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The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare.

We welcome a broad range of topics concerning both technical and economical aspects, for example wireless communication, mobile computing, low power devices and protocols, delay tolerant networks and other networking paradigms, distributed computing paradigms, big data, distributed systems, cloud computing, business and services models, user experiences and web applications. Researches addressing computing challenges in general mobile environments even not completely extreme are also welcomed by the conference. The conference will contain 3 days of excursions in the stunning nature of coastal northern California Mendocino county. Along the way, participants will get to see and experience the varying landscape and visit coastal areas, explore the Stornetta lands national monument, and hike to the Point Arena hot springs along the Garcia river. Net rural network where participants will interact with subscribers, operators and developers of this service to learn from their experience. The immersion will not only give a better idea of both the technical and user requirements of such rural deployments, but it will also give many opportunities for informal research discussions between the participants. Participants that have their own software for scenarios like this will also, to as great an extent as possible, be encouraged to test and demonstrate it within this environment. After the excursions, there will be two days of paper presentations and demos. Focus will still be on informal research discussions, with the hope that the field experience will give participants the ability to discuss the topics in a new light. Submission guidelines Join us on facebook and keep yourself updated with the latest news! Participants should submit 6 page papers about ideas and visions about the topics of the conference or demo proposals to be shown during the conference. Visionary and thought-provoking papers that are likely to generate much discussion during the conference are especially solicited. The aim of the conference is to maintain an informal environment, where new research ideas can be discussed and developed. We also hope to have a demo session where participants can show their implementations and systems. If you want to show a demo, please submit a 2 page demo proposal using the same submission system as for conference papers, including the prefix "Demo: We only accept PDF files, no greater than 6 pages in length 2 pages for the demos , including text, figures and references. Topics for the conference include, but are not limited to: Testbeds for large-scale sustainable testing of moobile communication systems Real deployments of networks in extreme environments Business and service models for networks in rural, remote, and other challenging environments Delay tolerant networking Big data research such as mining and modeling of mobility and social network Cloud computing for extreme scalability Mesh networks and sensor networks Low-power and intermittent-power protocols Mechanisms for emergency and urgent communications Distributed computing for mobile environments Networked applications and services Operating system and middleware support for mobile computing and networking Security, privacy, and trustworthiness of extreme communications Underwater networking Robotic communications and mobile augmented reality Protocols, architectures, and applications for the Internet of Things Due to logistics, the number of participants will be limited. Priority will be given to authors of papers and those who register first. Important dates Submission deadline: Jun 4, May 21, Notification of acceptance: June 10, Early registration deadline: July 1, Registration deadline: July 15, Conference dates:

Chapter 2 : What is Extreme Programming (XP)? - Definition from Techopedia

It focuses on the role that computing and communications can play in supporting federal, state, and local emergency management officials who deal with natural and man-made hazards (e.g., toxic spills, terrorist bombings).

Portable high-bandwidth radio modems that interface with portable computers and can be powered off the computer batteryâ€”these should be adaptable and interoperable with different frequency bands, channel conditions, and capacity requirements. Peer-to-peer distributed network protocols for setting up networks in the absence of wireline backbones. Bandwidth-efficient transmissions that allow increased capacityâ€"for example, in many crises like the Northridge earthquake or Hurricane Andrew, even people in the same neighborhood were cut off due to the breakdown of telephone service. A portable bandwidth-efficient battery-operated peer-to-peer network technology would allow information systems to be set up to provide important support to communities in a crisis. In theory, every information producer may be an information consumer and vice versa. Consequently, there is the need not only to reduce the amount of time needed for quantities of bits to be moved but, even at the limits of technology in increasing that speed, to transport more bits to more places. The set of people, workstations, databases, and computation platforms on networks is growing rapidly. Sensors are a potential source of even faster growth in the number of end points; as crisis management applications illustrate, networks may have to route bits to and from environmental sensors, seismometers, structural sensors on buildings and bridges, security cameras in stores and automated teller machines, and perhaps relief workers wearing cameras and other sensors on their clothes, rendering them what Vinton Cerf, of MCI Telecommunications Corporation, called "mobile multimodal sensor nets. Research Problems Motivated by Application Needs. Computing and Communications in the Extreme: Research for Crisis Management and Other Applications. The National Academies Press. A particular case, such as a response to a single disaster, may not involve linking simultaneously to millions or billions of end points, but because the specific points that will be linked are not known in advance, the networking infrastructure must be able to accommodate the full number of names and addresses. The numbering plan of the public switched telecommunications network provides for this capability for point-to-point voice circuit calling under normal circumstances. The explosive growth in Internet usage has motivated a change in the standard, Internet Protocol version 6, to accommodate more addresses. The need for successfully communicating across boundaries in heterogeneous, long-lived, and evolving environments cannot be ignored. In crisis management, voice communications are necessary but not sufficient; response managers and field workers must be able to mobilize data inputs and more fully developed information knowledge from an enormous breadth of existing sourcesâ€"some of them years oldâ€"in many forms. Telemedicine similarly requires a mix of communications modes, although not always over as unpredictable an infrastructure as crises present. Interoperation is more than merely passing waveforms and bits successfully; interoperation among the supporting services for communications, such as security and access priority, is highly complex when heterogeneous networks interconnect. The information and communications infrastructure is there to provide support to people, not just computers. In national-scale applications, nonexperts are increasingly important users of communications, making usability a crucial issue. What is needed are ways for people to use technology more effectively to communicate, not only with computers and other information sources and tools, but also with other people. Collaboration between people includes many modes of telecommunication: In crises, for example, the ability to manage the flow of communications among the people and machines involved is central to the enterprise and cannot be reserved solely to highly specialized technicians. Users of networks must be able to configure their communications to fit their organizational demands, not the reverse. This requirement implies far more than easy-to-use human-computer interfaces for network management software; the network itself must be able to adapt actively to its users and whatever information or other resources they need to draw upon. For networks to be adaptive, they must be able to function during or recover quickly from unusual and challenging circumstances. Unpredicted changes in a financial or medical network, such as movement of customers or a changing business alliance among insurers and hospitals that exchange clinical records, may also require adaptive response. Mobilityâ€”of users, devices, information, and other objects in a networkâ€”is a particular kind of challenge that is relevant not only to crisis response, but also to electronic commerce with portable devices, telemedicine, and wireless inventory systems in manufacturing, among others. Whenever the nodes, links, inputs, and outputs on a network move, that network must be able to adapt to change. Randy Katz, of the University of California, Berkeley, has illustrated the demands for adaptivity of wireless or, more generally, tetherless networks for mobile computing in the face of highly diverse requirements with the example of a multimedia terminal for a firefighter Katz, The device might be used in many ways: All of the data cannot be stored on the device especially because some data may have to be updated during the operation , so real-time access to centrally located data is necessary. The applications require different data rates and different trade-offs between low delay latency and freedom from transmission errors. Voice communications, for example, must be real time but can tolerate noisy signals; users can wait a few seconds to receive a map or blueprint, but errors may make it unusable. Some applications, such as voice conversation, require symmetrical bandwidth; others, such as data access and location signaling, are primarily one way the former toward the mobile device, the latter away from it. Research issues in network adaptivity fall into a number of categories, discussed in this section: For networks to be adaptive, they must be easily reconfigurable either to meet different requirements from those for which they were originally deployed or to work around partial failures. In many cases of partial failures, self-configuring networks might discover, analyze, work around, and perhaps report failures, thereby achieving some degree of fault tolerance in the network. Over short periods, such as the hours after a disaster strikes, an adaptive network should restore services in a way that best utilizes the surviving infrastructure, enables additional resources to be integrated as they become available, and gives priority to the most pressing emergency needs. Daniel Duchamp, of Columbia University, observed, "Especially if the crisis is some form of disaster, there may be little or no infrastructure e. That which exists may be overloaded. Adding capacity is desirable but may be difficult; therefore, a mechanism for load shedding is desirable. Some notion of priority is typically a prerequisite for load shedding. Self-Organization Self-organizing networks facilitate adaptation when the physical configuration or the requirements for network resources have changed. Daniel Duchamp cast the problem in terms of an alternative to static operation: Most industry efforts are targeted to the commercial market and so are focused on providing a communications infrastructure whose underlying organization is static e. Most communication systems are also pre-optimized to accommodate certain traffic patterns; the patterns are in large part predictable as a function of intra- and inter-business organization. Crisis management provides a compelling case for the need of networks to be self-organizing in order to create rapidly an infrastructure that supports communication and information sharing among workers and managers operating in the field. Portable, bandwidth-efficient peer-to-peer network technologies would allow information systems to be set up to support communications for relief workers. The issues of hardware development, peer-to-peer networking, and multimedia support are not limited to crisis management; they may be equally important to such fields as medicine and manufacturing e. Thus, research and development on self-organizing networks may be useful in the latter fields as well. Rajeev Jain, of the University of California, Los Angeles, suggested two main deficiencies in terms of communications or networking technologies in a Page 61 Share Cite Suggested Citation: In addition, portable cellular phones cannot communicate with each other if the infrastructure breaks down. Jain concluded that both of these problems must be solved by developing technologies that better integrate portable computers with radio modems and allow peer-to-peer networks to be set up without wireline backbones, by using bandwidth-efficient transmission technologies. Peer-to-peer networking techniques involve network configuration, multiple access protocols, and bandwidth management protocols. Better protocols need to be developed in conjunction with an understanding of the wireless communications technology so that bandwidth is utilized efficiently and the overhead of self-organization does not reduce the usable bandwidth drastically the current situation in packet radio networks. For example, images can convey vital information much more quickly than words, which can be important in crises or remote telemedicine. If paramedics need to communicate a diagnostic image of a patient such as an electrocardiogram or x-ray to a physician at a remote site and receive medical instructions, the amount of data that must be sent exceeds the capabilities of most wireless data communications technologies for portable computers. Technologies are now emerging that support data transmission rates in the tens of kilobits per second, which is sufficient for still pictures but not for full-motion video of more than minimal quality. A somewhat higher bandwidth capability could support a choice between moderate-quality full-motion video and high-quality images at a relatively low image or frame rate resulting in jerky apparent motion. Another example relates to the usefulness of broadcasting certain kinds of data, such as full-motion video images of disaster conditions from a helicopter to workers in the field; traffic helicopters of local television stations often serve this function. However, if terrestrial broadcast capabilities are disabled, it could be valuable to use a deployable peer-to-peer network capability to disseminate such pictures to many recipients, potentially by using multicast technology. The statement of James Beauchamp, of the U. Commander in Chief, Pacific Command, quoted in Chapter 1 underscored the low probability that all individuals or organizations involved in a crisis response will have interoperable Page 62 Share Cite Suggested Citation: Self-organizing networks that allowed smooth interoperation would be very useful in civilian and military crisis management and thus could have a high payoff for research. The lack of such technologies may be due partly to the absence of commercial applications requiring rapid configuration of wireless communications among many diverse technologies. Such a device should be able to act as if it were a high-frequency HF long-range radio, a very high frequency VHF air-to-ground radio, or a civilian police radio. Managing a peer-to-peer network of radios that use different protocols, some of which can emulate more than one protocol, is a complex problem for network research that could yield valuable results in the relatively near term. Network Management Network management helps deliver communications capacity to whoever may need it when it is needed. This may range from more effective sharing of network resources to priority overrides blocking all other users as needed. Network management schemes must support making decisions and setting priorities; it is possible that not all needs will be met if there simply are not enough resources, but allocations must be made on some basis of priority and need. Experimentation is necessary to understand better the architectural requirements with respect to such aspects as reliability, availability, security, throughput, connectivity, and configurability. A network manager responding to a crisis must determine the state of the communications infrastructure. This means identifying what is working, what is not, and what is needed and can be provided, by taking into account characteristics of the network that can and should be maintained. For example, the existing infrastructure may provide some level of security. Then it must be determined whether it is both feasible and reasonable to continue to provide that level of security. Fault tolerance and priorities for activities are other characteristics of the network that must similarly be resolved. In addition to network management tools to assess an existing situation, tools are needed to incorporate new requirements into the existing structure. During some phases, remote units may be used for data collection to be transmitted to centralized or command facilities that in turn will need only lower communication bandwidth to the mobile units. Adaptive network management can help increase the capability of the network elements, for example, by making the communications and computation able to run efficiently with respect to power consumption. Randy Katz has observed that wireless communication removes only one of the tethers on mobile computing; the other tether is electrical power Katz, Advances in lightweight, long-lived battery technology and hardware technologies, such as low-power circuits, displays, and storage devices, would improve the performance of portable computers in a mobile setting. A possibility that is related directly to network management is the development of schemes that adapt to specific kinds of communications needs and incorporate broadcast and asymmetric communications to reduce the number and length of power-consuming transmissions by portable devices. The response can be combined with those to other mobile devices, which are broadcast periodically to all of the units together at high power and bandwidth from the base stations. If a particular piece of information such as weather data is requested repeatedly by many users, it can be rebroadcast frequently to eliminate the need for remote units to transmit requests. Priority policy is a critical issue in many applications; the need for rapid deployment and change in crisis management illustrates the issue especially clearly. Priority policy is the set of procedures and management principles implemented in a network to allocate resources e. Priority policy may be a function of the situation, the role of each participant, their locations, the content being transmitted, and many other factors. The dynamic nature of some crises may be reflected in the need for dynamic reassignment of such priorities. The problem is that one may have to change the determination of which applications such as life-critical medical sensor data streams or users such as search and rescue workers have priority in using the communications facilities. Borrowing resources in a crisis may require reconfiguring communications facilities designed for another use, such as local police radio. A collection of priority management issues must be addressed: Who has the authority to make a determination about priorities? How are priorities determined? Page 64 Share Cite Suggested Citation:

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Chapter 3 : ExtremeCom - 7th Extreme Conference on Communication and Computing - The Mendonoma

Technology: Research Problems Motivated by Application Needs INTRODUCTION Chapter 1 identifies opportunities to meet significant needs of crisis management and other national-scale application areas through advances in computing and communications technology.

Thus, computing includes designing and building hardware and software systems for a wide range of purposes; processing, structuring, and managing various kinds of information; doing scientific studies using computers; making computer systems behave intelligently; creating and using communications and entertainment media; finding and gathering information relevant to any particular purpose, and so on. The list is virtually endless, and the possibilities are vast. Computing also has other meanings that are more specific, based on the context in which the term is used. For example, an information systems specialist will view computing somewhat differently from a software engineer. Regardless of the context, doing computing well can be complicated and difficult. Because society needs people to do computing well, we must think of computing not only as a profession but also as a discipline. The term "computing" has sometimes been narrowly defined, as in a ACM report on Computing as a Discipline: The fundamental question underlying all computing is "What can be efficiently automated? In earlier times, it was used in reference to the action performed by mechanical computing machines , and before that, to human computers [citation needed]. History of computing and Timeline of computing The history of computing is longer than the history of computing hardware and modern computing technology and includes the history of methods intended for pen and paper or for chalk and slate, with or without the aid of tables. Computing is intimately tied to the representation of numbers. But long before abstractions like the number arose, there were mathematical concepts to serve the purposes of civilization. These concepts include one-to-one correspondence the basis of counting , comparison to a standard used for measurement , and the right triangle a device for assuring a right angle. The earliest known tool for use in computation was the abacus , and it was thought to have been invented in Babylon circa BC. Its original style of usage was by lines drawn in sand with pebbles. Abaci, of a more modern design, are still used as calculation tools today. This was the first known calculation aid - preceding Greek methods by 2, years[citation needed]. Computer , Outline of computers , and Glossary of computer terms A computer is a machine that manipulates data according to a set of instructions called a computer program. The program has an executable form that the computer can use directly to execute the instructions. The same program in its human-readable source code form, enables a programmer to study and develop a sequence of steps known as an algorithm. Because the instructions can be carried out in different types of computers, a single set of source instructions converts to machine instructions according to the central processing unit type. The execution process carries out the instructions in a computer program. Instructions express the computations performed by the computer. They trigger sequences of simple actions on the executing machine. Those actions produce effects according to the semantics of the instructions. Computer software and hardware[edit] Main articles: Software and Computer hardware Computer software or just "software", is a collection of computer programs and related data that provides the instructions for telling a computer what to do and how to do it. Software refers to one or more computer programs and data held in the storage of the computer for some purposes. In other words, software is a set of programs, procedures, algorithms and its documentation concerned with the operation of a data processing system. Program software performs the function of the program it implements, either by directly providing instructions to the computer hardware or by serving as input to another piece of software. The term was coined to contrast with the old term hardware meaning physical devices. In contrast to hardware, software is intangible. Application software Application software, also known as an "application" or an "app", is a computer software designed to help the user to perform specific tasks. Examples include enterprise software , accounting software , office suites , graphics software and media players. Many application programs deal principally with documents. Apps may be bundled with the computer and its system software, or may be published separately. Some users are satisfied with the bundled apps and need never install one. The system software serves the application, which in turn serves the user. Application software applies the power of a particular computing platform or system software to a particular purpose. Some apps such as Microsoft Office are available in versions for several different platforms; others have narrower requirements and are thus called, for example, a Geography application for Windows or an Android application for education or Linux gaming. Sometimes a new and popular application arises that only runs on one platform, increasing the desirability of that platform. This is called a killer application. System software System software, or systems software, is computer software designed to operate and control the computer hardware and to provide a platform for running application software. System software includes operating systems , utility software , device drivers , window systems , and firmware. Frequently development tools such as compilers , linkers , and debuggers [6] are classified as system software. Computer network A computer network, often simply referred to as a network, is a collection of hardware components and computers interconnected by communication channels that allow sharing of resources and information. Networks may be classified according to a wide variety of characteristics such as the medium used to transport the data, communications protocol used, scale, topology , and organizational scope. Communications protocols define the rules and data formats for exchanging information in a computer network, and provide the basis for network programming. Well-known communications protocols are Ethernet , a hardware and Link Layer standard that is ubiquitous in local area networks , and the Internet Protocol Suite , which defines a set of protocols for internetworking, i. Computer networking is sometimes considered a sub-discipline of electrical engineering , telecommunications , computer science , information technology or computer engineering , since it relies upon the theoretical and practical application of these disciplines. The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents of the World Wide Web WWW and the infrastructure to support email. Computer programming and Software engineering Computer programming in general is the process of writing, testing, debugging, and maintaining the source code and documentation of computer programs. This source code is written in a programming language , which is an artificial language often more restrictive or demanding than natural languages , but easily translated by the computer. The purpose of programming is to invoke the desired behavior customization from the machine. The highest-quality software is thus developed by a team of various domain experts, each person a specialist in some area of development. But the term programmer may apply to a range of program quality, from hacker to open source contributor to professional. And a single programmer could do most or all of the computer programming needed to generate the proof of concept to launch a new "killer" application. Programmer , Software engineer , and Software developer A programmer, computer programmer, or coder is a person who writes computer software. The term computer programmer can refer to a specialist in one area of computer programming or to a generalist who writes code for many kinds of software. One who practices or professes a formal approach to programming may also be known as a programmer analyst. The term programmer can be used to refer to a software developer , software engineer , computer scientist , or software analyst. However, members of these professions typically[citation needed] possess other software engineering skills, beyond programming. Computer industry The computer industry is made up of all of the businesses involved in developing computer software , designing computer hardware and computer networking infrastructures, the manufacture of computer components and the provision of information technology services including system administration and maintenance. Software industry The software industry includes businesses engaged in development , maintenance and publication of software. The industry also includes software services , such as training , documentation , and consulting. Sub-disciplines of computing[edit] Main article: Computer engineering Computer engineering is a discipline that integrates several fields of electrical engineering and computer science required to develop computer hardware and software. Computer engineers are involved in many hardware and software aspects of computing, from the design of individual microprocessors , personal computers , and supercomputers , to circuit design. This field of engineering not only focuses on how computer systems themselves work, but also how they integrate into the larger picture. Software engineering Software engineering SE is the application of a systematic, disciplined, quantifiable approach to the design, development, operation, and maintenance of software , and the study of these approaches; that is, the application of engineering to software. The first reference to the term is the NATO Software Engineering Conference and was meant to provoke thought regarding the perceived " software crisis " at the time. Computer science and Computer scientist Computer science or computing science abbreviated CS or Comp Sci is the scientific and practical approach to computation and its applications. A computer scientist specializes in the theory of computation and the design of computational systems. Some, such as computational complexity theory , which studies fundamental properties of computational problems , are highly abstract, while others, such as computer graphics , emphasize real-world applications. Still others focus on the challenges in implementing computations. For example, programming language theory studies approaches to description of computations, while the study of computer programming itself investigates various aspects of the use of programming languages and complex systems , and humanâ€”computer interaction focuses on the challenges in making computers and computations useful, usable, and universally accessible to humans. Information systems "Information systems IS " is the study of complementary networks of hardware and software see information technology that people and organizations use to collect, filter, process, create, and distribute data. All IS degrees combine business and computing topics, but the emphasis between technical and organizational issues varies among programs. For example, programs differ substantially in the amount of programming required. Information technology Information technology IT is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, [38] often in the context of a business or other enterprise. Several industries are associated with information technology, such as computer hardware , software , electronics , semiconductors , internet , telecom equipment , e-commerce and computer services. System administrator A system administrator, IT systems administrator, systems administrator, or sysadmin is a person employed to maintain and operate a computer system or network. The duties of a system administrator are wide-ranging, and may vary substantially from one organization to another. Sysadmins are usually charged with installing, supporting and maintaining servers or other computer systems, and planning for and responding to service outages and other problems. Other duties may include scripting or light programming , project management for systems-related projects, supervising or training computer operators, and being the consultant for computer problems beyond the knowledge of technical support staff. Research and emerging technologies[edit] DNA-based computing and quantum computing are areas of active research in both hardware and software such as the development of quantum algorithms. Potential infrastructure for future technologies includes DNA origami on photolithography [42] and quantum antennae for transferring information between ion traps. This allows standardization of backplane interconnects and motherboards for multiple types of SoCs, which allows more timely upgrades of CPUs.

Chapter 4 : computing and communications in the extreme | Download eBook PDF/EPUB

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Page vi Share Cite Suggested Citation: Computing and Communications in the Extreme: Research for Crisis Management and Other Applications. The National Academies Press. Upon the authority of the charter granted to it by Congress in , the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Bruce Alberts is president of the National Academy of Sciences. The National Academy of Engineering was established in , under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Harold Liebowitz is president of the National Academy of Engineering. The Institute of Medicine was established in by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Shine is president of the Institute of Medicine. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the federal government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Bruce Alberts and Dr. Harold Liebowitz are chairman and vice chairman, respectively, of the National Research Council. Page vii Share Cite Suggested Citation: The goal of the series w as to bring together specialists in selected, nationally important application areas and researchers from the high-performance computing and communications HPCC research community to explore unmet technology needs and their implications for research. The applications discussed in the workshops were selected both for their importance to economic and societal goals and for the diversity of challenges they pose for computing and communications research. It considered applications in four areas of national importance: Although significant insights were gained from examining this broad set of Page viii Share Cite Suggested Citation: Crisis management incorporates preparation for, response to, and recovery from natural and technological disasters such as hurricanes, earthquakes, and oil spills; political-military crises; and related emergencies. Crisis management seemed an ideal focus because its diverse problems create demands for a number of different high-performance technologies. These range from high-performance computation to high-bandwidth, intelligent, and secure communications and information systems, as well as tools to support decision making and management of distributed groups of actors in a complex, uncertain, and rapidly changing environment analogous to command and control in military operations. Crisis management also provides a context for evaluating both where specifically high-performance technologies can make a significant contribution and where knowledge gained from research can lead to valuable advances in more mainstream i. The second workshop, held at the Beckman Center in June , examined the problems presented by crisis management and the strengths and shortcomings of existing computing and communications technologies for addressing them. Both civil and military crisis management were considered, although civil applications received more attention. The steering committee and workshop participants found crisis management to be an especially fruitful source of research topics that have the potential to advance the state of computing and communications on a broad front, in addition to meeting some of the pressing technology needs of civilian and military crisis managers. That workshop continued the emphasis on crisis management but also revisited the other application areas from the first workshop as additional sources of input and as a test of the generality of conclusions about crisis management needs. This report synthesizes and elaborates on

what was learned in the three workshops. The steering committee emphasizes that it was not the goal of the series to provide recommendations on how to solve the specific problems of crisis management and other application areas in the nation today. Solving crisis management problems such as slow or incomplete delivery of food, medicine, information, and financial assistance to people affected by a disaster requires resources, expertise, and effort in many areas in addition to computing and communications e. In that respect the workshops proved to be a rich source of ideas for the research community to consider. The steering committee for the Workshop Series on High Performance Computing and Communications acknowledges the contributions of the workshop speakers and participants. Their insights and creativity were central to this effort. We especially thank James Beauchamp, of the U. In addition, workshop participants Joel Saltz, of the University of Maryland, and Clifford Lynch, of the Office of the President, University of California, made valuable written contributions to the final report. The steering committee also thanks the NRC staff for their diligent assistance throughout the workshop series and preparation of the final report, including Marjory Blumenthal, John Godfrey, Gail Pritchard, and James Mallory. The steering committee and I are especially grateful to John Godfrey for his resourcefulness in identifying experts and information sources and his conscientious assistance in developing this report. His efforts to attract both crisis management and computing experts to join in this collaborative project and his consistent support in integrating materials and ideas from both perspectives were key to the successful outcome of this project. Finally, the steering committee is grateful to the anonymous reviewers for helping to sharpen and improve the report through their comments. Responsibility for the report remains with the steering committee.

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Computing and communications in the extreme: research for crisis management and other applications. [National Research Council (U.S.). Steering Committee, Workshop Series on High Performance Computing and Communications.].