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RESEARCH ARTICLE

NEXT GENERATION MOBILE COMPUTING

N. LAKSHMI PRASANNA[1], DR. R. V. KRISHNAIAH[2]
[1]RESEARCH SCHOLAR, DRKCET, HYDERABAD, INDIA
[2]PG CORDINATOR, DRKCET, HYDERABAD, INDIA

Abstract— ***Mobile Computing is human Computer interaction which a computer is expected to be transported during normal usage which includes Mobile communication, Hardware, Software. Many of these systems operate within degraded network, power, or computing environments, such as for first-responders in a catastrophe, mobile phone users in remote regions or in countries where communication infrastructure is degraded. The emergence of inexpensive remote-controlled aircraft in the market place for hobbyists and businesses has created new use cases and challenges in surveillance and security, property surveying, home and car showcasing, search-and-rescue operations, and entertainment. Such remote-controlled aircraft use cases are likely to operate in both urban and rural environments and will face degraded communication infrastructure and power management concerns while maintaining and respecting quality-of-service properties for information, in support of search-and-rescue crews, law enforcement, or other support needs. In each of this scenario's the desires and needs of the mobile computing customers are likely to outstrip the capacities of the supporting infrastructure, and the result can be degraded performance.***

Next generation mobile computing should increase the performance of receiving useful services and it should also increase the quality of services.

I. INTRODUCTION

"The combination of advances in hardware technology aligning with the current trends in web-based computing has led to a reduction in costs, thus increasing the availability of mobile computing paradigms."

Mobile computing is not a new field. Portable computer terminals have been used in various business domains for over two decades in both connected and disconnected fashion. In the connected world, remote access terminals have been used in applications such as remote police car terminals, taxi dispatching terminals and package delivery. For example, UPS introduced its delivery information acquisition device in the early '90s. These terminals have provided communication facilities and access to domain-specific databases from remote locations through the use of wireless bandwidth links. In the disconnected world, remote terminals have been used in inventory and stocking applications to gather data. The remotely gathered data is then transferred to central databases through fixed communication links. Inventory control tracking systems are typical examples of this usage paradigm.

While the concept of mobile computing is well established, industry has recently evolved to the point where the involved technologies have become sufficiently economical and powerful that mobile computing is now ubiquitous. This is evidenced by the consumerization of mobile computing through form factors such as tablets, smartphones and netbooks.

A number of synergistic technology improvements have driven the rapid advances in mobile computing:

• Central Processing Unit (CPU) advances are providing powerful computational abilities with lower power consumption.

• Memory technology is making it practical to build devices with large memory capacities in reasonable power consumption characteristics.

• Screen technology advances are supplying higher resolution and vivid colour screens.

• Touch-screen interface technology is removing the need for separate keyboards.
• Battery technology is supplying useful power reserves while requiring smaller amounts of space.
• Wireless network bandwidth is becoming ubiquitous, providing greater data transfer speeds at reasonable costs.

While advances in hardware have provided more capable devices at lower costs, the trends towards web-based computing have provided standardized tools and techniques for programming the new generation of mobile devices:

• Open communication protocols such as TCP/IP and HTTP.
• Decoupling the user device from server resources in a standardized fashion.
• Methods for presenting multimedia data types (audio and video) in addition to the more traditional forms-based data types.

II. LITERATURE REVIEW

The things that explores the next generation of mobile computing within the contexts of mission-critical scenarios, quality-of-service differentiation, and resource constraints. Specifically, we are particularly take care of the following topics:

- Tools and middleware that aid in the development of quality-of-service enabled or mission-critical applications—especially those that are readily extendable to mobile computing platforms
- Methodologies and foundations that enhance the state-of-the-art in mobile platforms and are targeted toward mission-critical or reduced capacity environments or quality-of-service

Tools and techniques that bridge mobile computing to cloud computing in order to better service

- mobile application or infrastructure needs when connectivity becomes available
- Tools and techniques that connect disparate mobile computing platforms which require differentiation, prioritization, or other quality-of-service between them
- Real-time applications that showcase the next-generation of mobile computing needs for businesses, governmental agencies, first-responders, or other users with mission-critical needs.
- Insights into the future of mobile computing that are backed up by current research or practice.

III. NEXT GENERATION MOBILE COMPUTING

Ubiquitous, pervasive mobile computing is all around us. We use mobile computing not only when we interact with our smartphones to connect with friends and family across states and countries, but also when we use ticketing systems on a bus or train to work or home, purchase food from a mobile vendor at a park, watch videos and listen to music on our phones and portable music playing devices. Any computation system that is expected to move and interact with end users or other computational systems despite potential changes in network connectivity—including loss of connectivity or changes in type of connectivity or access point—participates in mobile computing infrastructure, and the number of such systems is expected to grow significantly each year over the coming decades.

Many of these systems in urban areas take advantage of robust networking infrastructure, gigabit bandwidth backbones, high-speed relays, and unlimited power and recharging capabilities. However, many of these systems operate within degraded network, power, or computing environments, such as for first-responders in a catastrophe, mobile phone users in remote regions or in countries where communication infrastructure is degraded or even millions of people watching fireworks along a river and overwhelming the local networking infrastructure in a major metropolitan area. In each of these scenarios, the desires and needs of the mobile computing customers are likely to outstrip the capacities of the supporting infrastructure, and the result can be degraded performance to the point that no customers receive useful service (e.g., priority inversion that causes important information to be lost or delayed over frequent unimportant messages, complete loss of network links from a mobile customer to a communication control center or dropped calls or even text messages from a smartphone).

In addition to these current use-cases for mobile computing, businesses and governments are facing new challenges that extend to emerging mobile platforms or connect existing platforms with mobile computing environments. For example, the emergence of inexpensive remote-controlled aircraft (e.g., commercial quad copters like the Parrot AR.Drone) in the market place for hobbyists and businesses has created new use cases and challenges in surveillance and security, property surveying, home and car showcasing, search-and-rescue operations, and entertainment. Such remote-controlled aircraft use cases are likely to operate in both urban and rural environments and will face degraded communication infrastructure and power management concerns while maintaining and respecting quality-of-service properties for information, especially in gaming and coordinated tasks in support of search-and-rescue crews, law enforcement, or other support needs. Other next generation mobile computing initiatives like the DARPA F6 program for fractionated satellites in space showcase extreme scenarios (e.g., the remoteness of space) where government, business, and commercial applications must operate on a robust, distributed mobile cloud infrastructure that functions and enforces security between application layers despite line-of-sight and power management issues and competition between priority-differentiated applications, data sources, and users of the system. These new systems complement and augment existing computing infrastructure, technologies and practices with new ways of interacting with users and mobile computing despite potential connectivity, power, and computing challenges. In all of the described scenarios, hardware modifications may aid in increasing mobile computing efficiency under many conditions, but software that manages management, scheduling, and a host of other properties that are key to operating in reduced capacity environments or mission-critical scenarios. This issue will be beneficial to all application developers and not just mobile computing engineers or users because 1) many of the problems and solutions in the mobile space are applicable to all software engineering, 2) smartphone sales have already eclipsed personal computer sales per quarter and mobile computing devices such as smartphones and tablets will continue to gain market dominance, 3) it is becoming increasingly difficult for any service, device, or infrastructure to not interact with mobile computing infrastructure or devices.

IV. HOW CAN WE LEVER MOBILE COMPUTING?

- The extent to which you can lever the capabilities of mobile computing will depend on your business processes. The defining characteristic of mobile computing is portable access to your data and applications. The usefulness of this ability will depend on how you complete the various steps in your business processes.
- While mobile computing can present advantages in the implementation of your business processes, there are associated challenges:

4.1 Application Design

Application design in the mobile space can be more challenging than design for traditional form factors.

Mobile design presents additional challenges in user interface design, efficient use of hardware resources (battery life, network bandwidth), ability to operate in disconnected scenarios when the network is not available, and integration with your existing applications and enterprise architecture.

4.2 Security

Data must be protected while in transit between the server and mobile devices. Server resources must be protected from unauthorized access, and data must be protected to minimize business risk in the event that the mobile device is compromised.

4.3 Consumerization

Keen and aggressive uptake of mobile computing by public consumers has led to a proliferation of devices. Managing the number of device types that the user community will wish to use will pose an ongoing challenge. From an application development perspective this presents challenges as devices will vary with respect to display size and capabilities, types of available hardware resources (accelerometers, GPS capabilities, on-board cameras, etc.) and different user input modalities (touch screen, keypad, etc.). To do so are new as they are not required in the traditional desktop environment.

• Disconnected operation can be addressed through caching of data on the mobile device to provide data required for local operation, and the use of message queues to defer communication when network services are not available.

User interface challenges can be addressed by designing the user interface within the limitations of the mobile device. This can potentially involve the use of the device's SDK to build a native application, or levering the capabilities of HTML5 to build a modern browser-based application.

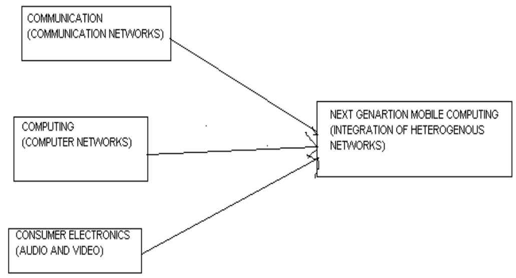
• Security challenges can be addressed through the use of secure communication protocols, password protected devices and applications, encryption of local data stores, and remote wiping capabilities for lost or compromised devices.

While mobile computing can extend the flexibility and utility of your business processes, the use of mobile devices present additional challenges that should be considered within the framework of your overall IT architecture.

4.4 MOBLE COMPUTING STORAGE REQUIREMNETS:

- Secure Flash Memory
- High Performance
- Low Power
- Thin form Factor

4.5 DIAGRAM FOR NEXT GENARTION MOBILE COMPUTING:



V. PROBLEMS WITH MOBILE COMPUTING

The success of mobile computing today is hampered by many debilitating factors. These include slow networks, wasteful protocols, disconnections, weak terminals, immature IP access to networks, poorly optimized Operating Systems (OS) for mobile applications, content conversions from wired to wireless networks, among others. One of the most critical factors holding back mobile computing in the cellular arena is that the available bandwidth for second- generation networks does not facilitate the type of high-speed access that most people have come to enjoy from their desktop. Mobile computing applications are still treated as a special evolving arena where slower speeds and limited services are tolerated for the convenience of being mobile. Wide-area mobile computing, in a form similar to its fixed desktop cousin, cannot be realized on a large scale comparable to cellular telephony until access speeds increase. Cellular networks have been optimized for voice since their inception. This has impeded the development of cellular data growth. The protocol development for cellular systems has not been congruent with protocol development for wired networks. This serves as a blocking point for seamless data networking over wired and wireless networks. Another major impediment to the success of mobile computing in second generation networks is the lack of terminals that can handle expressive graphics and long text messages. Today’s second generation phones allow only a few lines of text and have Graphical User Interfaces (GUI) that is not intuitive and natural to use from a computing standpoint. This makes t very difficult to perform even simple tasks such as retrieving email. Issues such as how to handle attachments and incorporate hyperlink into the text that is displayed on the handset have yet to be solved or standardized.

VI. CHALLENGES FOR NEXT GENERATION MOBILE COMPUTING

While the future of mobile computing in the context of next generation cellular networks looks promising, there are many challenges still to overcome to make it a reality. Some of the challenges facing researchers today involve the myriad optimization problems that are present within mobile computing in a 3G cellular environment. Issues such as optimal radio resource use in a crowded medium, efficient power saving algorithms that attempt to optimize throughput for dynamic environments subject to mutual interference, and most efficient use of limited spectrum are but a few of the current research topics. As mobile computing will put a greater emphasis on data communications and as voice begins to play less of a dominant role in the third generation, resource management techniques that apply to data traffic, instead of voice type traffic, need to be investigated. One example of this type of ongoing research can be found in . This work addresses the issue of power control in wireless data networks as opposed to voice networks and takes a game theoretic approach to the problem of assigning transmitter powers to users of error sensitive data applications. Here the cell is modeled as an economic system and the users are driven to maximize their utility. As data applications require the correct receipt of all bits, as opposed to voice, which can drop frames without a perceived loss in quality, utility is equated to the number of bits that can be successfully transmitted in the lifetime of the terminal battery. We will also see that the complexity presented by an increased user base with access to high-speed services will present problems in the areas of terminal mobility and disconnection management. While there are myriad optimization problems that require research, there are also many challenges that face hardware developers, software developers, content providers, service providers, and network managers alike.

6.1 TERMINAL DESIGN CHALLENGES:

One of the most pressing challenges facing the future of widespread mobile computing is the availability of appropriate end devices. Today most users of cellular networks access the system through a small hand-held device whose functionality and form are very closely tied to voice telephony. Most devices have limited display capability; perhaps a few lines suitable for displaying phone numbers and small icons. These displays most often lack the graphics power and resolution to display images, fonts, colors, and animation. Also the human interface for inputting data into the cell phone is usually limited to a few menu buttons at a numeric keypad. Clearly these devices do not provide an ideal interface t the visually complex and rich environment of the World Wide Web.

Current laptop computers are another option for the mobile data user. These devices are much larger, heavier, and bulkier than cellular telephones, but they provide extremely enhanced graphics, memory, and processing capabilities, many times rivaling or exceeding, traditional desktop computers. Their displays are much larger with increased resolution, and the interface for inputting data is intuitive and familiar. Thus a compromise must be reached that trades processing power with portability. We can see this tradeoff realized in the current offerings of Personal Digital Assistants (PDA), which forego telephony altogether, such as the PalmPilot from 3COM and Palm-sized computers such as the Cassiopeia form Casio. These devices are designed for more visually orientated activities and include larger displays and intuitive menu systems. Also these terminals provide more memory and computational power than the traditional cellular telephone. Qualcomm has realized a crossbreed named pdQ Smartphone that integrates the calendar and personal organizer functionality with a digital cellular phone.

The widespread acceptance and popularity of the latest PalmPilot, the Palm VII organizer which allows for wireless access to email and specific web sites, is an indicator that terminal design is evolving with the mobile customer in mind. This trend must continue and more intuitive interfaces need to be developed for interactive wireless computing to meet and exceed its high expectations. Another drawback to conventional electronic devices as a means for mobile computing is the limited battery power and short lifetime before recharging. Most cell phones can handle live voice conversations for around 6-10 hours before their batteries need to be recharged. The power requirements to support video, complex digital signal processing and computationally intensive applications are much higher than those for simple voice conversations. We can see this in the limited battery lifetimes of current laptop computers that are on the order of 4-8 hours. Advanced MAC layer protocols that attempt to conserve power for high-speed transmission, such as, need to be researched and implemented to improve the quality of mobile computing. These types of power saving algorithms will be a critical component of the mobile networks and represent a challenge to mobile computing researchers.

6.2 EVOLUTION OF THE INTERNET TO ENABLE:

Mobile Terminals Jn conjunction with the challenges facing appropriate terminal design for mobile computing is the challenge of presenting information content to limited display terminals . A number of initiatives attempt to address the problem of formatting web sites and other electronic information for transfer onto current mobile devices. As advances in terminal displays are being made, they are a still a long way from the quality of the desktop displays that web content was originally designed to be viewed on. Therefore efforts need to be made to adapt the complex visual data of the Internet for the more limited capabilities of mobile computing devices. For instance the Wireless Access Protocol (WAP) is attempting to be the de-facto world-wide standard for providing Internet communications to digital mobile phones, pages, personal digital assistants and other wireless terminals. The WAP protocol is furthered by large industry participation in the WAP Forum, which is a collection of handset manufactures, content providers, and software developers. The objective of the WAP Forum is to bring Internet content and advanced data services to mobile terminals by developing a global wireless protocol specification that will work across differing wireless network technologies. The operating systems used for mobile computing also represents challenging areas for evolution. Operating systems for wireless information devices differ from their desktop counterparts in three fundamental ways. One, they must be lightweight and not require extensive resources from the CPU. Secondly, they must be power conscious and not be wasteful of the terminal’s battery life. Thirdly they must be designed to handle frequent outages, unstable communication channels and synchronization effects. There are many companies actively involved in developing operating systems specifically for wireless information devices including Symbian, Microsoft, 3COM, and Sun Microsystems among others. The operating system behind the PalmPilot device is the PalmOS developed by 3com. This operating system has been implemented in many Smartphone products released by Qualcomm, Nokia, and Ericcson. Microsoft is aggressively marketing its WindowsCE operating systems for use in mobile phones, communicators, and PDAs as well. Recently it was announced that 3COM would incorporate Sun’s Java technology into its Palm computing platform. This would allow Java’s runtime environment for consumer products to be tightly integrated with the PalmOS. These types of partnerships signal a convergence of wired networking technologies with wireless and will be significant in furthering the capability and utility of mobile computing. Other efforts towards making Internet information more palatable to display impoverished terminals include web sites that act as portals specifically for mobile devices. One such example is Lucent’s Zingo that will provide specific information for mobile professionals which will allow content published in standard HTML format to be automatically reformatted for virtually any device with a built-in browser. Microsoft Corporation has also taken a similar step with the introduction of its own web portal, MSN Mobile, aimed at providing information and services to mobile customers. These types of initiatives point to a marked convergence of wired and wireless networking that needs to occur to further the state of mobile computing.

Wired networks need to become more conscious of the wireless end devices that access them in order to provide tailored information and services suitable to the device's capability and context.

6.3 HIGH SPEED DATA AND MOBILITY:

As transmission speeds increase by an order of magnitude, and packet data services become more prominent in the cellular arena, there is a growing concern surrounding the issues of mobility. The topic of resource management for multimedia traffic as mobiles cross over cell boundaries will be of increased importance in the third generation. Provisions for disconnection and reconnection management in this new framework need to be addressed. Network functions such as caching and re- synchronization are placed in a new light as access speeds, the intensity of handoffs, and the heterogeneity of networks increases. There is also a need to understand the demands of dynamic flexible service configurations for high-speed multimedia mobile communications. This will be particularly important as the bit rates and network resources will vary across different physical environments.

6.4 MIGRATION TO THE THIRD GENERATION:

Second generation systems and infrastructure are widely deployed and supported. Jn addition, a huge base of existing customers already exists and will continue to exist into the 21st century. Potential JMT-2000 operators do not want to have to discard their entire existing infrastructure, rather they would prefer that the new system should coexist and interwork with the present one and act as an adjunct to it. An orderly evolution path from second generation to third generation is required. Any migration towards the third generation must be approached with care to preserve the significant investments that service providers have in their legacy equipment. As of yet there are no clear migration strategies for service providers to adhere. Thus the timing of JMT-2000 implementation and commercialization is unclear. This may disrupt the availability of mobile computing services and applications. Therefore, this migration strategy plays a key role in the offering and subscription of mobile computing.

6.5 QUALITY OF SERVICE:

Another goal of the third generation systems is to offer some means by which quality of service may be guaranteed. This is a particularly difficult issue in the context of wireless communications as the channel is time varying, and subject to interference, and fading. There have been proposals for extensions of RSVP to the mobile environment but the performance of such schemes, and the ease of implementation have yet to be determined. Offering differentiated service quality also raises interesting questions in terms of billing and accounting. If a service provider is going to charge customers for a "premium" service, such as higher bit rates or lower delay, then there must be mechanism by which the service provider can quantify the actual performance that user receives. This introduces a good deal of complexity to integrate into the overall network management and accounting systems of the network.

VII. CONCLUSION

With the impending implementation of IMT-2000 systems, the next generation of cellular systems shows promises in advancing the status mobile computing significantly. These new communication systems will usher in a new mobility enabled communications paradigm that will allow new modes of computing applications and services. Access speeds approaching 2 Mbps, terminals that allow intuitive access to services, seamless and global operation across heterogeneous networks, and protocol design to facilitate packet data will further the wide spread acceptance of mobile computing as a preferred means to access networked information. The number of mobile professionals is increasing, as is the amount of information being placed on secure corporate web sites and the public Internet. Wide area cellular systems that provide high-speed web access coupled with advances in terminal and interface design could be the driving factor that makes mobile computing as ubiquitous and natural as fixed and cellular telephony is today. These developments offer the promise of extending enhanced data services to a vast number of subscribers. 32 million by the year 2006 worldwide growth of mobile subscribers will outpace that of the will exceed that of the fixed network by the year 2010. The groundwork is being laid now for this promising future through the evolutions towards IMT-2000 of current second- generation cellular systems (IS-95B, GPRS, etc.) and through the proliferation of handheld organizers and smartphones. Both the access systems and the access terminals must grow and mature in congruence, if the full potential of the mobile computing revolution is to be realized.

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Authors Bibliography

N. LAKSHMI PRASANNA, M.Tech in CSE from JNTUH, B.Tech from VIDYA VIKAS INSTITUTE OF TECHNOLOGY.

DR. R. V. KRISHNAIAH has received Ph.D from JNTU Ananthapur, M.Tech in CSE from JNTU Hyderabad, M.Tech in EIE from NIT (former REC) Warangal and B.Tech in ECE from Bapatla Engineering College. He has published more than 50 papers in various journals. His interest includes Data Mining, Software Engineering, Image Processing.