Americans should have access to a secure, uniform, interoperable health care record system. They suggest that the adoption of a uniform health information system can improve the patient experience, increase positive health outcomes, and realize significant savings. The Administration has made some progress, but there are key challenges that must be overcome in implementing such an overall system. For example, while large healthcare systems have made considerable progress in implementing such medical record systems, individual physician practices and small-to-midsized independent hospitals have been slower to make the expenditures necessary to deploy such systems.

C. PROMISING TELEMEDICINE TECHNOLOGIES REMAIN UNAVAILABLE FOR MOST EMERGENCY RESPONSE PURPOSES.

Telemedicine can help bring technology closer to the point of care, and the expert closer to the patient. In an emergency, health care workers need the ability to extend care to wherever the patient may be located, and to expand their own capacity for emergency response. Telemedicine technologies can break down the walls that often limit health care, bring experts into a hospital setting, or connecting doctors in the hospital to the patient. This virtual emergency room is critical in urban, suburban, and rural areas alike.

Telemedicine and telehealth technologies not only can extend modern health care to rural areas in which care may not be available, but it can also provide an efficient and potentially cost-effective care alternative to people suffering from debilitating conditions all across the country. But in an emergency, these technologies can be especially important because the patient may not be in the emergency room. For example, telemedicine technologies became essential for caring for Katrina evacuees. Sometime you cannot bring the patient to the expert, but you can bring the expert to the patient.

These technologies are uniquely suited for providing essential links between national resources and local responders; for bringing experts to the patient; and for enabling needed mobility and surge capacity. Yet telemedicine technologies are underutilized, unprepared, and unavailable for emergency response.

Through federal, state and private investments, over 200 telemedicine networks exist throughout the country currently linking over 3,000 medical and public health institutions. These networks allow medical services to be provided between large hospitals and smaller clinics and other facilities such as prisons, community centers and individual homes. Such networks can provide critical regional and national resources in times of emergency. The FCC's new pilot program provides over $400 million in funding to link local networks on a regional or multi-state basis, creating a network-of-networks that may link 6,000 health care providers and provides access to this network to public health officials in instances of public health emergencies. It's a critical first step in helping achieve a vision of a digitally connected health care system.

However, telemedicine and telehealth systems remain largely outside of emergency communications and planning sectors, and, internally, they are unprepared for emergency response. Therefore, this rich opportunity remains unavailable for most emergency response purposes. In addition, the lack of national reimbursement for many types of telemedicine services inhibits the deployment of telemedicine.[30] The best way to ensure access to medical and public health expertise in times of emergency is to build and support communications systems that link such institutions and support their use for the day-to-day delivery of healthcare.

D. DISASTER COMMUNICATION PLANNING IS STILL NOT MEETING THE CHALLENGES.

Healthcare communications capabilities in an emergency are still uncoordinated, uninformed, and underfunded. Yet despite increased federal and state funding since 2001 and lessons learned following 9/11 and natural disasters like large-scale hurricanes and floods, disaster communication planning in the healthcare arena remains sporadic, disconnected and under-funded.

9/11 and Hurricanes Katrina and Rita demonstrated the need for redundant forms of communications, including IP networks, satellite networks, and portable wireless systems that are readily deployed when a disaster destroys the existing communications infrastructure. Efforts in the wake of the disasters have been focused on redundancy, secondary communications systems, power backup, and moving to more survivable IP based communication systems.

A communications failure on 9/11

On 9/11, America witnessed it first modern communications failure. Among the thousands of casualties on 9/11 was our communications infrastructure. According to the National Academies[31], on 9/11:

- 95% of cell phone calls at 11 a.m. failed to get through
- the central office for the phone system cut off 300,000 landline phones
- television stations were knocked off the air
- police and fire department radios failed

By contrast, only 2% of Internet addresses remained off-line for an extended period. The Internet's inherent network efficiencies were on display on September 11th prompting the National

[30] Reimbursement for consultations via interactive videoconferencing or through the use of store-and-forward electronic communications continues to be an important issue at the national, state, and local levels. State reimbursement policies for Medicaid vary across the country. Local systems third party payers have individual practices for payment that vary from region to region and state to state. See: http://www.atmeda.org/news/Reiumburement%20White%20paperfinal.pdf

[31] "The Internet Under Crisis Conditions: Learning from the Impact of September 11", National Research Council, available at http://books.nap.edu/openbook.php?isbn=0309087023 and http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=10569

Academies of Science to find afterwards that the Internet held up better than other communications technologies on that fateful day.[32] 9/11 demonstrated IP networks overall resilience in an emergency through its flexibility, redundant packet routing, and adaptability. But six years after 9/11, America has done too little to build on these lessons and to advance the use of IP networks in EMS, public health and other medical care facilities in order to avoid future communications failures.

Communications failures during Katrina:[33]

Katrina created another catastrophic communications failure and highlighted once again how fragile and woefully outdated the emergency communications system in this country has become. In the wake of Katrina:

- Nearly 3 million telephone lines were knocked down
- Wireline switching centers failed
- Thirty-eight 9-1-1 call centers went offline
- More than 1,000 cell sites went out of service
- Over 20 million phone calls did not go through the day after the hurricane hit
- An estimated 100 broadcast stations were knocked off the air

As a result, hundreds of thousands of people were stranded without news and emergency information, the ability to contact emergency responders, or communicate with their loved ones. More importantly, emergency responders and hospitals had difficulty communicating, coordinating with one another, and doing their jobs.[34] IP based voice communications once again played a critical role in the aftermath of Hurricane Katrina. As many communications systems failed, IP based voice communication networks kept hospitals communicating,[35] enabled the Louisiana Department of Health and Hospitals to flexibly set up voice lines,[36] and even allowed the

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[32] "The Internet Under Crisis Conditions: Learning from the Impact of September 11", National Research Council, available at http://books.nap.edu/openbook.php?isbn=0309087023 and http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=10569

[33] FCC Chairman Martin statement to Katrina panel: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-264196A1.pdf

[34] The lack of reliable communications following Hurricane Katrina hindered both the operation and evacuation of Charity Hospital in New Orleans for several days. (Government Technology, January 26, 2006 News Report, http://www.govtech.com/gt/98123).

[35] Baton Rouge General Hospital, which still had a broadband connection after the hurricane but no long distance services, was able to set up a VoIP service to communicate with the outside world. The hospital ultimately used nine voice-over IP converters and wireless-enabled laptops with VoIP software installed for long distance communications and to set up a public branch exchange for communications within the hospital and sharing patient data. (Government Technology, Aug 31, 2005, *By Corey McKenna*, http://www.govtech.net/magazine/channel_story.php/96493)

[36] The Louisiana Department of Health and Hospitals (DHH) was the first organization to deploy a pre-configured VoIP kit to gain phone service and Internet access in the wake of Katrina. 3Com Corporation donated the VoIP equipment to emergency and government organizations to support their communications needs in the aftermath of Hurricane Katrina.

New Orleans Mayor to communicate with the President when every other form of communication failed.[37]

As FCC Chairman Kevin Martin later told the Katrina panel[38], *"I would also like to see a greater use of IP technologies that are capable of changing and rerouting telecommunications traffic. In the event of a systems failure within the traditional network, such IP technologies would enable service to be restored more quickly and would provide the flexibility to initiate service at new locations chosen by consumers."*

Each kit included a VoIP phone system with voice mail and auto attendant, which enabled DHH to provide all callers with recorded information on recovery efforts and to the ability to route calls to the appropriate emergency personnel. The phone system was networked so that calls could be transferred between multiple locations. (Source: 3Com Release 9/1/05)

[37] After the failure of basic landline phone service, and mobile and satellite phones (which eventually lost battery power and could not be recharged) left city officials without an ability to communicate with the outside world for 2 days after the storm, New Orleans city leaders downloaded softphones and relied virtually entirely on VoIP services for five days in the wake of the storm. The Mayor's staff got eight VoIP lines up and running from the mayor's emergency headquarters. When President Bush called Mayor Nagin on August 31 from Air Force One, they spoke on an IP based VoIP voice line. (Source: Wall Street Journal, 9/9/05, Communications Business Daily)

[38] http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-264196A1.pdf

E. IMPORTANT EMERGING THREAT IDENTIFICATION NETWORKS ARE NOT INTEGRATED INTO THE HEALTH COMMUNICATIONS SYSTEM.

Linking health information networks is key to reducing the time it takes to detect and respond to disease outbreaks, whether they are naturally occurring or the result of a bioterrorist attack. Yet today's public health system cannot protect people from existing or emerging mass health threats such as disease outbreaks (like a pandemic flu), food contamination, or a bioterrorist attack, without access to timely and comprehensive information.

Current emergency communications networks are almost always designed and deployed to respond to immediate threats. However, the parallel public health communications systems, such as the Health Alert Network, National Electronic Disease Surveillance System (NEDSS) and the USDA Food Emergency Response Network are geared to the identification, communication and response to emerging threats such as infections, food contamination and biological hazards. These emerging threat networks have not received the attention or funding of the immediate emergency response systems and lack the communications capabilities to become reliable, strong components of the nation's defense against threats to the American population.

- ***Linking Systems***. Linking data and systems can help create a better barometer to improve diagnosis and identification of outbreaks and potential bioterrorism incidents. 9-1-1 data may provide the diagnostic clues that may indicate an unusual infectious disease outbreak so that public health authorities can be alerted. Likewise when EMS data can be integrated and aggregated, it can create a powerful early detection system.

  Linking the Centers for Disease Control and state/local health departments with EMS may be critical to the identification and rapid response to a widespread viral outbreak such as an influenza pandemic or bioterrorism event such as release of anthrax. One recent study found that twelve states lack an electronic disease surveillance system that can collect and integrate data from multiple sources, is compatible with CDC's national system, and is accessible electronically via the Internet.[39] Maintaining separate stove-piped systems for public health and emergency response that cannot share information presents a dangerous situation that at best could lead to harmful delays, and at worst could unnecessarily expose the public to avoidable threats.

- ***Improving timeliness of data.*** The events of 9/11 and subsequent anthrax attacks highlighted the need to improve the timeliness and predictive abilities of public health

[39] 38 state plus DC have a disease surveillance system which states track health that is compatible with CDC's national system, including integrating data threats in a manner compatible with the standards of CDC's National from multiple sources, using electronic lab reporting, and using an Electronic Disease Surveillance System (NEDSS). http://healthyamericans.org/reports/bioterror07/BioTerrorReport2007.pdf

surveillance to better detect possible outbreaks. However, the timeliness for most current public health surveillance systems is not satisfactory for effective disease control, and must be improved. In spite of the high value of diagnosis for syndromic surveillance, most hospitals cannot send diagnosis data soon enough for timely, population-based syndromic surveillance. Rather than waiting for a diagnosis, the use of the patient's "chief complaint," when appropriately categorized, can speed early detection.[40]

- ***Using real-time emergency data.*** Monitoring 9-1-1 data can allow earlier detection of outbreaks, and can be an integral component of a broader real-time syndromic surveillance system.[41] People who may be become ill may call 9-1-1 for assistance. As a result, an increase in health-related calls to 9-1-1 may provide a sign that an epidemic is emerging -- prompting public health officials to conduct an investigation. In addition, many 9-1-1 agencies use CAD systems to help manage the call, quickly gather information, triage calls into predefined categories, and store information in accessible databases. Not only is the data collected in real time, but it frequently includes the precise patient location, allowing data to be mapped on an ongoing basis. As soon as the 9-1-1 call has been completed, syndromic surveillance systems could analyze this information -- looking for atypical patterns by comparing incoming data to historical patterns. When a trigger alerts, automatic notification can be sent to designated officials in public health, EMS and 9-1-1.

The potential for early detection of health hazards is significant when datasets are linked to other elements of the health care system as part of regular, daily operational procedures. However, linking these disparate systems requires more effective communications integration, privacy safeguards, and robust data security.

F. THE HEALTH CARE SECTOR LAGS IN ITS IT TRANSITION.

IP-based communications technologies have as much potential to transform hospitals and healthcare delivery in the 21st century as ATMs and electronic banking did for financial services in the 20th century. IP communications have transformed almost every aspect of our lives and every sector of our economy. Anyone with an ATM card has near instant access to cash around the clock and around the globe; we communicate with billions of emails sent from millions of interoperable devices around the globe everyday; Fed Ex and UPS can locate and deliver millions of packages a day transiting around the globe.

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[40] However, surveillance is hampered by the variability of free text "chief complaint" data.

[41] See http://www.cdc.gov/EPO/dphsi/syndromic.htm

Americans now use IP networks for collaboration, communications, and a dizzying array of new capabilities. The glaring exception, however, is our EMS and health care systems.

According to an American Medical Association survey, while 96 percent of physicians use computers in their offices, and 84 percent have a computer network in place, these computers are often not interconnected with other resources in the health care system. Only 35 percent of physicians report a connection with a hospital or laboratory.[42] This apparent isolation of health care IT usage limits efficiency, communication and productivity.

As a result, health care costs continue to be far higher in the United States than in any other advanced nation, whether measured in total dollars spent, as a percentage of the economy, or on a per capita basis.[43] Health care IT investments could help slow the rising costs of health care. However, as compared to other countries, the United States invests the least per capita in Health Information Technology.[44] By contrast as of 2005, the United Kingdom's public investment per capita in Health Information Technology (HIT) was nearly 450 times that of the United States.[45]

Key systems include:

- **Electronic Health Record (EHR).** EHR systems provides a doctor with real-time access to patient information, complete longitudinal record of care, and can help provide capabilities if paper records get lost or are otherwise inaccessible in a disaster.
- **Clinical Decision Support (CDS).** Clinical decision support systems can provide doctors with state-of-the-art medical knowledge at the point of care as well as real-time diagnostic and treatment recommendations – helping to improve efficiency, for example, by reducing redundant lab tests.
- **Computerized Physician Order Entry (CPOE).** CPOE systems allow physicians and other providers to enter orders into a computer system – minimizing handwriting and other communication errors and potentially helping to reduce errors in drug prescribing and dosing. If all hospitals had Computerized Physician Order Entry, RAND estimates that around 200,000 adverse drug events could be eliminated each year, at an annual

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[42] Chin T. More than a third of medical practices are electronically connected. American Medical News 2002; January

[43] Health care costs are far higher in the United States than in any other advanced nation, and are rising significantly faster than the overall economy or personal incomes for more than 40 years. See "The High Cost of Health Care," New York Times Editorial, November 25, 2007.

[44] J. Cylus and G. F. Anderson, Multinational Comparisons of Health Systems Data, 2006, The Commonwealth Fund, May 2007
http://www.commonwealthfund.org/usr_doc/Cylus_multinationalcomparisonshltsysdata2006_chartbook_972.pdf?section=4039

[45] Ibid.

savings of about $1 billion.[46] But today, only 15 percent of hospitals have deployed this new technology.[47]

Telehealth/Telemedicine. Telemedicine and telehealth technologies can help extend modern health care to rural areas, provide an efficient and potentially cost-effective care alternative for home-bound patients, enable remote monitoring of patients, allow remote consultations, and facilitate better communications between EMTs in ambulances and emergency room physicians.

Despite having the world's best doctors, and hospitals, lack of modern communications and IT systems has created woeful inefficiency, a stifling bureaucracy, and enough mistakes to make medical errors the third-leading cause of death, behind heart disease and cancer.[48] These failings could be exacerbated when the next disaster hits. However if we act quickly and decisively, there is a potential that thousands of lives, and billions of dollars can be saved in the process. But it takes a more modern communications infrastructure.

G. THE FUNDAMENTAL NEED FOR IP-BASED NETWORKING REMAINS UNMET.

There is a fundamental need to modernize and invest in interoperable, survivable, standards-based, broadband systems and networks that can integrate existing and future networks. Studies suggest that the overall business case for Health care IT depends on the degree to which health data can be efficiently exchanged between different computer systems.[49] Without this networking capability, health data cannot follow patients as they obtain care from different providers, and responders can't communicate throughout the system.

The road to interoperability is paved with broadband and enabled by a number of factors. There is now a growing consensus that taking advantage of advances in information and communications technologies can mean a more feature-rich IP-enabled emergency response system. Most business and government agencies are already transitioning to IP-based networks because they are more efficient, cost-effective, secure, and reliable – providing new flexibility that was never before

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[46] http://www.rand.org/pubs/research_briefs/RB9136/index1.html

[47] E. Poon, et. al. "Overcoming Barriers to Adopting And Implementing Computerized Physician Order Entry Systems in U.S. Hospitals" Health Affairs, July/August 2004: 184-189.

[48] The JOURNAL of the AMERICAN MEDICAL ASSOCIATION (JAMA) Vol 284, No 4, July 26th 2000 article written by Dr Barbara Starfield, MD, MPH, of the Johns Hopkins School of Hygiene and Public Health, indicates medical errors are the third leading cause of death in the United States.

[49] Walker J, Pan E, Johnston D, Adler-Milstein J, Bates D, Middleton B. The value of health care information exchange and interoperability. Health Affairs. 2005. Wang S, Middleton B, Prosser L, et al. A cost-benefit analysis of electronic medical records in primary care. Am J Med. 2003;114:397-403. and RAND http://www.rand.org/pubs/working_papers/2005/RAND_WR313.pdf

possible. These IP-based networks can enable major advances in the ability of emergency responders, 9-1-1 calltakers, medical and public health agencies to communicate more efficiently and effectively. The ability to send and receive critical information to, from and beyond emergency services networks, makes possible a set of potentially life-saving advances in disaster scenarios. These networks have the potential to empower patients with information, and doctors and nurses with the tools to improve the quality of care.

Unless there is purposeful attention paid to infrastructure requirements at the local, regional, and national level, it is unlikely that piecemeal technology adoption will result in the connected infrastructure necessary to realize the quality of care and economic efficiency gains promised by IT.

III. WHERE WE NEED TO BE -- A DIGITAL DIAGNOSIS

The full promise and potential of modern IT and enterprise Internet Protocol (IP) technologies have yet to reach health care and EMS. Information technology and IP-based networks are necessary elements of an adaptive, flexible, and responsive health system information communications network. Yet the health care sector is under-utilizing modern communication technologies; they are getting left behind, and the lack of IP-based networks and interoperable systems underlie this fundamental challenge.

Too often today, EMS responders, doctors and nurses must practice 21st century medicine with 20th century communications technology. The health care sector, which has yet to see the same productivity improvements that other sectors have seen from the move to online systems, still operates primarily with paper-based records – leaving the nation's health care system strangled with high paperwork costs, administrative inefficiencies, cumbersome communications, and preventable medical errors.[50] If we are to unleash the full potential of our health and safety workers, then the information on a patient that resides inside a doctor's office must be capable of being sent across the network to hospitals, laboratories, specialists, insurers, and researchers. Enabling this transformation requires that patients, doctors, and administrators can manage their information securely and trust that sensitive medical information will be protected.

Like the arteries of a digital health care circulatory system, IP networks can pump live-saving information throughout the system and enable information flows to every extremity.

IP Networks are a basic building block of this digitally connected health care system. But to achieve their full potential, these IP networks must bridge all parts of the emergency communications chain – to create a seamless world of communications. Like the arteries of a digital health care circulatory system, IP networks can pump live-saving information throughout the system and enable information flows to every extremity.

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[50] The Institute of Medicine estimates that between 44,000 and 98,000 Americans die each year from medical errors. Many more die or have permanent disability because of inappropriate treatments, mistreatments, or missed treatments in ambulatory settings. The current paper based system limits the ability to consolidate and distribute comprehensive patient information to those delivering care, and creates the potential of medical errors based on misinterpretation of patient details or delay in updating/relaying new information. See http://www.abovenet.com/newsandevents/events/docs/healthcare_webinar_abovenet_april17.pdf

1. THE EMERGING VISION OF IP'S POSSIBILITIES FOR EMERGENCY AND HEALTH CARE SYSTEMS COMMUNICATIONS

A. THE PROFOUND POTENTIAL OF AN INTEROPERABLE IP BASED EMERGENCY COMMUNICATION NETWORK OF NETWORKS.

With a commitment to planning, investment, and integration, IP networks can bring extraordinary improvements in communications. The potential for human benefit is profound. For example:

- **For 9-1-1 caller information.** Automatic crash notification technology could alert call-takers to a high-speed crash where the driver is incapacitated. A 9-1-1 caller could relay picture or video of an injured child taken at the scene with a cell phone.
- **For call-taker capability.** In a mass casualty event, or power or network failure, 9-1-1 calls can be received in overflow locations. Dispatchers can route patients to hospitals based on bed-availability.
- **For EMS patient monitoring.** Real-time biometry data and video enables monitoring of patients from the incident scene and on the way to the hospital utilizing a variety of telemetry tools. If a patient can't be moved immediately, remote consultation and diagnosis shortens the time to treatment, potentially saving lives and shortening recovery time.
- **For transport communications.** Cameras inside ambulances capture video of situations and patients to send to emergency room doctors for assessment, consultation, and preparation. As a result, an emergency room doctor's knowledge of the injury enables quicker and possibly more accurate treatment.
- **For emergency manager communications.** Emergency managers can more effectively respond to mass casualty events because event monitoring systems provide real-time maps showing 9-1-1 caller locations, available EMS resources, deployed resources, patient status, and disposition.
- **For doctor effectiveness.** Doctors are able to access electronic patient records (regardless of where those records are located), physician order entry systems (eliminating illegible handwriting that can lead to medical mistakes), and e-prescribing systems. As a result, doctors are able to avoid dangerous drug interactions by accessing the information about the drugs already prescribed.
- **For hospitals efficiency**. Hospitals are able to utilize a single network for voice, video, and data – delivering new capabilities, mobility, and savings. Hospitals could connect with remote experts who in an emergency provide surge capacity, remote patient monitoring, medical education and mentoring, and the delivery of basic health information.
- **For family pocketbooks.** By enabling broader health IT transformation and savings, the average family is projected to save thousands of dollars a year in health costs.

- **For remote patient monitoring and treatment.** At home, patients using broadband connections can check their pulse, screen their vision, monitor blood pressure, take their temperature, record glucose levels, and send this information in real-time to medical staff.
- **For outbreak detection.** Health officials could identify emerging health care trends or outbreaks sooner by monitoring, for example, types of medicines being prescribed, 9-1-1 call meta-data, or reported symptoms as people enter the health care system.
- **For life-saving research.** Researchers could sift through vast amounts of patient data to accelerate adoption of promising new treatments, or to spot dangerous drugs faster.
- **For triage center communications.** Hospitals that need to temporarily erect facilities for a triage staging area in an emergency could utilize wireless networks to establish remote communications and access all of their in-hospital application and services.
- **For communications providers.** Communications providers could manage networks to reduce costs, help eliminate single points of failure, extend capabilities, enable EMS, medical and public health to take advantage of private sector innovations, and ensure more robust communications in an emergency.
- **For statewide and regional system integration and coordination.** Emergency medical and health communications centers can integrate and coordinate the day-to-day needs of EMS, hospital, public health and related providers. These centers assure that appropriate resources are dispatched, that these responders are linked to medical overseers by the most expeditious means and to public health colleagues as needed for response and surveillance, and provide the ability to ramp up for major multiple casualty incidents.

B. EVER-GROWING RECOGNITION OF THE NEED TO MOVE TOWARD IP

Throughout EMS, medical, and public health facilities, there is a widely recognized need to extend communications capabilities beyond voice – to converge voice, video, and data and a plethora of applications using common networking technologies. Only then can communications systems used by emergency medical and public health care facilities be integrated with existing and future emergency communications networks.

By recognizing the power of IP-based communications technology – common in large and small businesses for improving communications and information sharing – EMS and public health entities can unite disparate users, adopt enhanced and secure applications that use open standards, and facilitate interoperability through a "network of networks" strategy.

There is growing agreement around this need, and a common vision is arising for the use of integrated IP networks.

- For public safety, for example, Silicon Flatirons has recommended the "development of a next generation network ("NGN") for public safety … [which] should be broadband,

Internet Protocol (IP)-based and capable of handling voice, data, image, video, and multi-media content." [51]

- The FCC's Network Reliability and Interoperability Council VII, Focus Group 1D, has recommended a "single, interconnected Internet Protocol system should be used for all emergency communications, connecting a wide variety of agency-run and public networks, both wireline and wireless." [52]

- For Hospitals, the Markle Foundation has recommended development of nationwide health information exchange built on common Internet protocol networks through a "Common Framework model ... [that] achieves a health information sharing environment with a decentralized "network of networks" approach based on common, open technical and policy standards and enforcement."[53]

- ComCare's E-Safety vision is a "unified emergency Web services information architecture that ties together the various data systems used by law enforcement, fire, emergency management, public health, emergency medical, transportation, and homeland security and others" using Internet Protocol networks.[54]

These progressive approaches need to be supported, linked and integrated. To make these visions a reality, hospitals and EMS providers need sufficient bandwidth – not just for day-to-day operations, but for surge capacity. These networks must be able to grow as technologies change, utilize common off-the-shelf technologies, and take advantage of the benefits that convergence brings.

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[51] Toward A Next Generation Network For Public Safety Communications, by Dale N. Hatfield and Philip J. Weiser, Silicon Flatirons Program, University of Colorado School of Law, May 17, 2007. At: http://www.silicon-flatirons.org/conferences/Hatfield_Weiser_PublicSafetyCommunications.pdf

[52] http://www.nric.org/meetings/docs/meeting_20051216/FG1D_Dec%2005_Final%20Report.pdf

[53] The Connecting for Health Common Framework: Overview and Principles, Markle Foundation, http://www.connectingforhealth.org/commonframework/docs/Overview.pdf

[54] ComCare E-vision at: http://www.comcare.org/ESafetyVision.html

C. THE EMERGING VISION OF INTEROPERABLE IP-BASED NETWORKS FOR OUR EMS SYSTEMS.

The Advisory Committee set out to outline "where we need to be." In an ideal world, EMS responders need to be able to connect anytime, from anywhere, with any device, regardless of the access method.

Below is the vision for where we need to head:

- ***Integrating and ensuring geographic interoperability with other public safety networks.*** Communications networks must be geographically integrated and based on functional needs enabling routine, reliable communications among EMS, fire, law enforcement, and other public safety agencies. Integrating EMS helps facilitate a more effective, coordinated, and cohesive response during both routine and large scale operations, and helps ensure optimal utilization of resources over large geographic regions.

- ***Ensuring wireless compatibility without gaps.*** Well-integrated radio, cellular, satellite, and other communications systems can provide robust, secure, and redundant service for both emergency and EMS-based community health service purposes.

- ***Integrating EMS with 9-1-1 dispatchers and calltakers.*** 9-1-1 calltakers and dispatchers must become an integrated node in an IP-based system of emergency broadband networks. Public safety answering points need the ability to integrate voice, caller geographic location, automatic vehicle location systems, vehicular automatic crash notification (ACN) systems, as well as user generated voice, text, and images into emergency response systems.

- ***Enabling EMS event monitoring systems.*** Every agency or facility with an EMS responsibility should be linked with an "EMS event and resource monitoring system". These systems generally consist of a computer, mobile data unit (MDU), and/or personal data assistant (PDA) that enables access to overall data on activities in a general geographic area of responsibility. An icon on a map can mark all EMS and related resources including details about the availability of those resources. As soon as a PSAP enters information into a system, the screen can show the EMS dispatch by type (e.g. "cardiac.") It enables easy one-stop access to real-time information on the type of call, patient(s) status, and disposition. Hospital staff, airmedical responders, and other EMS resources use the system to anticipate their involvement in an EMS event and/or to call in additional resources. It can be centrally coordinated by a regional or statewide emergency medical communications center.

- ***Enabling smarter decision-making in the field and better preparation at the receiving facility.*** Robust EMS communications systems can help make available on-line medical resources and enable transmission of relevant real-time patient data to a receiving medical facility. Such capabilities potentially allow medical decisions of greater complexity to be made in the field and permit a greater degree of preparation at the receiving facility – saving time, improving outcomes, and potentially saving lives.

- ***Developing patient records data earlier in the process.*** Communications systems enable data collection and facilitate commencement of patients' medical records earlier in the course of their injuries/illnesses.

- ***Transmitting and receiving real-time patient data.*** Telemedicine and electronic patient monitoring and reporting technologies fully support emergency and EMS-based community health service operations.

Dispatching Digital Ambulances.

In Texas, they put their digital dreams on the road. The DREAMS (Disaster Relief and Emergency Medical Services) effort links medics in the field with doctors in the emergency room. This digital EMS system includes a high-tech interactive digital ambulance. The program develops and tests a variety of telemedicine and telecommunications technologies that feature real-time remote monitoring of patients who are in locations where hospital care is not readily available. These technologies are being designed to offer emergency medical care in rural areas, on the battlefield, and in disaster areas.

The program has resulted in numerous accomplishments, discoveries, and improvements. These digital ambulances – capable of communicating with voice, video, or text – can deliver high-quality video and real-time patient data to the remote ER physician, greatly enhancing the physician's situational awareness in the ambulance to support the medical decision-making process. The ambulance hardware integrates communications systems with commercial, off-the-shelf medical and computer devices such as digital video cameras, GPS navigation systems, rugged laptops, signature pads, bar-code scanners, vital signs monitors, 12-lead ENCs, portable blood analyzers, ultrasounds and more. The system allows the ER physician to receive video, audio, real-time medical data, and text from the ambulance and transmit audio, text, and video annotations to the ambulance. The ER physician can remotely control the multiple video cameras in the ambulance to pan, tilt, or zoom to view the patient's injuries. With colored, on-screen markers, the physician can coach the EMTs through treatment that extends beyond normal EMS protocols. To make it all possible, they combine multiple low-bandwidth communications systems like cell phones, satellite phones, and data radios in order to produce enough bandwidth to send things like video.

D. THE EMERGING VISION OF INTEROPERABILITY IN OUR HEALTH CARE NETWORK.

America is still just in the beginning stages of an incredible IP revolution. Most experts believe we have seen only a fraction of its potential, and that the best is still ahead. On the horizon are a host of new data intensive network applications that can help make Americans more healthy, safe, and secure. Innovation in networking technology is essential to helping unlock these extraordinary new opportunities.

From prescriptions to medical histories and life-critical hospital charts, patient care today relies on an increasingly antiquated, costly, and error-prone system of pen-and-paper notations. The potential of information technology to reduce the number of medical errors, reduce costs, and improve patient care is enormous.

Some hospitals are striving to become largely paperless and filmless – by making patient records, lab results, clinical decision support, prescription systems, physician order entry, and health information exchanges accessible over the network. Radiology can complete a series of X-rays and make them immediately available to an entire team of orthopedic surgeons, instead of first waiting for the film to develop and then hand-delivering them to every necessary surgeon. It reduces paperwork bottlenecks, increases staff productivity, and helps cut down on the amount of time a patient generally waits for healthcare decisions.

There is broad national agreement that we need a national health information communications network. The JAC heard testimony from leaders of the successful Health Emergency Response Data System (HERDS) network, a New York based health information exchange application, recommending that we need a national health information communications network infrastructure – with a national plan, standardization, and a funding process.[55]

E. UNIVERSAL BROADBAND'S ROLE IN THIS VISION FOR THE FUTURE.

Ensuring that every American has access to broadband service throughout the country is also an essential health care communications imperative. Broadband access can mean access to telemedicine applications, health information, and the ability of health care workers to work remotely in an emergency.

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[55] Presenters included Mary Ellen Hennessy, Deputy Director, Division of Primary and Acute Care Services, New York State Department of Health and Ivan J. Gotham, Ph.D., Director, Bureau Healthcom Network Systems Management, New York State Department of Health, http://www.fcc.gov/pshs/docs/advisory/jac/ppt/nysdoh102907.ppt

Telemedicine and telehealth can:

- Extend the continuum of patient care beyond the "walls" of a hospital
- Make possible remote access to clinical services for patients
- Enable distance education, disease management, consumer outreach
- Provide significantly improved, cost-effective access to quality healthcare

Broadband also enables a host of remote patient monitoring technologies. Whether patient procrastination, age, isolation, or distance, sometimes patients do not stay in regular medical contact and do not seek appropriate medical care until there is a medical emergency. Innovative home health-care monitoring devices and systems now allow doctors to remotely monitor high-risk patients and their blood-pressure, pulse, and other measures over broadband. Progress can be monitored and intervention made before a medical crisis occurs. These technologies can avoid expensive house calls, provide real-time feedback, and allow resources to be focused on the most urgent cases. Some are even using video over broadband for regular video consults.

Telemedicine is not just about connecting health care to people at home. Every hospital, clinic, doctor's office, and medical facility should have also affordable access to broadband. Broadband access can help level the playing field between urban and rural medical capabilities. With broadband, training becomes more accessible; second opinions don't require long car trips for patients; and live-saving technologies can often be extended to wherever the patient may be located.

As FCC Chairman Kevin Martin correctly notes[56], *"In order to receive the benefits of telemedicine, electronic health care records, and other healthcare benefits, health providers must have access to underlying broadband infrastructure. Without this underlying infrastructure, efforts to implement these advances in health care cannot succeed."*

2. THE NUTS AND BOLTS OF IP NETWORKS: UNDERSTANDING THE ATTRIBUTES AND PROMISE OF IP.

IP networks, common in Fortune 500 business, are essential for enabling a converged IP network of networks for emergency communications. JAC heard testimony from a number of witnesses who outlined some of the key benefits of integrating and utilizing IP-based communications systems. Compared to traditional analog voice communications systems, IP networks offer a number of inherent advantages and capabilities that are essential for improving both EMS and health care emergency communications.

[56] http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-07-198A2.pdf

A. IP NETWORK ATTRIBUTES:

- **Interoperability.** IP networks can enable interoperability regardless of the transmission layer (leased line, DSL, WiFi, WiMax, Mesh, Satellite, Microwave, P25, Cellular). Technologies like Radio over IP can enable interoperability with legacy systems.
- **Affordability.** Converging voice, video, and data onto a single network not only helps hospitals become better prepared in a disaster, it also allows health care institutions to harness communications cost savings of up to 70 percent.[57] Importantly, using IP networks also enables broader health care IT transformation, which is estimated to save the health sector between $77 billion and $165 billion a year and deliver annual savings to the average family of about $2,200.
- **Converge-ability**. Utilizing voice, video, and data applications across a single converged managed network. Utilizing Radio over IP (RoIP) in the field, and the related IP Multimedia Subsystems (IMS) in the enterprise.
- **Compatibility**. By utilizing common open protocols and standards, IP networks and technologies like Radio over IP that utilize VoIP in their core can bridge the gap between legacy and leading-edge technologies, by utilizing—rather than stranding—prior investments.
- **Continuity** – Ability to use a variety of alternate IP-based communications networks, to use voice and data applications from any available broadband connection in an emergency, and to utilize a variety of flexible network configurations, and bandwidth allocation services.
- **Resiliency.** Utilizing IP network's inherent distributed architecture to enable multiple packet pathways between any two points, eliminating many single points of failure, and enabling the network to automatically and efficiently work around failures.
- **Agility.** An integrated, agile networking platform, capable of utilizing common off-the-shelf IP-based applications and services, is necessary for delivering dynamic IT applications for healthcare organizations. Over IP, Hospitals and EMS workers can connect to Regional Health Information Networks and a variety of applications for electronic medical records, e-prescribing, patient tracking, and syndromic surveillance to name just a few.
- **Mobility.** Extending communications, patient data, telemetry and rich media to and from the point of care. In the hospital, integrating IT systems on handhelds, converging fixed and wireless networks using IMS, boosting mobility and health care productivity.
- **Accessibility.** IP VPNs and other technologies can enable remote access to voice and data applications which can be essential in enabling telemedicine, communicating in the event of a major quarantine, and extending the productive hours of the day.
- **Scalability.** EMS and health facilities must be able to grow capacity as needs change over time, but also to add surge capacity in a mass casualty or other emergency. Managed IP networks better assure that capacity is available for critical applications when that capacity is required –

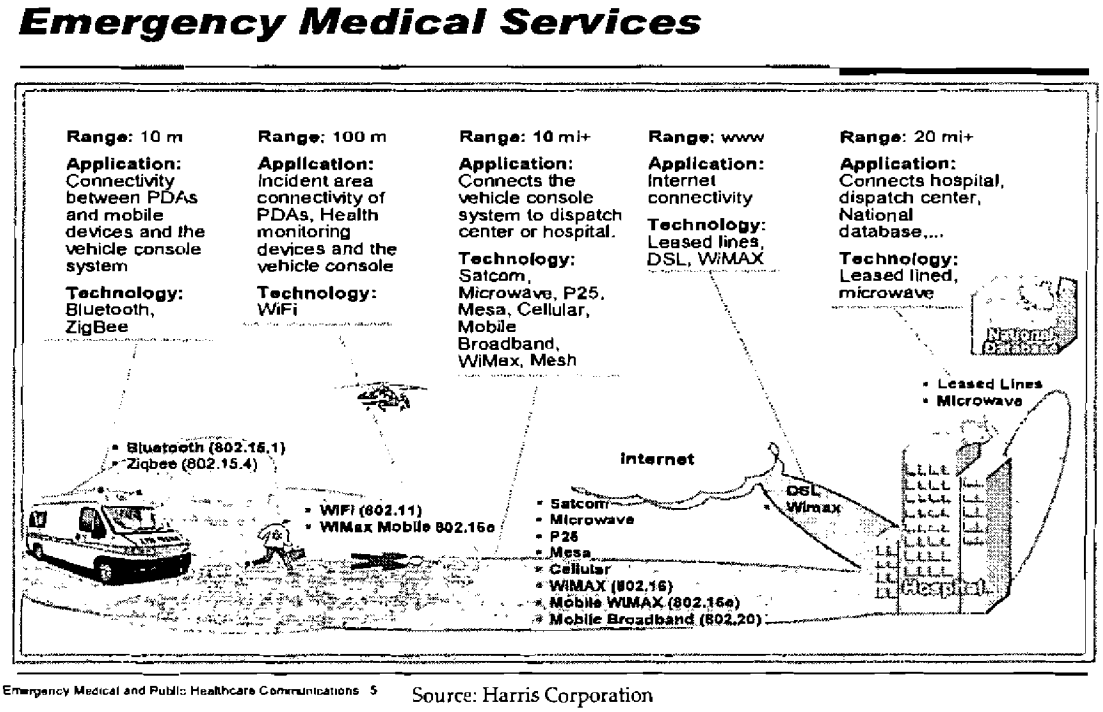
[57] http://www.globalcrossing.com/news/2005/march/07.aspx

enabling a guarantee of a certain level of network performance – especially in times of network congestion.

- **Extendibility.** IP networks enable care to be extended through telemedicine to nearly any broadband-capable location, and can extend capabilities to nearly any device, application, or service connected to the Internet.
- **Secure ability.** Managed IP networks and security applications that protect traffic and systems against unauthorized intrusion and malicious attack are a linchpin for protecting privacy and enabling end-to-end security management as required to meet HIPAA regulations, and to protect public safety communications.[58]

B. NEXT GENERATION IP PLATFORMS FOR EMERGENCY MEDICAL AND PUBLIC HEALTH COMMUNICATIONS NETWORKS

There are a variety of different communications capabilities used by emergency medical responders, which offer different communications ranges and speeds. Different technologies have been deployed based on geographic constraints and existing infrastructure – often leading to stove-piped solutions. What is needed are next generation networks that can span these systems.



Source: Harris Corporation

[58] The Health Insurance Portability and Accountability Act (HIPAA) of 1996 requires end-to-end encryption of data traveling between medical locations, thus encouraging the use of customer premises-based VPNs in that vertical.

The transition to IP-based networks would also set the stage for large-scale converged systems rollouts. However, to utilize these capabilities, IP networks must be scalable, capable of prioritizing emergency traffic, and must be managed to minimize latency and enable real-time converged communications. The chart below highlights some of the network considerations for enabling these applications.

Converged Network Needs and Capabilities		
Application/Use	**Needs**	**Network Consideration**
Voice **For:** o Consultation/instructions between physician, medic and patient o 9-1-1 incoming calls o Communication within hospital enterprise and with public	**Between:** o Public and 9-1-1 o 9-1-1 dispatch and EMS o EMS and public safety o Jurisdictions o EMS and hospital o With aerial transport o Hospital to hospital o With public	o Network must support bi-directional, full duplex voice (voice over IP - VoIP). o Network needs QoS to support real-time communication (low latency/jitter) o Perceived voice delay must be minimized
Data Store & forward video/images, streaming biometric data, medical history, patient tracking, etc.	**For:** o Electronic medical records o Patient tracking o E-prescribing o Connecting with Regional Health Information Networks o EMS transmission of real-time, multi-vital sign telemetry (pulse, blood pressure, oxygen saturation, EKG, capnography), ultra-sound images, or other high definition video. o Hospital/lab transmit ion of high definition X-rays, MRI, 3D Catscans, Ultrasound video, X-ray fluoroscopy, remote diagnostics o Communicating with providers, patients, insurers o Biometry monitoring devices	File transfer can tolerate longer latency/jitter. In general data that can be passed tolerating delay or buffer time has less stringent requirements for the network.
Media-Rich Communication Video for observing an accident scene, patient or for physician – patient/medic interaction	**Enables:** o On-scene video o Telemedicine o Telepresence o Consultation o Collaboration	Video resolution and frame rate and quality are linked to available bandwidth, latency and jitter. High-resolution video/images may be sent as store and forward (not real time).

3. PUTTING THE CAPABILITIES OF IP INTO ACTION.

A. IP'S ROLE IN HOSPITAL NETWORK CONVERGENCE.

Converging voice, video, and data onto a single network not only helps hospitals become better prepared in a disaster, it also allows health care institutions to harness telecommunications cost savings of up to 70 percent,[59] integrate disparate applications in entirely new ways, and boost productivity by as much as 15%.[60] Convergence is so well-accepted in the private sector that by the end of 2006, an estimated 21% of enterprise phone lines were served by converged IP networks.[61] In fact, the convergence of voice and data is the fastest-growing technology segment in the enterprise communication sector.[62]

However, the health care sector is significantly lagging other industries in network convergence. While the business sector is increasingly adopting a wide array of converged IP data and voice solutions, there is a troubling higher than average lack of adoption of converged IP technologies in the health care sector. For example, 43% of health care IT managers say they have not yet deployed a converged IP network – significantly higher than the rest of businesses in America (32%). Health care is also the least inclined sector to plan on converging network capabilities any time soon. Fewer than half of health care respondents indicate an intent to deploy or expand current converged deployments over the next 18 months.[63] Of those that do plan to invest in convergence, 26% of respondents from the health care sector said disaster recovery planning is a key driver for implementation of a converged network.

Because the health care sector is behind in its adoption of converged IP technologies, they are lagging in other key IP technologies. For example, the Health Care segment lags other US industries in the adoption of both VoIP and IP VPN solutions, with 23% and 32% adoption rates, respectively, vs. 33% and 37% among US businesses, respectively.[64] Although VoIP can provide

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[59] http://www.globalcrossing.com/news/2005/march/07.aspx

[60] Avaya estimates businesses can achieve an estimated 15% increase in personal productivity through smarter communications technologies like VoIP.

[61] 14.7 million enterprise IP telephony lines, according to Gartner research. Business Week, July 10, 2006, CEO Guide to Technology, By Rachael King, "Internet Telephony: Coming in Clear"

[62] According to the Telecommunications Industry Association, computer-telephony integration (CTI) was the fastest-growing component of the enterprise market in 2005 with a 10.5 percent increase to $5.7 billion. Videoconferencing equipment, which rose 10 percent to $825 million, came in a close second.

[63] Ibid

[64] In-Stat Health Care Sector analysis: http://www.instat.com/abstract.asp?id=224&SKU=IN0603082DDHC

essential cost savings, the lag in adoption of IP VPNs is especially troubling because they can be essential for providing mobility, remote access while ensuring data integrity, and security in accordance with HIPAA.

Technologies that Enable Convergence:

While IP networks can enable these benefits, not all IP networks are built the same. Converged healthcare, clinical, business, and EMS applications, can only perform well on well-designed managed networks with sufficient bandwidth to enable reliable, secure, application-aware networking. Bandwidth needs are likely to expand as networks move from handling simple data, to handling richer media like converged voice, video, remote diagnostics, high-definition imaging, and even tele-presence technologies. As digital images become clearer, their files become larger.

As bandwidth needs grow, so too will the use of real-time communications applications that require steady streams of bandwidth. However, converged networks create unique network management challenges. Many of the emerging real-time life-saving technologies (remote surgical procedures, tele-presence networks, and even converged voice and video) require very consistent and predictable handling of traffic by the network. Packet loss, delays in packet transmission ("latency"), and inconsistent packet delivery interval times ("jitter") have significant impact on a variety of emerging real-time health care applications.

To reduce latency and jitter, managed networks are generally needed that can prioritize real-time (and potentially life-saving) communications ahead of packets used for file transfer and e-mail. IP Multimedia Subsystem technology is a network technology designed specifically to overcome these convergence challenges.

IP Multimedia Subsystem – converging VoIP, video, data and mobility

One of the key technologies that will help enable network convergence is called IP Multimedia Subsystem (IMS) -- a next generation managed network architecture which enables the convergence of voice, video, and data over both wired and wireless networks. IMS enables voice communications over an IP network utilizing VoIP's Session Initiation Protocol (SIP) -- providing one common signaling protocol for all the infrastructure components, as it establishes and then controls all sessions – whether voice or multimedia data.

IMS architecture has some important advantages for health enterprises because it can speed convergence and integrate a variety of access methods and applications. IMS enables a common set of features and functionality across a variety of devices (whether a computer, mobile phone, PDA, or a traditional telephone set), over wired and wireless networks, and without regard to the physical location of the user. It means that rather than having three devices -- one to access a wireless network, another to access a wireline network and its services, and perhaps a third for a specific kind of emergency or private communications capability -- an IMS-enabled network allows any device to access a variety of common services.

IMS convergence enables:

- **Access independence** -- Access from a mobile device, computer, traditional phone, stationary device, or PDA
- **Global mobility** – Access from wherever a user happens to be
- **Consistent experience** – Consistency across wireline, wireless, fixed or mobile access
- **Seamless transitions** – Ability to seamlessly move across access networks and not drop the call. For example, communications can be *mobile* when a doctor is en-route to the hospital, and then through an unnoticeable network transition, the conversation continues over a *fixed* line once she gets to the hospital.
- **User based functionality** -- Users can control the communications mode - voice, text, pictures, video – communications type – person-to-person, person-to-group, or person-to-content communications, wherever they happen to be, and on whatever device they choose.

IMS architecture holds particular promise for emergency communications:

- For emergency responders, IMS can allow responders to communicate using any device, instead of requiring specific devices for specific kinds of communications.
- For hospitals and other facilities who use public or enterprise networks to communicate and are not on public safety licensed bands, they could interoperate with first responders at the network level.
- For consumers, once IMS is broadly deployed by network operators, as expected, it can enable emergency audio broadcast alerts to be received by users according to their location and circumstances – perhaps some retrieving the voice message from their mobile or landline phone, while others receive the same alert information via text on a portable device, or via email at their computer.

IMS can speed convergence, integrate public and emergency communications beyond what is available today, and enable a rich new set of services that can be critical in an emergency. While IMS standards continue to be improved and perfected, many network providers are already embracing it. Many observers believe IMS will become the standard architecture to support multi-application networks of the future.

Healthcare facility convergence empowers the mobile health care workforce:

Communications mobility is essential in healthcare facilities. In an industry where even seconds can make a difference, un-tethering health care workers from fixed-line communications carries benefits far beyond the bottom line. IP mobility solutions provide an up-to-the-minute means to track down a caregiver, check a patient's lab results, or communicate with a co-worker.

Health care has a huge mobile workforce. Many medical workers don't sit at desks, but constantly move from patient to patient. Doctors are often affiliated with more than one hospital, may also work at clinics as well as in private practice, may be on-call from home, and must be reachable no matter where they are. Home health care nurses are mobile by nature too.

In this mobile setting, traditional fixed line phone systems sometime are more a means for leaving a message and playing phone tag, rather than a medium for a live two-way conversation. But a delayed response time of even five minutes can sometimes have a big impact on the patient. Cell phones, which could bridge health care mobility needs, have in some cases been restricted in hospital areas due to concerns that sensitive medical equipment could be affected by RF interference.[65] Many hospitals are now turning to Wi-fi enabled VoIP phones which have the opportunity to provide new flexibility, features, and mobility.

Bridging Human Language Barriers.
Language barriers can be a major hurdle to the delivery of emergency care. Twenty-three million Americans have only limited ability to speak English – representing 8.6% of our nation's residents. Many studies have shown lack of English skills is a primary barrier to receiving adequate health care. To meet their needs, some forward thinking hospitals are turning to converged VoIP and video networks to bridge language barriers between doctor and patient. Once an IP network is deployed, the move to voice and video over IP enables each patient to receive care in his or her own language through the delivery of remote translation in real-time where the hospital does not have an on-site translator for that particular language. It is an example of the type of technologies that can be possible if we accelerate IP network convergence.

One common device converges three cutting-edge technologies -- WiFi, VoIP, and speech recognition -- to create a new life saving communication tool. These wearable communication badges use voice recognition to enable hands-free, voice commands which enable workers to call out a name to initiate a conversation – almost like a Star Trek communicator. One study found that for a 300 bed hospital, these voice activated phones saved nurses 1,100 hours per year and the

[65] For example, the FCC's web site says, "hospitals have limited the use of mobile phones, due to concerns that sensitive medical equipment could be affected." http://www.fcc.gov/oet/rfsafety/rf-faqs.html#Q14

hospital 3,400 hours a year.[66] While saving time and saving money are important, hospitals are also now finding these wireless voice badges can also prove essential for inclusion in hospital disaster preparedness plans.[67]

A reliable and secure Wireless Local Area Networks (WLAN) is key for these types of health-care deployments. U.S. hospitals and healthcare facilities are already deploying Wi-Fi networks at a rapid pace, spending a total of $650 million on wireless local area networks (WLAN) in 2005. By 2010, it is projected that figure will grow to more than $2 billion.[68]

B. RADIO OVER IP - EMS CONVERGENCE AND INTEROPERABILITY

While hospitals are beginning to reap the rewards of IP networks and the communications convergence and interoperability they enable, EMS convergence and interoperability is just as critical. To foster this kind of EMS interoperability, there is growing consensus around the need for interoperable communication gateways that can integrate dissimilar systems by converting land mobile radio, wireline, and cellular audio into common Voice over IP (VoIP) protocols, and then leveraging the ubiquity of wired IP networks as a common transport medium to tie the various agency networks together.[69]

These scalable IP-based Radio over IP (RoIP) systems, as some are called, can transcend the limits of today's legacy systems and address the need for common digital public safety radio communications standards for first responders and homeland security and emergency response professionals. They can do so by linking legacy systems in a way that is spectrum-efficient and increases the effective reach and coverage, flexibility and reliability of public safety communications.

Utilizing IP-based open standards based gateways and networks enables highly secure, interoperable communications between disparate systems. These systems are designed to work with existing and future radio-based and wire-line systems, including legacy public safety radio networks (P25 and non-P25 radio networks and devices), as well as other communications systems

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[66] Vocera saves hospitals hours, By Glenn Fleishman, at http://www.wifinetnews.com/archives/003083.html

[67] See "Wireless Voice Communication in Hospital Disaster Preparedness and Recovery," at http://www.vocera.com/solutions/documents/Disaster_Preparedness_WP_WEB.pdf

[68] according to market research firm Kalorama Information

[69] See for example, The President's National Security Telecommunications Advisory Committee (NSTAC) report on Emergency Communications and Interoperability which for example discusses the need for 4.3.3 Internet Protocol-based Interoperability for first responders at http://www.ncs.gov/nstac/reports/2007/NSTAC%20Report%20on%20Emergency%20Communications%20and%20Interoperability.pdf