SURVEY AND ANALYSIS OF MOBILE COMPUTING METHODS

S.U.Thakur

S.S.S.K.R.Innani Mahavidyalaya
Karanja (lad), Dist. Washim (M.S.), India
sonal.thakur9@gmail.com

ABSTRACT

Advances in wireless networking have prompted a new concept of computing called mobile computing in which user can carrying portable device Java access to a shared infrastructure, independent of their physical location. This provides physical communication between people and continuous access to networked services. Mobile computing revolutionized the way where computers are used and in the upcoming years, it will become more perceptible. As more and more people enjoy the various services brought by mobile computing, it is becoming a global trend in today's world. At the same time, securing mobile computing has been paid increasing attention. The goal of this paper is to point out some of the characteristics, applications, limitations and issues of mobile computing.

keywords: *security, mobile cloud, privacy, data security.*

Introduction

Mobile computing is an interaction between human and computer by which a computer is expected to be motivating during normal usage. Mobile computing involves software, hardware and mobile communication. Respectively, mobile software deals with the requirements of mobile applications. Also, hardware includes the components and devices which are needed for mobility. Mobile computing means being able to use a computing device while changing location properties. Portability is one aspect of mobile computing. The radical evolution of computers, especially in hardware (towards smaller size and weight, higher performance, lower power consumption, lower cost) and communications (wireless and satellite networks, cellular telephony, WANs, INTERNET), has introduced the idea of mobile computing (Imielinski and Badrinath, 1992). This means that users don't have to be tethered on expensive wired workstations in order to exchange data. All they need is a mobile computer that is portable computers communicating via wireless networks. Mobile computer will be the 'communication car' for people of 21st century: the freedom to communicate in anyway, from everywhere and any time (Weiser, 1991 & 1993). Mobile computing is tightly depending on available infrastructure of distributed systems. As a result, we can see it as an extension of distributed systems computing. Furthermore, the addition of ideas like mobile agents imposes mobility to a wide range of technological approaches towards future distributed information systems (Gray; Kotz; Nog; Rus and Cybenko, 1996). The benefits of on-the-move network connectivity are obvious. However, there is serious networking and systems issues to be solved before the full benefits of mobile computing systems are realized in practice. One critical issue is security (Hardjono and Seberry, 1995).

1. Different types of Mobile Systems

In many ways, mobile computing has several characteristics reminiscent of distributed systems. In order to understand mobile systems, one must first understand where the similarities and the differences of distributed and mobile systems lie. The following section is an explanation of the different types of distributed systems ranging from the traditional type to nomadic, ad-hoc and finally ubiquitous ones.

Traditional Distributed System

Traditional distributed systems consist of a collection of fixed hosts that are themselves attached to a network– if hosts are disconnected from the network this is considered to be abnormal whereas in a mobile system this is quite the norm. These hosts are fixed and are usually very powerful machines with fast processors and large amount of memory. The bandwidth in traditional systems is very high too.

Furthermore, the execution context is said to be static as opposed to a dynamic context whereby host join and leave the network frequently. In a traditional system, location rarely changes as well and hosts are much less likely to be added or deleted from the network. Traditional distributed systems also need to guarantee non-functional requirements such as scalability (accommodate a higher load at some time in the future), openness (possibility to extend and modify the system easily), heterogeneity (integration of components written using different programming languages, running on different operating systems, executing on different hardware platforms), fault-tolerance (recover from faults without halting the whole system) and finally resource-sharing (some form of access control).

Nomadic Distributed System

This kind of system is composed of a set of mobile devices and a core infrastructure with fixed and wired nodes. Mobile devices move from location to location, while maintaining a connection to the fixed network. There are problems that arise from such shifts in location. The mobile host has a home IP address and thus any packets sent to the mobile host will be delivered to the home network and not the foreign network where the mobile host is currently located. Such problem can be solved by forwarding packets to the foreign network with the help of Mobile IP. Nevertheless, Mobile IP also suffers from efficiency (routing issues), QoS, security (authentication of mobile host at foreign network and end-to-end security required) and wireless access (reduced capacity) problems.

These systems are susceptible to the uncertainty of location, a repeated lack of Connections and the migration into different physical and logical environments while operating. However, compared to ad-hoc networks, nomadic systems still have comparatively reliable connections and services since most of these are actually supported by the fixed infrastructure ("backbone") of the network. The non-functional requirements mainly differ, compared to the traditional distributed systems, in the heterogeneity (affected by the presence of both fixed and mobile devices across the network as well as the variations in technologies (e.g.: wireless)), resource sharing (must take into account different issues when the resources need to be discovered) and fault tolerance of the system (considered to be quite the norm). Quality and provision of these resources must be carefully considered too.

Ad-Hoc Mobile Distributed System

Ad-hoc distributed systems are possibly the only type of network that comes close to mobile networks in the sense that every node is literally mobile. It is these networks that are very much seen as the systems of the future, whereby hosts are connected to the network through high-variable quality links (e.g.: from GPS to broadband connection) and executed in an extremely dynamic environment. A-hoc systems do not have any fixed infrastructure which differs them both from traditional and nomadic distributed systems. In fact, ad-hoc networks may come together as needed, not necessarily with any assistance from the existing (e.g.: Internet) infrastructure. When nodes are detached from the fixed/mobile network they may evolve independently and groups of hosts opportunistically form "clusters" of mini-networks. The speed and ease of deployment make ad-hoc networks highly desirable. These kinds of systems are extremely useful in conditions where the infrastructure is absent, impractical to establish or even expensive to build (e.g.: military applications, high terrain uses, and emergency relief operations).

However, being a relatively new technology, this field of networking demands a lot of research to be done to improve it, especially its non-functional requirements as well as algorithms for routing protocols (e.g.: distance vector and dynamic source routing algorithms).Security threats have to be dealt even more cautiously in ad-hoc networks. Designing secure key distribution in an ad-hoc network might be an extremely hard task. Any reliance on a certificate of authority is not trivial at all, for the same reasons that reliance in any centralized authority is problematic. Additional problems include the increased packet sizes required by authentication extensions, unicast/multicast routing, Quality of Service support and power aware routing. Furthermore, due to the limited transmission range of wireless network interfaces, multiple hops may be needed to exchange data between nodes in the network (c.f.MANET).

2. Theory in Mobile Computing

This section is only an introductory section so it will not go into any detail other than state what the current trend of search in these two fields related to mobile computing are.

Models

Models permit the precise description of existing languages and system semantics. In fact, they enable the formal reasoning about the correctness of such semantics. Models are very much used to emphasize parallels and distinctions among various forms of mobility (logical and physical) and are concerned with the formulation of appropriate abstractions useful in specification and evaluation of such mobile systems.

Models are mainly concerned with the characteristics of mobile units such as the unit of mobility (who is allowed to move), its location (where a mobile unit is positioned in space) and its context (determined by the current location of mobile units). There are many existing models and many more are still in research4:

- Random mobility model
- Markovian model
- Exponential Correlated Random Model
- Nomadic Community Model

Algorithms

The current algorithms applied reflect the assumptions that are made about the underlying system. Unfortunately, many of these assumptions are not suited for current algorithms for mobile systems. Mobile algorithms are obliged to treat in much detail space and coordination of mobile systems. In particular, algorithms have to carefully take into consideration location changes, the frequency of disconnection, power limitations and the dynamic changes in the connectivity pattern of mobile systems. This field of theory is in fact spread among a vast spectrum of research due to the large diversity of mobile systems5.

3. Middleware

A lot of research has been made in recent years into the translation of traditional middleware into that of mobile distributed systems. However, this is not as easy as researchers first thought due to the differences between traditional and mobile systems stated previously. Traditionally, middleware for physical mobility6 has been application centered (e.g.: Bayou system). Nevertheless, this approach is not suitable for a generic form of mobile computing and therefore a general purpose middleware becomes a necessity. Hiding mobility is increasingly more difficult or even meaningful, thus a new core of abstractions that extend distributed middleware with support to mobility must be fully researched.

Another reason for the so-called “lack” of a suitable mobile system middleware is that Traditional distributed systems have been around for over 20 years whereas mobile systems are a new technology which has been around at most 10 years. This means that this new field is still very much into research.

Middleware for nomadic and ad-hoc mobile distributed systems has a set of comparable characteristics that influence how the middleware should in fact behave. Mobile devices require light computational load – existing middleware for heavy computational load such as that found in traditional distributed systems cannot be applied. The intermittent connection nature of mobile systems also requires an asynchronous form of communication. Additionally, unlike fixed distributed systems, mobile systems execute in an extremely dynamic context which in turn necessitates that devices be aware at all time of their environment (e.g.: type of connection they are switching to).Middleware for mobile distributed systems is split into different research areas such as context-aware middleware (principle of Reflection); location-aware middleware (e.g.: Nexus);data sharing-oriented middleware (e.g.: Bayou, Coda, Odyssey); tuple space-based middleware (e.g.: Lime, TSpaces). This paper will only have a brief look at the tuple spacebased approach and, in particular, Lime will be used as an example.

Tuple Space Middleware

The classical definition of a tuple space is that of a shared associative memory consisting of a collection of tagged data records (tuples). Tuples may be created and placed in the tuple space and they can be access concurrently by several processes with blocking primitives. In a mobile context a completely asynchronous (de-couple communication) and decoupled model is suitable and thus tuple space middleware is appropriate. Tuple spaces needn’t depend either on the machine or platform in which they are running. Tuple spaces have proven to be suitable for mobile computing because of the dynamic context nature (migration and connectivity patterns) of mobile systems. They are an attractive approach for coordinating mobile units across a mobile computing environment. i.e. movement of mobile hosts in a building or even large regions of the planet Concurrency: State models and Java Programs,

LIME

Lime (**L**inda **I**n a **M**obile **E**nvironment) is a java-based middleware that provides a coordination layer that can be exploited successfully for designing applications that exhibit either logical or physical mobility - or both. The fundamental design criteria underlying Lime comes from the realization that the defining problem of mobile computing is dealing with, and exploiting, a dynamically changing context. To achieve its goal, Lime borrows and adapts the communication model made popular by Linda8.Lime provides coordination among processes (Lime agents) via a shared memory mechanism. When processes use Lime to coordinate, no messages are explicitly sent to other processes. All communication occurs through access to a shared medium, namely the tuple space.

The difference between Linda and Lime is that the former breaks up the tuple space of the latter into several tuples spaces. Each one of these tuple spaces is associated to a mobile unit9 and every mobile unit has access to an interface tuple space that is constantly and exclusively attached to that unit and transferred along with it when movement occurs. The tuple space that can be accessed through this interface is thus shared by construction and is temporary because its content changes according to the movement of mobile units.

Lime is a very powerful tuple space-based middleware since it promotes the reduction of details of mobility (transparency) and the distribution to changes to what is perceived as the local tuple space. This allows designers of mobile systems to be alleviated from the burden of constantly maintaining a view of the context consistent with changes in the configuration of the system. However, transparency could lead to an oversimplification of a system. In some cases, where there is a need to achieve a high amount of context awareness, this may not be favorable.

Nonetheless, Lime offers several "solutions" such as making information about the system configuration available via LimeSystem10; allow actions to be taken in response to a change in the configuration of the system by setting reactions on the tuple space; and broaden .Linda operations with tuple location parameters that permit to function on different projections of the transiently collective tuple space.

The Characterstics of Mobile Computing

There are several characteristics to mobile devices and mobile computing. Many of these are shared with other technologies but have unique significance when it comes to mobile computing.

- **Portability** – As the name "mobile" implies, the devices have to be able to easily move to different locations, while remaining functional.
- **Connectivity** – The ease of being able to connect to the Internet and receive or transmit data is an essential component to mobile computing. Connectivity through mobile carriers over a 3G or 4G-type network, as well as Wi-Fi capabilities, are basic requirements for mobile devices.
- **Interactivity** – This could almost go without saying, but like most other computing technologies, the ability for a mobile device is critical. The interactivity becomes more significant with mobile devices, as they typically have less computing power than other types of technology.
- **Individuality** – Individuality may sometimes be overlooked, but it is a basic component of the concept of mobile computing. Mobile devices, including smart phones and tablets, are designed for individuals and have become a sort of extension to people in many aspects of their lives. From this perspective, how individuals interact with mobile devices remains unique.

Issues in Mobile Computing

1. Security Issues

- **Confidentiality**: Preventing unauthorized users from gaining access to critical information of any particular user.
- **Integrity:** Ensures unauthorized modification, destruction or creation of information cannot take place.
- **Availability**: Ensuring authorized users getting the access they require.
- **Legitimate**: Ensuring that only authorized users have access to services.
- **Accountability**: Ensuring that the users are held responsible for their security related activities by arranging the user and his/her activities are linked if and when necessary.

In this paper the author had discussed various kinds of security issues and protocols that are used for securing the data when communicating between them. Mainly author has discussed on symmetric and asymmetric key encryption mechanisms for providing security to the data across the network.

2. Bandwidth

Bandwidth utilization can be improved by logging (bulk operations against short requests) and compression of data before transmission. Additionally, lazy write back and file perfecting can help the network in times of peak demands. Lazy write back is very helpful in the sense that the data to be written may undergo further modifications. The technique of caching frequently accessed data items can play an important role in reducing contention in narrow bandwidth wireless networks. The cached data can help improve query response time. Since mobile clients often disconnect to conserve battery power the cached data can support disconnected operations

3. Location Intelligence

As the mobile computers move they encounter networks with different features. A mobile computer must be able to switch from infrared mode to radio mode as it moves from indoors to outdoors. Additionally it should be capable of switching from cellular mode of operation to satellite mode as the computer moves from urban and rural areas.
In mobile computing as computers are working in cells and are being serviced by different network providers, the physical distance may not reflect the true network distance. A small movement may result in a much longer path if cell or network boundaries are crossed. It will also lead to updating of the location dependent information as described above. This can increase the network latency as well as risk of disconnection. Service connections must be dynamically transferred to the nearest server. However, when load balancing is a priority this may not be possible.

4. Power Consumption

Mobile Computers will rely on their batteries as the primary power source. Batteries should be ideally as light as possible but at the same time they should be capable of longer operation times. Power consumption should be minimized to increase battery life. Chips can be redesigned to operate at lower voltages. Power management can also help. Individual

Future Trends

mobile cloud is the convergence of cloud computing and mobile applications It is one of the hottest trend in cloud computing that is expected to play an increasingly important role in the future the need of mobile cloud stem from following trends

Enterprise & consumer applications are getting increasingly smart

The day of using mobile phone just to access the exchange and browsing the web is given away into using the mobile for accessing spreadsheet delivering presentation & performing data processing to cater to the intensive computing needs on the mobile, advance apps run from the cloud

Phone network provider are trying to climb up the value chain

For a long time the infrastructure providers have always feared that they will be relegated as "dumb pipe" utility companies. Thus companies such as Vodafone and Verizon are putting a lot of focus on developing the mobile cloud as a value-add option

4G LTE (Long Term Evolution) compatible devices are supporting bandwidth with intensive application

3G standards are getting replaced by faster 4G LTE standard and the increasing bandwidth availability has opened new doors for mobile cloud applications.

Entry of iPods into enterprise space

Tablets are now entering the enterprise space and are projected to supplement the PCs in the nearby future. From data centers to construction firms, tablets are finding their uses in innovative setting. By moving apps from the Pc to the tablet,
Enterprises are putting more efforts on their mobile cloud services

HTML5

The increasing adoption of HTML5

standard is making it easy to design apps that relay on mobile clod .Html5 supports offline caching that enables the apps to use the mobile cloud better while still providing a gracefully degraded service when the device is not connected to the network

The rise of mobile commerce

Consumer are now increasingly buying things from mobile commerce store and also using mobile phone as their wallets .These applications are enabled by the mobile cloud infrastructure

Fragility of mobile device

While enterprises are putting increasingly important apps in the mobile, their robustness people have far higher probability of dropping their mobile phone then breaking their PC. This necessitates the need to store the apps and data on the cloud

Increase in worker mobility

With the increases in worker mobility, the demands have moved from mere data consumption on the mobile device to performing information creation on the mobile.

Fragmentation of devices

In the past 5 years, the number of data devices used by an information worker at ho has exploded. We have multiple PCs at the office , carry a smart phone and tablets, use a laptop at home .the need to access the data from all the devices is making it necessary to use applications that tap the mobile cloud.

Conclusion

Mobile computing technology provides anytime and anywhere service to mobile users by combining wireless networking and mobility, which would engender various new applications and services. However, the inherent characteristics of wireless communication and the demand for mobility and portability make mobile computing more vulnerable to various threats than traditional networks. Securing mobile computing is critical to develop viable applications. In this article, we discussed the security issues faced by mobile computing technology

References

Zapata, M.G. (2002). "Secure Ad hoc On-Demand Distance Vector Routing", ACM SIGMOBILE Mobile Computing and Communications Review, Vol. 6 , No. 3, pp. 106-107.

Imielinski, T. and Badrinath, B.R. (1992). "Mobile wireless computing: Solutions and challenges in data management", Technical Report DCS -TR-296/WINLAB-TR-49, Department of Computer Science, Rutgers University, NJ.

Imielinski, T. and Badrinath, B.R. (1993). "Data management for mobile computing", SIGMOD RECORD, vol. 22, no. 1, pp. 34-39.

Beller, M. J., Chang, L.F and Yacobi, Y. (1993). "Privacy and authentication on a portable communications system", IEEE Journal on Selected Areas in Communications, vol. 11, no. 6, pp, 821-829.

Bharghavan, V. (1994). "A protocol for Authentication, Data and Location Privacy, and Accounting in Mobile Computing Environments", Proceedings of the ACM Conference on Computers and Communications Security, Fairfax, Virginia.

Gray, R., Kotz, D., Nog, S., Rus, D. and Cybenko, G. (1996). "Mobile agents for mobile computing", Technical Report PCS-TR96-285, Department of Computer Science, Dartmouth College.

Hardjono, T. and Seberry, J. (1995). "Information Security Issues In Mobile Computing", Information Security - the Next Decade, Proceedings of the IFIP TC11.

Varadharajan, V. (1995). "Distributed Object Systems Security, Information Security - the Next Decade", Proceedings of the IFIP TC11, Eleventh International Conference On Information Security, IFIP / Sec '95, Capetown, South Africa, Chapman and Hall, London-Melbourne, 305-321.

Zhang, Y. and Lee, W. (2000). "Intrusion Detection in Wireless Ad-Hoc Networks", Proceedings of the 6thInternational Conference on Mobile Computing and Networking (MobiCom'2000).

Hu, Y. C. and Johnson, D. B. and Perrig, A. (2002). "SEAD: Secure Efficient Distance Vector Routing in MobileWireless Ad-Hoc Networks", Proceedings of the 4th IEEE Workshop on Mobile Computing Systems andApplications (WMCSA '02), pp. 3-13.

Duchamp, D. (1992). "Issues in Wireless Mobile Computing", Proceedings Third Workshop on Workstation Operating Systems, April 1992, 2-10.

Campbell, R., Sturman, D. and Tock, T. (1994). "Mobile Computing, Security and Delegation", International Workshop on Multi-Dimensional Mobile Communications, Japan.

Katz, R.H. (1994). "Adaptation and Mobility in Wireless Information Systems", IEEE Personal Communications, 1st Quarter, 6-17.

Weiser, M. (1991). "The Computer for the Twenty-First Century", Scientific American, **265(3)**, 94-104.

Weiser, M. (1993). "Some Computer Science Issues Related to Ubiquitous Computing" Communicatin ACM, 36(7), 75-85.