each vendor, the following standard procedure was used.

Multiple vendors will be evaluated based on their ability to dial a predetermined range of numbers within the scope of this demonstration. The scenario the demonstration will be modeled after is that of a bomb threat in a centralized group of buildings. Based on this scenario and the inherent constraints associated with the timeline of the demonstration the following parameters are being put in place.

(1) Each vendor must demonstrate the ability to stop all calls after 15 minutes.
(2) Each vendor must provide a report of the number of people reached by the dialing as well as number of busies encountered etc…
(3) Each vendor will set their software to NOT leave a recording if an answering machine is encountered.
(4) Each vendor will set their software to stop calling on a ring no answer after 18 seconds.
(5) Each vendor will configure their software so that there is 1 callback attempt if a busy signal is encountered on the first call.
(6) UCF will provide the needed recordings so that all of the messages should be the same length.

FM and Weather Radio: Three types of WNR/FM receivers have been tested in the demo: WR300 (13 units), FR300 (22 units) and WX268(5 units). This comparison is mainly focusing on how quickly the user can learn the system and how easily the user can turn to the selected alert message. Some of units may be designed for the well-trained specialist. They will not be suitable for use in ordinary school offices and operated by staff members who are very likely not trained for the operation.

C Summary of Demonstration results and performance measurement

Short summary

Sirens: Federal Signal and McCord Whelen sirens are very comparable. However, only the tone alert is capable to cover a large area. We can select either of them based on the factors listed in Appendix F.

Server based system: Reverse 911 system is better than the Database system. These systems will have a very limited capability, so it is well suited for communication between emergency teams and key persons in each school, college, or department.

Hosted systems: 3N is better than SWN and Emergency email systems. 3N and SWN are very close in performance. These are suitable for massive call volume (typically a few thousands of call per 5 minutes). Trunk limitation needs to be considered carefully before adopting this type of system.

Weather radio: WR300 is the choice.

Detail discussion:

Siren comparison:

Based on the results from student observers (in Appendix E), voice is much poorer than tone. The FS siren is slightly better than the MC one, even the MC one is more powerful and higher than the FS one. Voice performance is not acceptable. A UCF engineer measured the tone and voice levels and confirmed the output difference. It is expected that the MC siren could cover 67% more area due to the height and loudness difference, compared with the FS one. However, the results are very similar (see (in Appendix E)). There is a marked area where none of observers heard siren, either tone or voice. It is clearly indicated that this area needs to be covered by another siren at a different location. Consequently, two sirens are essential for the UCF campus, even for tone. We found that two 5 story buildings and tall trees are in the area separated the siren site and the striped area. Woody areas significantly altered the quality of voice.

We also include a detailed breakdown analysis for siren comparison in Appendix F. Many factors need to be considered before the purchase of a siren, including maintenance and updating costs.

Reverse 911 and 911 broadcast systems: From the reports of student observers (Appendix E), two systems have very similar results: 7 good, 10 bad, and 32 did not receive anything. The overall capacity is much worst than hosted systems. Based on the report from our engineer, Reverse 911 has an edge over the 911 broadcast system. Furthermore, the Reverse 911 system has a mass call feature which provides very similar functions as hosted systems.Mmore details of the comparison are in Appendix G.

Hosted systems: Reports from observers (in Appendix E) showed that SWN and 3N are similar: 28 good, 8 somewhat, 3 bad, and 10 nothing received. Emergency email is much worse than SWN and 3N: 19 good, 3 somewhat, 8 bad, and 19 nothing received. The engineer report in Appendix G shows 3N system is slightly better than the SWN system, particularly in terms of call-stop function. Call stop function is very important in the hosted system. If the system cannot terminate calls quickly, then during the emergency the message calls, it could flood the trunk over a uncontrollable period.

Based on the observer reports(Appendix E), we rate the weather radios as follow.
FM: WR300 and FR300 good, WX268 bad
Weather radio: WR300 is much better than WX268 and FR300.

VI.3. Budget estimates and justification

We use Federal Signal Corp siren for illustration purposes. The budget may change.

	Manufacturer	Description	Model number	Quantity	Unit cost	Cost
1	Federal Signal Corp	siren	Mode4016 siren and parts (see quote)	1	44,482	44,482
2	Reverse 911	dialer	R911 system (12 port) and Mass call feature	1	31950	31950
3	Database system corp	dialer	Pace Voice broadcast and software	1	33620	33620
4	Midland (Costco)	NWR/FM	Midland® WR-300	20	48.6 (inc. tax)	972
5	ENT (circuitcity)	NWR/FM	Grundig FR300 Emergency Radio with TV/Weather/AM/FM Bands	20	53.9 (inc. tax)	1078
6	**Jensen (target)**	NWR/FM	MR600	50	20.00 (inc. tax)	1000
7	Sony (target)	NWR/FM	ICF36	50	27 (inc. tax)	1350
8	First alert	NWR/FM	**WX268**	5	100	500

All units can be put into a pool for bids from any university or college.

Justification

(a) Buy one siren without installation: $35,000 to $44,000.
The purchase will be made after the demonstration. We will encourage companies for free demonstration. Without purchase possibility, the vendors will not come to perform the demonstration.

(b) Only two vendors with reasonable company history and reputation were identified to provide speed-dialers. It is very difficult to judge the quality, suitability, and performance of their products. Demonstration provides a very unique opportunity to evaluate each company and their claims. We propose in the demo to buy two reverse 911 or 911 broadcast systems: $31,950-$33,622 and do a thorough investigation before committing ourselves to one company. An evaluation form can be found in demoprocedure.doc document.

We have done an extensive search on the web for companies that produce speed dialers. Many vendors that provide equipment for telemarketers are shifting their focus to emergency notification systems. These vendors include (1) Auto dialer from Talking Technology International, Inc (http://www.tti.net/psychosoft/psychosoft.html); (2) Rapidreach system (http://www.enera.com/index.html); (3) Teleminder system (http://www.teleminder.com/company.html), etc. Many host based service providers also sell products. The reverse 911 system has been implemented to comply to the standard ("Minimum Standards for Emergency Telephone Notification Systems" NENA 56-003,

June 12, 2004, Original) and deported in many counties in Florida. Thus, it is an ideal candidate. However, we found that 911 broadcast provides very similar products. So, these two companies are selected. We believe these two companies are the only two with a reasonable history and reputation.

(c) Weather radio: Around $5,000. Five types of weather radio receivers have been identified. We will purchase a total of 145 units. These units will be given to student evaluators (one for each evaluator). During the demonstration day, they will use them in different locations and different times. We will evaluate the performance, user-interface, and suitability for each unit. Collectively, we will have a good understanding on strength and weakness of each type of unit.

VII. Conclusions and Future Study Directions

A UCF research program was funded to study Intra-Campus Emergency Communications within the Florida State Community Colleges and Universities (FSCCU). As part of the initial research project, we selected three campuses out of 39 Florida public universities and colleges to perform an initial study of the requirements for an all-hazards emergency communication system. to the study has defined several alternative efficient and cost effective ways to notify students and faculty in a variety of complicated and dynamic campus environments. Our results have shown that multiple systems are needed to meet the alerting objectives for any campus. Four basic recommendations have been identified. A demonstration was conducted to evaluate each system from different vendors. After the demo, we will issue this report and its recommendations and an RFP to all 39 Florida Public Universities and Colleges to improve their emergency notification capability. Our recommendations will also form a basis for a unified all-hazards alert system for all Florida school systems.

Future activities: There are several additional tasks that need to be accomplished, based on the results of the studies to date. These tasks include the following:

(1) Establish procedures and guidelines for using the systems.

It is important to know how to use these equipment units correctly. For example, when a siren is activated, precise alert messages must flow to the FM station, webpage, and phone hotline. Furthermore, the host-based massive alert message must be activated after informing key posts in each department using the reverse 911 or 911 broadcast speed dialer. The timing and sequence of activating each unit are critical to ensure an effective alert.

(2) Establish a guideline for purchasing and evaluating each unit

It is very complicated to understand each unit and there are too many options related to the purchasing of each unit. A lack of understanding regarding their functionalities can result in choosing a wrong system or a wrong configuration. For example, a cheap siren may sound like a good choice, but if it cannot effectively cover the designed area, then the campus may need several sirens, which could cost much more than another more expensive single model or option. UCF's experience in using these units will be used to develop guidelines to be used by other colleges and universities.

(3) To establish a unified phone database for server based and host-based alert service

At this stage, each college and university uses their own database software. If each campus pursues their own database for reverse 911 or 911 broadcast speed dialer and

host-based alert service, then we will create many types of databases, which will be very difficult to communicate each other. Our goal in this part is to create a uniform database format across Florida Public Community College and Universities, so that in the future the database can be easily managed and moved across campuses. If we do this correctly now, we will then save much time and a lot of effort in future. This is one reason why we shall pursue a centralized reverse 911 or 911 broadcast dialer across the entire system.

(4) To further study and evaluate other alert systems which may have major influence in the near future.

In this study, we have noted other alert methods which may have major market in the near future. For example, the cost of satellite phone could drop significantly in the next year or two, and may be a good candidate for a backup system. For another example, we may initiate a nation-wide initiative to establish a guideline for facility on campus (similar to Unified Facility Code for US army facility). Such an effort could save millions of dollars for thousands of campuses to upgrade their facilities against natural and man-made disasters.

In the long term, we would like to research all-hazard alert systems. As we see from this study, it would be valuable if we can do a quantitative quality analysis on all-hazard alert systems comprised of multiple systems. For example, can we show 90 percent of people (rather than 80 percent) on campus can be alerted by introducing a method? It is a very complicated task. The influencing factors include (but are not limited to) the quality of siren, coverage of wireless communications, FM, and trunk capacity of telephone, indoor and outdoor voice intelligibility, etc. Furthermore, as shown in our survey, the behavior of students, faculty and staff could significantly affect the results. For example, the alert capability is still zero if a person does not pick up an alert phone call, or ignores the email.

To better understand all-hazard alert systems, it is essential to study alert systems from a multidisciplinary perspective. The continuing research goals are:

(i) to establish a unified set of guidelines and standards for application of all-hazard alert systems on the campus environment;

(ii) to establish a platform and a road map to develop, evaluate, test, and study all-hazard alert systems, and

(iii) to train the users.

The research involves multi-disciplinary, multi-system and multi-services aspects. Many faculty members from several UCF Colleges – Engineering, Optics and Photonics, Health and Public Affairs (disease and public safety), Science (Communications, Psychology, Chemistry, Biology) – will participate in this research. In addition, experience from other Florida campuses will be continuously incorporated into the studies. The systems under consideration are comprised of acoustic systems such as siren and intercom, telecommunication systems, wireless systems (phone & internet), and broadcast systems. The UCF services involved include Police, Facilities Planning, Environmental Health & Safety, Physical Plant, Computer Services & Telecommunications. The issues addressed are those involved with the application of emergency systems, and the solutions will be directly applied to developing guidelines and insight applications on a variety of campus environments during a variety of crisis scenarios.

Multi-disciplinary research is now a main direction for many funding agencies. Our current work will help us to secure future funding and is essential to guiding the State Working Group

on how to increase the hazard alert capabilities on all 39 Florida university and community college campuses.

In the next three months we will also apply for an NSF MRI grant, potentially covering the testbed equipment needed to conduct this multi-disciplinary research. We aim to be the first university in Florida (probably in U.S.) to establish an all-hazard alert system testbed for a dynamic campus environment. This testbed will not only serve the 39 Florida public universities and colleges, but will also be a vehicle to obtain other sources of federal grants from DOC, DOD, DOJ, DHS, NSF, etc. We are also conducting research on unified alert system standards for campus and other open environments, and for establishing a roadmap and a testbed platform to evaluate all-hazard alert systems in many other community environments such as high schools, hospitals, shopping malls, and theme parks.

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44.

VIII. Appendices

Appendix A Campus information

In the following table, we list the enrollments, the main campus sizes, the number of buildings on the main campuses, and the type of campus environments. Head count is from http://www.fldcu.org/factbook/quickfacts.asp#population and other data are mainly from websites of each university. Head count for community colleges for year 2003-2004 is from http://www.firn.edu/doe/arm/cctcmis/pubs/factbook/fb2005/factbk05.pdf .

Name	Student enrollment(2004)	Main campus (acres)	No. of Buildings	Typical story	Other
UCF	42,837	1415	117	4	Metro, On-site
FAMU	13,070	415	131	4-6	Metro, Hill top
FAU	28,000	800	90	3-6	Metro, near ocean
FGCU	6,198	760	20-30	1-3	Metro, near ocean
FIU	35,061	342	50-60	2-8	Metro
FSU	38,694	463	120		Metro
NCF	691	142	??	2-3	Small town
UF	48,560	2000	900	5 more	Metro
USF	42,557	1700	120	3-5	Metro
UWF	9,611	1600	70?	1-2	Rural, woody, hillside
UNF	14,641	--	--	3	Metro
Community	colleges				
Brevard	26,635		24		Small town
Broward	54,526	150	41		Metro
Central Florida	20,378	60	40		Small town
Chipola	5,347	40 out of 105	34		Rural
Daytona Beach	29,979	??	About 40		Small town
Edison	18,104	140	21		Urban
FCC Jacksonville	59,341	??	??		Metro/urban
Florida Key	3,118	3-5	16		Small town
Gulf coast	21,549	40	21		Metro
Hillsborough	49,666	??	??		Metro
Indian River	38,219	232	32		Metro
Lake city	7,227	100	25		Rural/forest
Lake-sumter	7,464	114	13	1-2	Rural
Manatee	19,515	100	37		
Miami Dade	132,023	185	14		Metro
North Florida	3,097	98	24		
Okaloosa_Walton	14,127	??	22		Small town
Palm Beach	46,353	114	40		Metro
Pasco-Hernando	13,306	??	12		Rural
Pensacola	21,137	80	32		Metro
Polk	19,759	100-160	8		Rural
St. Johns River	9,163	??	6		Rural
St. Petersburg	53,775	74	18		Metro
Santa Fe	23,420	??	28		Small town
Seminole	27,753	200	17		Small town
South Florida	8,584	228			
Tallahassee	24,904	192	38		Metro
Valencia	57,821	180	18		Metro

Appendix B Survey Question Set I

To Administrative officer,

Dear Sir/Madam, Please find 10 copies of survey set I. Please ask students or faculty members or staff members in your department to fill in the survey form. Once you get more than 6 copies, please send it together with Survey set 2 to ?????. **Deadline is ----.**

To Surveyee,

Dear Sir/Madam, We will greatly appreciate your help if you can spend five minutes to fill out the following survey study and return it via the provided envelope. This is part of a study which will determine how to improve the campus emergency communication facility for Florida State Universities and Colleges. Any further information, please contact ???? via Email: ????.

Pick one answer that is most appropriate.

What do you carry most of time when you are on campus? Mobile phone_____; Notebook with wireless connection_____; PDA with wireless connection_____; Radio AM/FM receiver_____; Satellite radio phone_____;

What is the best way to inform you during the emergency? Why?_____
_____

Which brand of fire alarm system does your building have? (check the main entrance of the building on the first floor, you shall see a fire alarm management box or check pull station box, record the brand name such as Simplex, etc)_____

Are you willing to pay around $7 to $14 per year for the following service? Yes____; No____.

Your university may have a chance to introduce a host-based notification system. During the emergency, the university will send a notification to a service provider and the service provider will contact you via all possible ways which you registered (including mobile phone, regular phone, PDA, blackberry, notebook, fax, email, even your parents' phones). During the emergency most of mobile and regular phone services are allocated to emergency service only. Many regular phone users experienced block-out, but this service can quickly reach you and get your status back to university, so university can inform the party which you nominated (such as your parents) promptly. Universities are unlikely to be able to cover all bills. The only possible solution is to share between universities and students/faculty/staffs. Your answer to this question will determine the feasibility of this service.

Any potential problem?_____
_____

1) What does your campus have based on your knowledge? Conventional Phone___, VOIP phone____, Mobile phone____, Email___, WLAN____, WWW_____, Fire Alarm_____, Fire alarm with intercom____, TV in hallways _____, Campus FM radio____, Campus weather siren____, Weather alert radio___.

2) After Hurricanes or during power outage, which of following infrastructures on your campus was not function for days? Conventional Phone___, VOIP phone____, Mobile phone____, Email___, WLAN____, WWW_____, Fire Alarm_____, Fire alarm with intercom____, TV in hallways _____, Campus FM radio____, Campus weather siren____, Weather alert radio___. None of them worked_____.

3) Do you have the emergency or campus safety website on your campus website?
Yes ___ No ___, if no, then skip questions 4-6

4) Can you quickly find out the emergency or campus safety website on your campus website?
Yes ___ No ___

5) Do you visit the emergency or campus safety web address very often?

Yes, once per week___, once per month___, rarely (less than once per 3 months ___

6) When you hear a siren wail but you do not know its meaning, can you quickly find it out from the emergency or campus safety web-address? Yes ___ No ___

7) Do you know campus emergency phone number? Yes ___ No ___

8) Can you find the campus emergency phone number quickly (within 2 minutes)? Yes ___ No ___

9) Do you know the emergency officer in your department? Yes ___ No ___

10) Do you know your campus radio frequency? Yes ___ No ___

11) Do you carry a FM radio receiver when you are in school? Yes ___ No ___

12) Have you received any email notification of emergency on your campus over the last 12 months? Yes ___ No ___

13) During your last experience of emergency on the campus, how do you notice the emergency (including fire alarm)? Siren/fire alarm ___, TV ___, radio ___, desktop phone ___, mobile phone____, my friend told me ____.

14) What is your estimated probability that you will pick up a ringing phone and not ignore it? - even if you are in the middle of a meeting or classroom. 100%___ , 75% ___, 50% ___, 25%___, 0% ___.

15) How often do you check your email when you are in your office or study room? Always____, frequently___, occasionally ___, rarely ____, never ___.

16) Do you have a campus siren system on the campus outside the buildings? Yes ___ No ___

17) Have you ever heard of siren sound on the campus (not those from emergency fire / police vehicles)? Yes ___ No ____

18) Do you know the different meanings between alterative steady siren sound and alterative wail siren sound? Yes ___ No ____

19) Do you see any safety information stations around the campus (including emergency phones around the campus)? Yes ___ No ____

20) Do you notice any sensors deported on your campus to detect chemical, or biological or radioactive agents? Yes ___ No ____

21) In case of power outage and telephone out of service, does your department still have a method to communicate with outside? Yes___No___. if yes, what is it? _____.

22) Do you know of any capability in your campus to inform all students and staff members to evacuate within 5 minutes? Yes___No___. if yes, what is it? _____

23) If an emergent situation occurs that requires half of your building to evacuate and another half to stay indoors and shut the door and air-conditioner, what would be the best way to inform you? Siren/ fire alarm with voice announcement____, Email ___, phone call ___, emergency FM radio ___, door to door knock ____, emergency web-site____.

24) What is your suggestion on how to improve your campus emergency notification system?

---

25) With very limited resources, what is the first priority to fix any problem that you know of in the current campus emergency notification system?

Appendix C Survey Question Set II

To Administrative officer

Dear Sir/Madam, Please find 10 copies of survey set 1 and a copy of survey set 2. We will greatly appreciate your help if you can spend fifteen minutes to fill out the survey study question set 2. Once you have done it, please collect at least 6 survey set 1 papers, and return it via the provided envelope to ????. This is part of a study which will determine how to improve the campus emergency communication facility for Florida State Universities and Colleges. **Deadline is ????**.

Pick one answer that is most appropriate.

What do you carry most of time when you are on campus? Mobile phone_____; Notebook with wireless connection_____; PDA with wireless connection_____; Radio AM/FM receiver_____; Satellite radio phone_____;

What is the best way to inform your department during an emergency? Why? _____
_____

Which brand of fire alarm system does your building have? _____ (check the main entrance of the building on the first floor, you shall see a fire alarm management box or check pull station box, record the brand name such as Simplex, etc). **Have you heard a voice announcement in the fire alarm system**? Yes_____, No_____

Are you willing to pay around $7 to $14 per year for the following service? Yes____; No____.

Your university may have a chance to introduce a host-based notification system. During an emergency, the university will send a notification to a service provider and the service provider will contact you via all possible ways which you registered (including mobile phone, regular phone, PDA, blackberry, notebook, fax, email, even your parents' phones). During the emergency most mobile and regular phone services are allocated to emergency service only. Many regular phone users experienced block-out, but this service can quickly reach you and get your status back to university, so university can inform the party which you nominated (such as your parents) promptly. Universities are unlikely to be able to cover all bills. The only possible solution is to share between universities and students/faculty/staffs. Your answer to this question will determine the feasibility of this service.

Any potential problem?_____
_____

1) What does your campus have based on your knowledge? Conventional phone___, VOIP phone____, Mobile phone____, Email___, WLAN____, WWW_____, Fire Alarm_____, Fire alarm with intercom____, TV in hallways _____, Campus FM radio____, Campus weather siren____, Weather alert radio___.

2) After Hurricanes or during a power outage, which of following infrastructures on your campus was not functional for days? Conventional phone___, VOIP phone____, Mobile phone____, Email___, WLAN____, WWW_____, Fire Alarm_____, Fire alarm with intercom____, TV in hallways _____, Campus FM radio____, Campus siren____, Weather alert radio___; None of them worked_____.

3) Do you know the campus safety /emergency website on your campus website? Yes ___ No ___, these websites also containing emergency notification system information_____, _____, _____

4) What do you think needs to be improved the most on this website?_____

5) Do you know the emergency officer in your department? Yes ___ No ___

6) Does your department have emergency evacuation procedure? Yes ___ No ___

7) If you receive the emergency notification from a higher authority, how do you inform students and faculty members in the building using existing facilities?

Call each of them, one call at a time_____

Email all of them,_____

Run to classrooms and knock door to door_____

Activate fire alarm for evacuation order, _____,

Door to door knock for shelter order, _____

Others_____

8) Do you know your campus radio frequency? Yes ___ No ___

9) Is there a TV set or a FM radio receiver or both in your office? TV ___ Radio ___, None___

10) Is the TV or FM on all the time during office hours? TV only____, Radio only____, all____None____

11) Have you received any email notification of emergency on your campus over the last 12 months?

Yes ___ No ___,

12) What will be the best way to inform you if an emergent situation is developing on campus that will affect your department is a specified way?

Siren/fire alarm ___, TV ___, radio ___, desktop phone ___, mobile phone____, email_____.

13) What is your estimated probability that someone in your office will pick up a ringing phone within one minute? 100%___ , 75% ___, 50% ___, 25%___, 0% ___.

14) Do you have a campus siren system on the campus outside the buildings? Yes ___ No ___

15) Have you ever heard a siren sound on the campus (not those from emergency fire / police vehicles)? Yes ___ No ____

16) Do you know the different meanings between an alterative steady siren sound and an alterative wail siren sound? Yes ___ No ____, if not, where to find the information?_____

17) Do you see any safety information stations around the campus (such as emergency phone booths or web information station around the campus)? Yes ___ No ____. If yes, can any improvement be made on these stations_____

If not, do you think they will be helpful to you or your department in emergency? And how?_____

18) Do you notice any sensors deported on your campus to detect chemical, or biological or radioactive agents? Yes ___ No ____

19) In case of power outage and telephone out of service, does your department still have any method to communicate with outside? Yes___No___. if yes, what is it? _____If no, which system do you think is the most effective? Why?_____

20) Do you know of any capability on your campus to inform all students and staff members to evacuate within 5 minutes? Yes___No___. if yes, what is it?_____

If no, which system do you think is the most effective?_____ Why? _____

21) If an emergent situation occurs that requires half of your building to evacuate and another half to stay indoors and shut the door and air-conditioner, what would be the best way to inform you? Siren/ fire alarm with voice announcement____, Email ___, phone call ___, emergency FM radio ___, door to door knock ____, emergency web-site____.

22) What is your suggestion on how to improve your campus emergency notification system?

_____

23) With very limited resources, what is the first priority to fix any problem that you know of in the current campus emergency notification system?_____

_____

Appendix D Demo agenda and evaluation form

Agenda for demo day: Feb 6, 2006
Venue: Key Florida Ballroom C and D
Hotel Information: http://www.ist.ucf.edu/hotels.htm

Morning:

9:00 am: Welcome address by Dr. Batarseh, ECE chair, UCF
9:15 am: Introduce the background of the project
By Mr. Pete Olson, Director, Office of National Security Initiatives, FAMU
9:35 am: Major study results and demo overview
By Dr. Wei, PI, ECE. UCF.
10:15 break
10:30 McCord Siren presentation
10:45 Federal Signal Siren Presentation
11:00 Reverse 911 system introduction and capability
11:15 Database system introduction and capability
11:30 3N host-based notification
11:45 SWN host-based notification
12:00 Emergence wireless network host-based notification

Lunch 12:15- 1:45pm
Afternoon:

2:00-4:00 Live demo (siren, FM, R911 type, and host-based service)
Coordinated by Mr. James Uhlir, Jr. , UCF emergency planning manager,
and his UCF team.
4:00-5:00 Optional additional presentation.
Tyco Fire alarm for notification,
Codha wireless ??
Any vendor wish to present additional materials.
5:00-5:20 Close remark and question answers.Demo procedure:
(1) 2:00 pm-2:05 pm Check siren, r911, host-based, student observers, etc.
(2) 2:05 pm: Activate the first siren by Federal Signal System for voice announcement
Inform UCF FM broadcast to make demonstration announcement.
(3) 2:08 pm: Activate the first siren by Federal Signal System for 90 sec tone.
(4) 2:15 pm: Activate the second siren by McCord for voice announcement
(5) 2:18 pm: Activate the second siren by McCord for 90 sec tone.
(6) 2:20-2:30 pm: let student observers to reposition and r-911 preparation.
(7) 2:30-2:45 pm: activate the first r911 dialer (database system)
(a) Dial to pre-selected 100 numbers (some phones in 5 buildings and attendees' mobile numbers)
(b) Dial to 200 student observers
(8) 2:45-3:00 pm: activate the second speed dialer (reverse 911 system)
(a) Dial to pre-selected 100 numbers (some phones in 5 buildings and attendees' mobile numbers)
(b) Dial to 200 student observers
(9) 3:00-3:05 pm: A short break
(10) 3:05-3:20: the first Host based all hazard notification system (SWN) demo
(a) Dial to 300 numbers (some phones in 5 buildings and attendees' /student observers' mobile numbers)
(b) SMS to 300 student observers' mobile numbers
(c) Dial to 1165 pre-selected numbers in 5 buildings
(11) 3:20-3:35: Second Host based all hazard notification system (3N) demo, repeat (12)
(12) 3:35-3:50: Third Host based all hazard notification system (Emergence Wireless Network) demo, repeat (12)
(13) 3:50-4:00: Official demo complete and student observers submit their reports.
(14) 4:00-5:00: Optional (additional demo, to be decided).

Attention: Capability to alert the hearing impaired is needed in demo.

Demo Outline and Survey form for student observers:

(1) At 2:00, student observer must be at position specified at the back of this sheet.
(2) From 2:00-3:50, the student observer will perform the following tasks. The student observer shall activate his/her mobile phone at the ready-for-receive mode.
(3) Between 3:50-4:20, the student observer must submit this form to the location specified at the back of this sheet in order to get payment.

All student positions are randomly assigned by their team leader. Each team covers one part of campus. Students must be spread indoors and outdoors and must stay at the same place for two hours to ensure a fair comparison.

Time line	Record			Comments
	Action item	Quality (circle one)		
2:00	Confirm your position on campus			
2:05	Siren 1 (voice)	Good, somewhat, bad		
2:08	Siren 1 (tone)	Good, somewhat, bad		
	WUCF/FM	Good, somewhat, bad	89.9 MHz	
2:12	Siren 2 (voice)	Good, somewhat, bad		
2:15	Siren 2 (tone)	Good, somewhat, bad		
	Weather radio	Good, somewhat, bad	Seminole county	
	Weather radio	Good, somewhat, bad	Orange county	
2:30-45	R911 Call 1	Good, somewhat, bad		
2:45-3:00	R911 Call 2	Good, somewhat, bad		
3:00-3:05	Break			
3:05-3:20	Host Call 1	Good, somewhat, bad		
	Host SMS 1	Good, somewhat, bad		
	One more call	Good, somewhat, bad		
3:20-3:35	Host Call 2	Good, somewhat, bad		
	Host SMS 2	Good, somewhat, bad		
	One more call	Good, somewhat, bad		
3:35-3:50	Host Call 3	Good, somewhat, bad		
	Host SMS 3	Good, somewhat, bad		
	One more call	Good, somewhat, bad		
3:50-4:20	Submit this form and get paid			

Appendix E Observers data and siren quality distribution

Student observers:

Action item	good	somewhat	bad	not receive/hear
R911 Call 1	7	0	10	32
R911 Call 2	6	1	10	32
Siren 1 (voice)	12	9	11	17
Siren 1 (tone)	19	7	7	16
Siren 2 (voice)	12	2	12	23
Siren 2 (tone)	14	4	10	21
Host Call 1	28	8	3	10
Host SMS 1	23	0	5	21
One more call	7	1	9	32
Host Call 2	30	2	6	11
Host SMS 2	26	0	7	16
One more call	9	0	11	29
Host Call 3	19	3	8	19
Host SMS 3	19	2	6	22
One more call	18	2	9	20
Total: 49 observers return their form (38 /w radio and 11 /wo radio)				

Radio Type: WR300(13 observers)

Action item	good	somewhat	bad	not receive/hear
WUCF/FM (89.9MHz)	9	0	0	4
Weather radio (Seminole county)	8	1	0	4
Weather radio (Orange county)	8	1	0	4

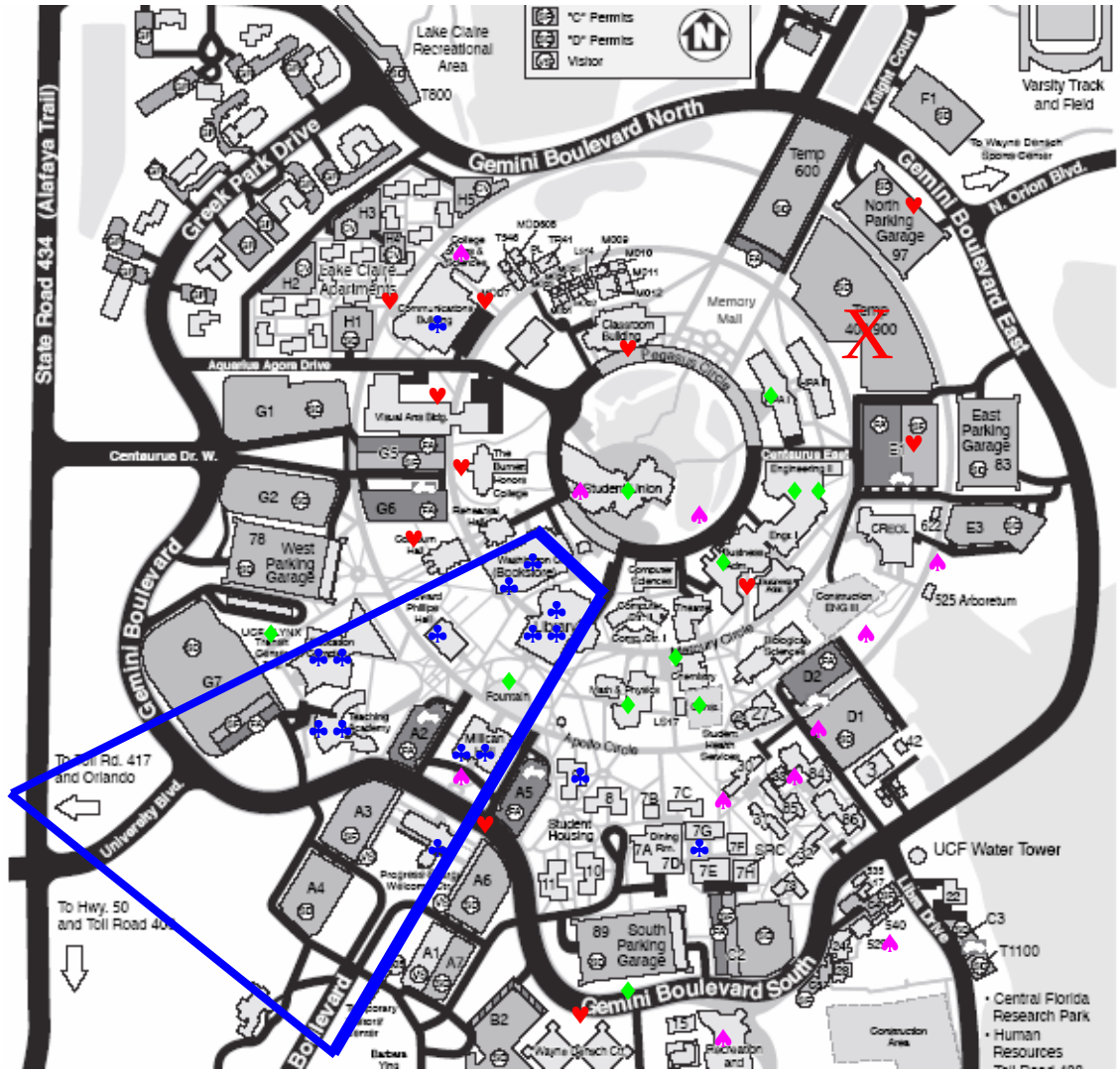
Radio Type: WX268(3 observers)

Action item	good	somewhat	bad	not receive/hear
WUCF/FM (89.9MHz)	1	0	1	1
Weather radio (Seminole county)	0	0	2	1
Weather radio (Orange county)	0	0	2	1

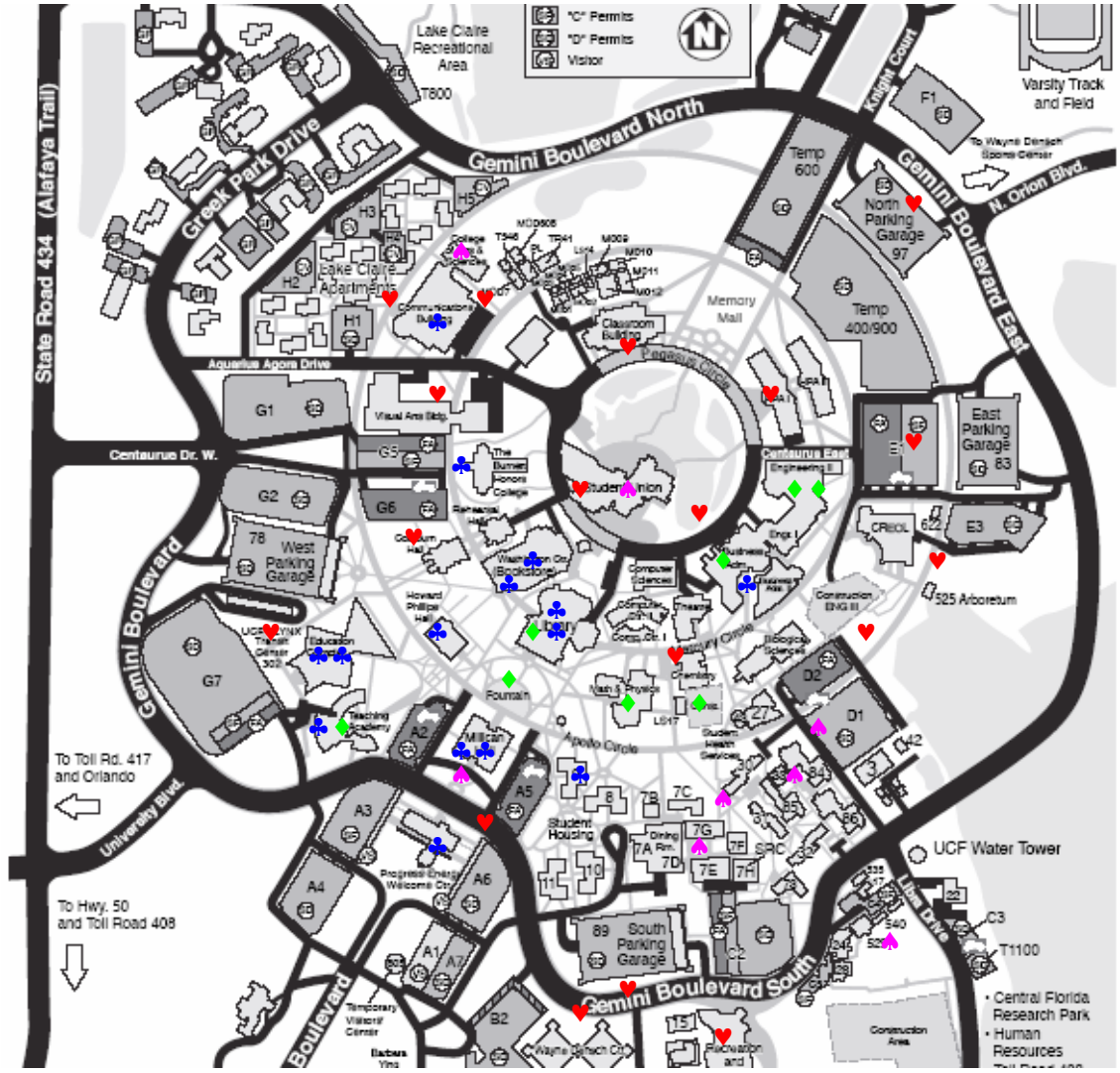
Radio Type: FR300(22 observers)

Action item	good	somewhat	bad	not receive/hear
WUCF/FM (89.9MHz)	16	0	5	1
Weather radio (Seminole county)	3	2	10	7
Weather radio (Orange county)	3	4	10	5
Total: 38 observers with radio (11 observers without radio)				

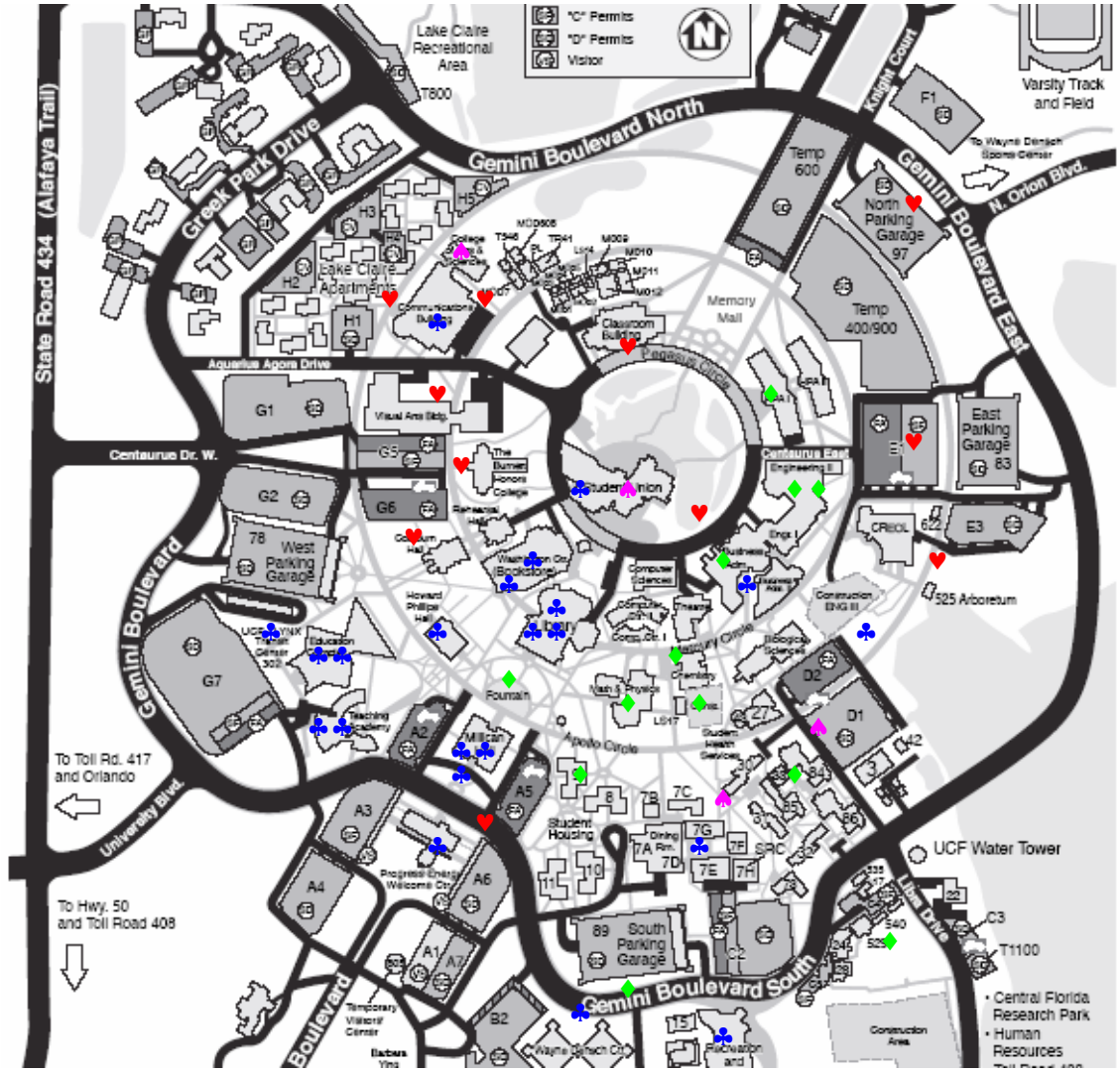
Siren coverage plots: Bad strips are high-lightened.



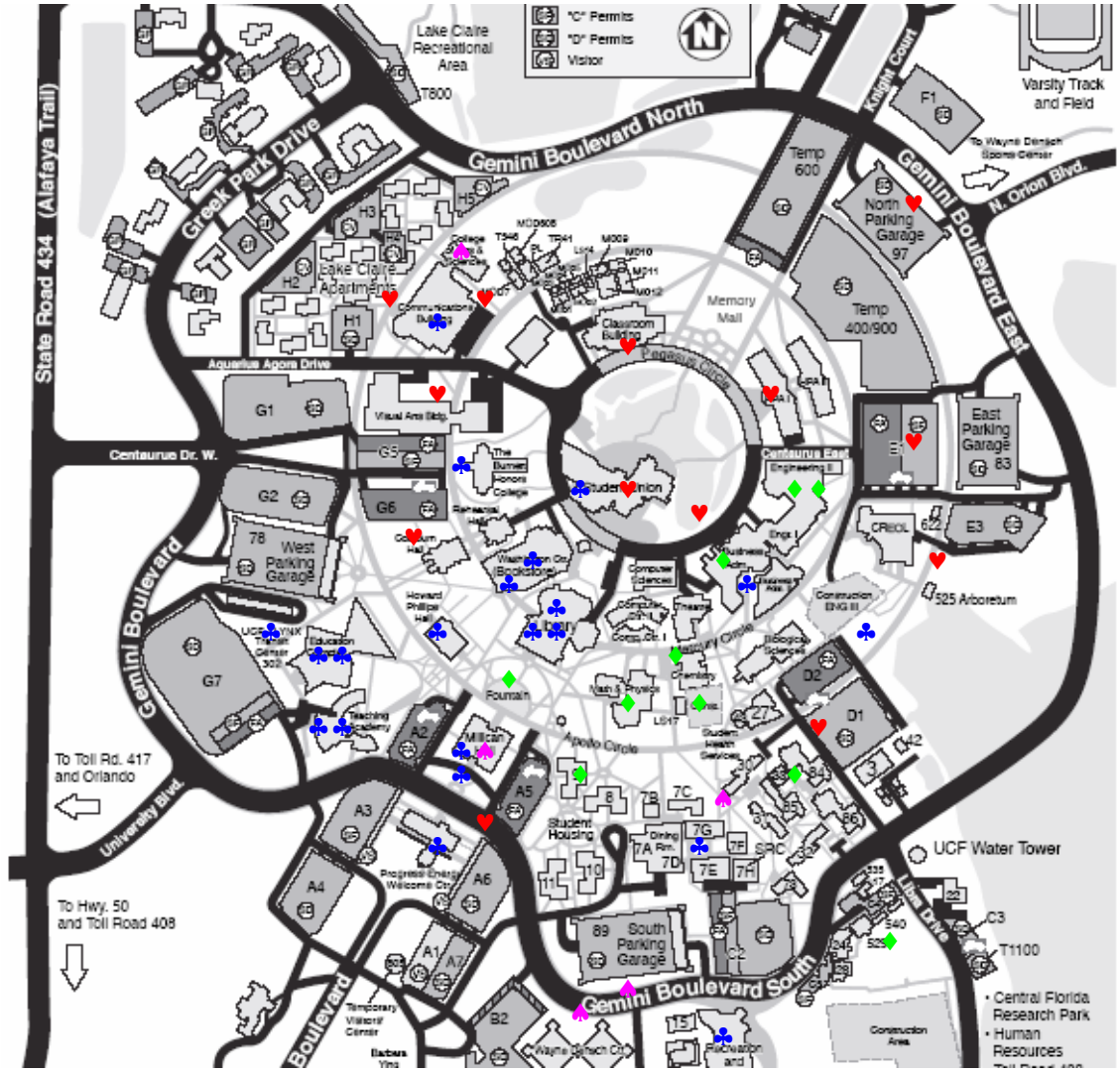
Siren 1 (voice): ♥(good) ♠(somewhat) ♦(bad) ♣(not hear)



Siren 1 (tone): ♥(good) ♠(somewhat) ♦(bad) ♣(not hear)



Siren 2 (voice): ♥(good) ♠(somewhat) ♦(bad) ♣(not hear)



Siren 2 (tone): ♥(good) ♠(somewhat) ♦(bad) ♣(not hear)

Appendix F Siren quality test results and cost analysis

Brief Test Results and Cost Analysis for Sirens

by Ms Kim Diep, UCF Environmental Health and Safety

	Unit 1	Unit 2
Items	**Federal (Frontier Comm.)**	**Whelen (McCord Comm.)**
Test results in dBA at Max. and equip. out put	105.6 dBA 1600 Watt	110 dBA 2000 Watt
Unit base	$30,045.00	$26,343.00
Activation equip.	$9,210.00	$3,581.00
PC equip.	$3,000.00	Client PC
Software and license fee	$1,800.00 life time	In the activation cost
Installation	One unit: $7,390.00 Two units: $9,540.00	One unit: $8,490.00 Two units: $11,990.00
Shipping	$1027.00 per 2 sirens	$750.00 per 1 siren
Training	$1,500.00 (ns)	$1,000.00 (4 hours)
Opt. activation	$10,010.00	$1600 + $25,631.00
Opt. equip. (solar power)	Don't have	$1,730.00
Warranty	2 years parts, no onsite labor. After warranty, $150 per 100W driver (may have 25% discount) On-site warranty for 2 years-$1,300.00.	2 years parts, no onsite labor. Labor $90/hr plus mileages. Parts have 5 years. Last 3 of 5 years, $75 per module change. After $200/unit.
Batteries	4 Rechargeable, 36-60 months life. With power out, 30 min. continuous operation	4 Rechargeable, 39 months life. With power out, 30 min. continuous operation
Compatibility	At 800 MHz range, it won't work with the indoor fire scope light	Claimed to work with most system and frequencies
Maintenance fee	Not included. Non-warranty on-site repair, $150.00/hr, 4 hours min.	Not included. Hour cost depends on contractor, and may have mileages charge if from AL.
System life	10 years min. on controllers, 15-20 on speakers array.	

Comments:

Both units would meet our research purposes. Both sirens have the tone and voice functions that can be modified per our needs. At the test site, both sirens gave out different tones. Therefore, the test results show participants prefer one tone over the others. As for voice, both sirens provide audible level at 1500 feet. Most indoor participants could not hear tone or voice very well. At some selected locations, participants actually reported to have bad experiences with the test.

If the appearance is not matter, either siren can serve as an outdoor warning system, provided that the location for installation is carefully selected. Will one siren be sufficient for the whole campus? We can only find out by conducting further studies.

Whelen claims to work with most radio frequencies we/UCF have, but may cost more in installation/repair charge since their tech. people come from AL (three days min. including traveling time). Federal has the advantage of being local, but 800 MHz won't work with indoor scope light. Both vendors do not include maintenance cost in their quotations. Unless this can be work out with them, we should assume the annual maintenance is at least $2000.00. Service charges for repair per hours are standard; it is technician's call about the labor cost (which depends on the honesty of the tech.). To avoid any unexpected cost in future, at the time of purchase, make sure to go through with the vendor the details before sign the contract.

Appendix G Test and analysis of server based and host based systems

By Scott Merritt, MBA, PMP, CCVP, Senior Systems Analyst, UCF TeleData Services 407-823-6795, smerritt@mail.ucf.edu

Introduction

UCF TeleData Services has been investigating the feasibility of dialer systems to be used to contact large numbers of students and faculty in a short amount of time since October of 2005. This has been at the request of contacts at contacts at Brevard Community College as well as UCF Department such as Orientation and Undergraduate admissions that have a need to contact large numbers of people and relay pertinent information. In the meantime UCF CS&T had also been investigating using this type of application for notifying people of issues such as power outages and the like.

Dr. Wei contacted UCF TeleData Services to partner with him on a study funded by the US Department of Homeland Security. Dr. Wei defined the scope of UCF TeleData Services in this project to be primarily focused on the technical aspects of the mass telecommunications devices to be considered In particular UCF TeleData Services was tasked with:

- Developing the standards for testing for the mass notification vendors
- Providing feedback on the performance of the vendors involved in the demo
- Installing 2 vendor provided servers on-site for testing
- Providing recommendations for using VOIP to lower the TCO for a state-wide system

This report is provided to Dr. Wei to be used to assist in writing the recommendations for the allocation of funds to implement an effective emergency dialer system for the State University System. It is expected that an additional $1.3 million dollars will become available to fund the selected systems in the next year.

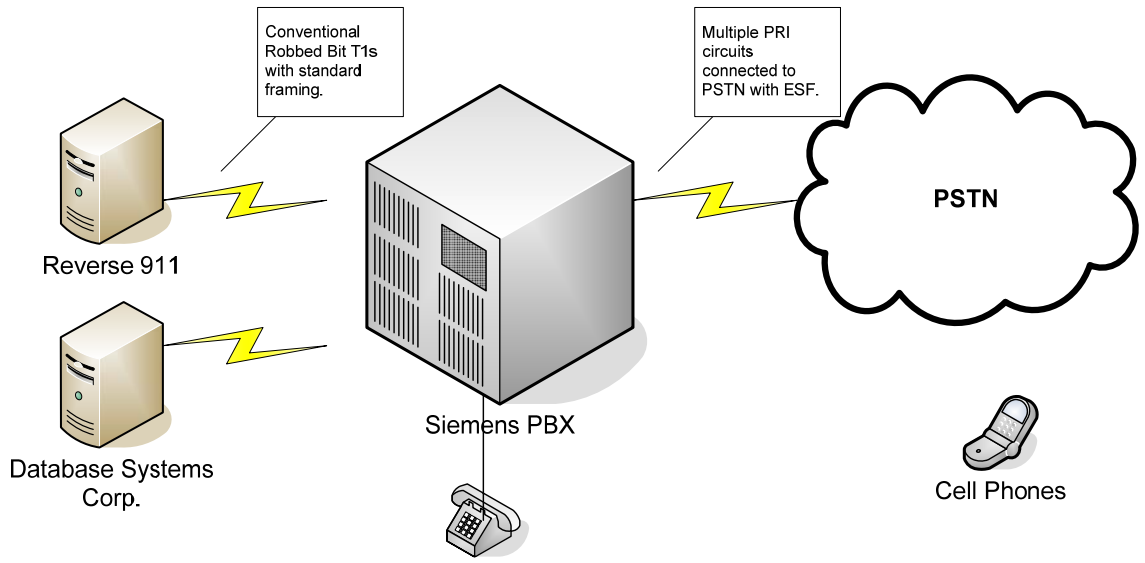
A demo was held on February 6th 2006 to show the proof of concept for the mass notification systems. The following vendors demonstrated there systems or provided information for review.

3N On-Line	Data Systems Corporation
Reverse 911	DCC USA
Emergency E-Mail Systems	Send Word Now

Evaluation of Server Based Systems

Reverse 911 and Database Systems Corporation were two server based solutions provided for the purposes of this trial. The Reverse 911 Server was purchased by and for UCF and will stay with UCF once the trial is complete. The Database Systems Corporation Server was provided by FAMU for this demonstration. Both systems were setup in the Switch room and connected to the Siemens PBX via conventional T1 lines. Neither provided system would work with a PRI.

The topography of the trial setup is shown below.



The advantages of a server based system revolve around cost and control.

A server based system can save money for repetitive mass notifications in certain applications. This is based on the pricing model the hosted providers offer. If there is a need for notifying people on a regular basis of routine matters then the subscription based minute usage costing model the hosted providers offer can get very costly. However, an on-site system is capable of notifying about 2,000 people with a 30 second message in approximately an hour with only 1 T1 connected to the server. This service could be run every day for no additional costs versus the costly minutes of usage model to provide this service via hosted providers. To provide a higher throughput it would be necessary to purchase more T1 connectivity to the associated PBX which is a one-time charge.

A server based system offers levels of control which may allow for easier access to sensitive information. Providing sensitive data about students such as their contact information to a third party provider could become an administrative intensive activity. Privacy concerns are greatly reduced when you own your own system and can maintain it in an environment which allows you to take care of the data security in-house. Additionally, other systems such as the enterprise ERP system can much more easily be tapped into with an in-house server based system.

Reverse 911 http://www.reverse911.com/

The Reverse 911 vendor fully engaged UCF in preparing for the demo. They had an engineer come on site to work with the UCF voice engineer on configuring and installing the Reverse 911 server. This server seemed well designed for the applications UCF is looking into performing on a routine basis. These applications include items such as mass calling to distribute information on topics such as orientation time / location changes, overdue fines, acceptance notifications and other mass notification needs. In addition, the server offers the capacity to perform other functions as well.

- Geozone notifications allow notifications to be sent to the entire range of phone numbers associated with a particular zone. For instance, a strange package is detected in the

hallway of the administration building with the push of a button a message could be sent to everyone in the building to please get out of the building as quickly as possible.

- The mobilization feature allows calls to be sent to a list of people until the required numbers of people have responded. For example, the EOC could have a predefined list of people required to respond to a building fire after-hours. Once the required number of people had been notified and responded by pressing a "1" when they heard the message the calls would stop going out.

The overall impression of the Reverse 911 server was very favorable. Some caveats that were noted during installation were that it would not come up when connected to a PRI off the Siemens PBX. Additionally, the server was not capable at the time of installation of dialing 5 digit extensions across the PRI to the PBX. Creating calling lists and launching them was not an intuitive process however it was simple enough once training had occurred.

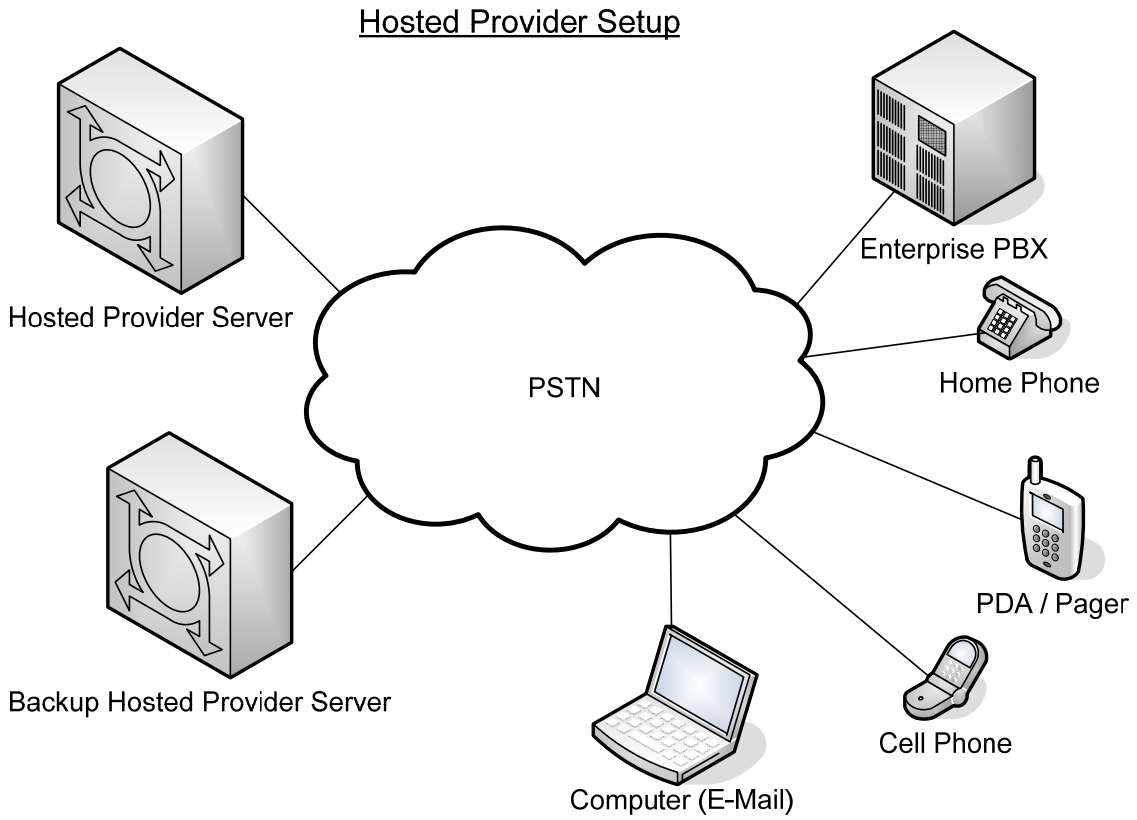
Database Systems Corporation http://www.databasesystemscorp.com/

This vendor had easy to use software as well. The vendor shipped the server with the software already installed and it connected to the PBX with a conventional T1 fairly easily. The UCF voice engineer was able to get the server installed and begin making test calls over the T1 within about an hour.

The vendor was not as engaged in this demonstration as the Reverse 911 vendor was. The product offering from this company seems to be aimed more at call center solutions than emergency broadcast solutions. This is an acceptable server that works but seemed more limited in emergency broadcast functionality than did the Reverse 911 server.

Hosted System Analysis

The rest of the vendors involved in the demonstration presented hosted systems. A hosted system is an ASP type product which allows an enterprise to enter their data via a web interface to the hosted provider. The hosted provider then uses that data to facilitate mass notifications at the customer's request. The hosted provider will typically have two primary sites to store data at and to send out notifications from. This lessens the likelihood of an emergency taking down both of the sites at one time. It also allows for more throughput to the PSTN as they are sending calls from multiple sites. The providers are typically able to provide notifications via E-Mail, pager, and SMS in addition to sending out voice calls to the list.



The hosted provider model as demonstrated by the vendors on February 6th does provide multiple advantages and disadvantages.

- Network congestion and lack of available bandwidth is one thing the hosted model attempts to overcome. The hosted providers are able to send out a tremendous number of calls in a short amount of time. However, it is important to determine the other customers of the hosted provider prior to committing to them. For example, if Seminole Public Schools, UCF, and the City of Oviedo all use the same provider and a tornado touches down and all three enterprises attempt to launch a mass notification using the same provider will that provider have the bandwidth to handle such a request?

- A hosted provider has to ensure they are engineered correctly to send out calls in a fashion which does not take out the end users equipment. For the purposes of the demonstration several of the vendors demonstrated a lack of understanding of enterprise PBX systems and basic trunking concepts. For example, the Phonemail system was completely overwhelmed so messages were unable to be delivered.

- A hosted provider provides a lower cost solution in terms of maintenance and upkeep. No server is needed at each site. All of the equipment is maintained by the vendor.

- The hosted provider costing model can be expensive and easily go over budget if multiple emergencies are experienced. The hosted model does not appear to be as cost effective as

the server model if the system is to be used to send out routine notifications about issues such as overdue books or other routine announcements.

- The hosted model has a higher chance of succeeding in the notifications as the hosted systems have a larger amount of bandwidth at their disposal.

- The hosted systems will still be up and running in the event of a natural disaster. For example, a hurricane may take out the University Communication Systems but a hosted system with a server location in Minnesota would not be impacted and would still be able to place calls to the people who needed to be notified.

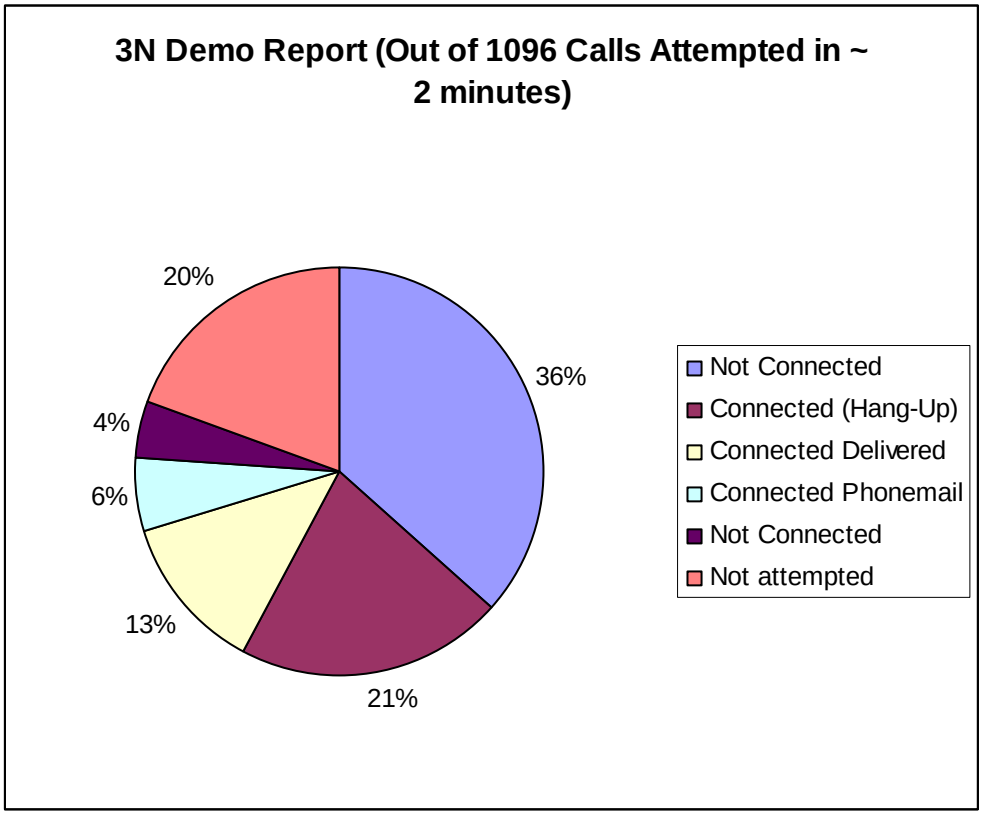
- A hosted system offers a couple of security issues. First, there is the issue of providing a third party with confidential student contact information. The second issue of concern is the fact that the lists sent to the vendors will outline the people contacted in the event of emergencies such as kidnappings, robberies, bomb threats, etc… Unauthorized access to these lists could impair the efficiency of emergency response teams.

The following comments about each vendor were gleaned over the course of the demo and during conversations and e-mails sent from the vendor during the course of setting up the demo. NO information is being relayed that the vendor indicated was proprietary or confidential. Several of the vendors are willing to discuss their technology more in depth in a setting without their competition around and in some cases an NDA is required.

The following details specifics about each vendor as all of the vendors demonstrated the same basic abilities.

3N

UCF TeleData services have been working with 3N for a few months now and have seen their product demonstrated multiple times. They are capable of sending out a large number of calls and have a very engaging sales team. The sales team seems very interested in working with UCF and the SUS. For the demonstration 3N busied out all of the trunks on the PBX for approximately 30 seconds. 3N sent a report after the demonstration. These are the results of 1,096 test calls in approximately 2 minutes according to the reports they provided and manually confirmed via CDR data in the PBX.



Send Word Now

The Send Word Now vendor has been used by CS&T at UCF for several months now for activities such as alerting IT Staff of power outages to critical servers. The send word now was able to make approximately 2,000 calls into the system. Send Word Now busied out all of the local PBX trunks for ~ 30 seconds as well. The vendor did not appear to have an easy way to stop the calls once they had started. All of the other vendors demonstrated the ability to stop the calls once started.

Emergency E-Mail

This vendor seemed more concentrated on providing web service and e-mail alerts rather than enterprise system mass notification. In addition, the interface for launching the calls from their system seemed more technical and less user friendly than the interface provided by the other vendors. There was no indication on the PBX of a busy out of all of the trunks during their demonstration of their system. The report they sent to UCF after the demonstration shows that they only had 330 successfully attempted calls while they had over 1416 failed attempts. They explained this as not being aware of the capabilities of an enterprise PBX.

Reverse 911

This vendor did not demonstrate a solution for the hosted solution but does have one and was very cooperative in demonstrating a solution for the server based solution. They also offer a hybrid solution which allows the user to get most out of their server based system and have the capabilities of the hosted system when the need arises.

Dialogic

A good majority of the vendors showing their product are companies which were formed in response to 9/11 and are relatively new companies. This vendor has been around since 1982 and offers all of the capabilities of the other vendors. Including the ability to integrate with Peoplesoft. One of the users of the Dialogic system form FSU was present at the demo and explained to some of the other spectators that Dialogic really did offer an excellent product that was easy to use.

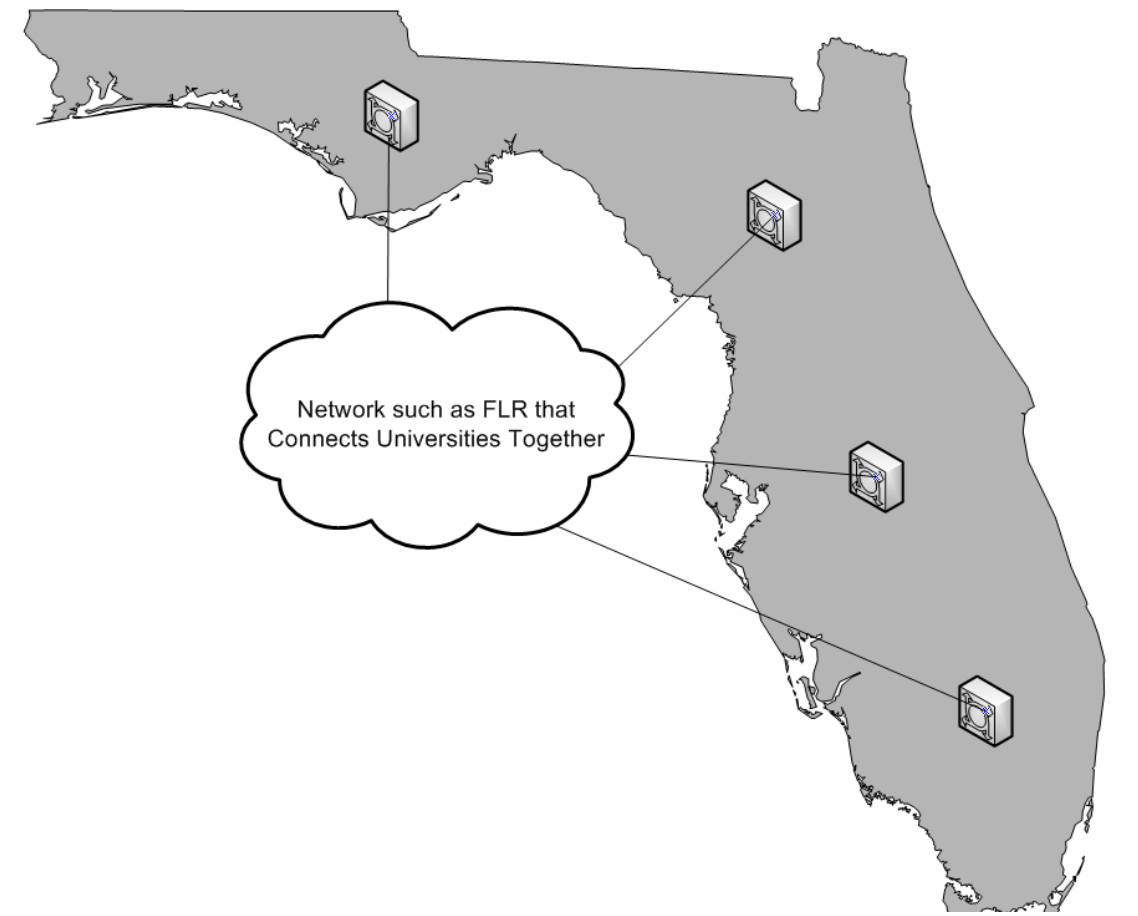
Many of the other vendors did want to discuss customer references. Dialogic was very proud of the references they have and more than willing to have the SUS contact them. Some of the companies in addition to the Department of Homeland Security in Florida already using their services are listed below.

Riviera Beach Fire and Rescue	Plantation Police Department	Comcast - Sarasota
Comcast - Miramar	Palm Beach Gardens Police Dept	Atlantic Broadband - North Bay Vlg
Comcast - Jacksonville	Walton County EOC	Homestead AFB
Florida DMAT 4	St Petersburg Police Department	Polk County Public Safety
Comcast - Naples	Palm Beach County Sheriff	Florida DOH
Comcast - Panama City	Seminole County Emergency Mgt	MacDill AFB
North Broward Hospital Dist.	University Community Hospital	Florida Regional DMAT
Clay County Public Safety	Brevard County EMA	Florida One DMAT INC
PEDI - Poison Control Center	City of Sunrise	Pasco County EMA
Alachua County Sheriffs Ofc	CF Industries	Sarasota County EMA
Atlantis Police Department	Palm Beach County EOC	AFRC 482FW Homestead ARB
AFRC 919 SOW Duke Field FL	Comcast - Tallahassee	NAS (CNRSE) - Jacksonville
Hollywood Police Department	ANG - 125 FW/CP - Jacksonville FL	Florida Power & Light
Lee County Sheriffs Office	Jacksonville Fire and Rescue	Hillsborough Cty Emergency Planning
Marion County Sheriff	Miami-Dade County 911	Maitland Fire Department

How can VOIP Help?

In this scenario VOIP only comes into play when discussing the hybrid and server based systems. VOIP is the ability to send voice calls over mediums using IP connectivity. These include the Internet, Internet 2, Corporate LANs, and any other network utilizing a recognized and supported protocol. Due to the criticality of emergency messages a certain level of service would be expected in these communications.

VOIP could help by utilizing a Statewide Network connecting the SUS and Community Colleges together to route overflow calls to the areas where it would be least expensive to put the calls on the PSTN. An example of such a network would be the Florida Lambda Rail network. That network could be used to transport VOIP calls in between communication servers placed at various Universities.



Each of these communication servers could route calls to the gateway which provides the lease expensive calling path to the target. Priorities could easily be assigned so in some cases according to how quickly the message needed to get out so that all of the Gateways could be used to make calls as needed. Gateway / Gatekeeper technology already exists to route e.164 numbers via area code and office preface and ensure quality of service.
Currently, in order for a University to have a server and send calls out to 24 phones at one time the University would need to have at least one T1 there for servicing those outbound calls to the PSTN. As the needed number of calls goes up so does the requirement to have more dedicated T1 circuits. T1 circuits are pricey and having a bunch of them sitting around that you only use during emergencies is not very cost effective. However, if 11 Universities in the SUS allocated one T1 worth of bandwidth to be available for emergency calls then that brings the total number of channels available to make simultaneous calls up to 264. As community colleges and other networks possibly become involved that brings the number up even higher. Cost would be kept low at each of the sites for routine announcement and survey type calls but in emergency situations the bandwidth available statewide could be used to get the message out extremely quickly.

This technology would also allow for the SUS to only have to maintain a small number of servers to cover the entire state while providing a redundant high availability service at low cost and with no third parties controlling sensitive data.