Supporting BYOD (Bring Your Own Device) in an Educational Campus through MANET

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ABSTRACT

The "bring your own device" (BYOD) is the concept of encouraging people for bringing their own devices to work or study and is gaining popularity in both corporate and educational environments. The concept of BYOD is beneficial for the education sector due to its cost saving ability for the institutes and providing the comfort of using personal devices. The rapid and accelerating move towards the adoption and use of mobile devices has increasingly provided students and teachers the ability to study on the move. The colleges and universities have been adapting their networks and policies to accommodate personal mobile computing devices for quite some time. Since the time laptops became affordable and smartphones and tabs are a common possession, undergraduate and graduate students have been bringing their own devices to campus. Wireless and mobile technologies influence the evolution of the teaching and learning and press forward the development of new mode of education enabling anytime, anywhere and anyhow learning. New wireless technologies can be used to boost interactivity, thus helping people to remain online even while on the move. The institutions need to develop a learning platform suitable to support Bring Your Own Device (BYOD). Institutions that are proactive in their approach towards BYOD will stand a chance to gain critical benefits from its implementation. A Mobile Ad Hoc Network (MANET) is defined as a collection of two or more nodes connected with each other through some kind of wireless communications and networking capability that enables them to communicate with each other without the need of any centralized server. This enables the wireless nodes to dynamically form a network to exchange information without using any existing fixed network infrastructure. The main advantages of MANET are robustness, flexibility and mobility. In this paper we have explored the possibility of implementing BYOD in a university set up through MANETs.

Keywords-- BYOD, MANET, Learning systems, adhoc networks

I. INTRODUCTION

The use of wireless technology paves the way for a literal interpretation of mobile ubiquitous computing. People can get online, be reached, and interact anywhere and anytime. In this paper, we discuss a platform based on wireless technologies to support learning communities in university campuses and how it could be used to improve ubiquitous interactivity and cooperation among teachers and students. The requirements of modern learning have changed and aspects such as community interaction, flexibility, pervasive learning and increasing mobility in communication habits have become more important. To meet these challenges learning platforms must provide support on mobile learning. Most approaches try to adopt centralized and static learning mechanisms to mobile devices. However, technically it is not possible for all kinds of devices to be connected to a central server. Therefore we introduce an application of a mobile learning network which can operate decentralized with the help of ad hoc network architecture i.e. MANET.

Bring your own device (BYOD) is the concept of encouraging people to bring and use their own devices at work. It has become a popular term in the corporate world and more and more employees are bringing their personal devices like laptops, smartphones and tablets to work or use them remotely to access corporate information. BYOD empowers the employees by giving them the flexibility to work anywhere and whenever they want and on the device of their choice. Various surveys show that this makes the employees are more productive, interactive and satisfied.

In this generation of highly technologically advanced workforce, the employees demand a greater flexibility in how, when and where they can work and access data and information. With the ability to use their own device, people can be more productive at any time and from any place on their preferred smartphone, tablet or notebook. [13]

Organizations are either utilizing their existing IT infrastructure or implementing software-as-a-service (SaaS) apps to support the secure and efficient execution

of a BYOD policy. If the implementation of BYOD is done in the right manner, it maintains data privacy and also ensures the security of sensitive business information. Another advantage is that there is no need for a large IT team for device provisioning and maintenance and the IT department can instead focus on offering secure services, secure access to virtual desktops and apps, and cloud-based services. This is possible because people will naturally take better care of their own devices and have a better understanding of its full capabilities. Not only does this reduce the reliance on IT support, it enables organizations to set and achieve cost saving targets, including reducing device procurement costs and support expenses. [12]

II.   INTRODUCING A "BRING YOUR OWN DEVICE" POLICY TO THE CLASSROOM

Bring Your Own Device (BYOD) in the classroom means that the students will carry their own devices like laptops, tablets and smartphones to the class and use their own devices instead of depending on the devices provided by the school/ college. The adoption of bring your own device in the education sector can be motivated by two factors. One factor is cost cutting and the second one is adaptation of technology. The cost saving due to students bringing their own devices is a big factor to motivate the educational institutes to promote BYOD. The second factor of technology adoption is equally important. We are promoting usage of technology and also this leads to green education. It is always easier to keep a track of studies if using the same device in school and home. The concept of Bring Your Own Device is already very popular in the business sector and its advantages have been well understood. Now, a number of educational institutions are considering BYOD due to the benefits it can offer to classroom learning. Bring Your Own Device is a relatively new trend and its advantages and disadvantages are being explored to understand its implementation in both the business and education sectors [13]. On one hand, BYOD brings many benefits to the effective classroom learning, but there are many concerns associated with its implementation that leave many educational institutions pondering whether or not BYOD should actually be promoted. BYOD has already been implemented in a number of educational institutions across the globe but, not without in-depth consideration beforehand with regard to the method of implementation. A solid BYOD policy begins with identification of the issues that surround BYOD use in the classroom and by staff when outside the classroom. BYOD can work well in the education sector, provided we identify the benefits, challenges, drawbacks, and future implications of establishing a BYOD policy.

III.   WIRELESS ADHOC NETWORKS

An Adhoc network is a set of independent nodes connected together with a wireless link [1]. The nodes in the ad hoc network communicate with other nodes without any physical connection or fixed topology. The nodes can instantly form the network whenever the need for communication is established and communicate using radio waves. It is a distributed network and the nodes communicate with each other without fixed station access point (AP) or base station. [2]. Due to the absence of a centralized server, the nodes in an ad hoc network also act as routers to send and receive the data. The main advantage of adhoc networks is that due to their non-static nature, the single point of failure is avoided which makes them more robust and ideal. A wireless adhoc network also referred to as a mobile adhoc network (MANET) is a collection of two or more devices or nodes which are connected to each other through wireless communication media. The networking capability of these networks is established with or without the need of any centralized server or access point. These nodes can dynamically form a network to exchange information without using any existing fixed network infrastructure. It is an autonomous system in which mobile hosts are connected by wireless links and these nodes are free to act as nodes themselves or as routers at the same time as per the communication requirements of the network. All nodes in a wireless ad hoc network may have to act as a router and host at the same time as the network topology in an adhoc network is also dynamic and may change with nodes joining and leaving the network. These special features of Mobile Ad Hoc Network (MANET) makes this technology of great use but is accompanied by several challenges [8].

All the nodes and devices are responsible to organize themselves dynamically for the communication between each other and to provide the required network functionality in the absence of fixed infrastructure. Thus, in such kind of networks, the maintenance, routing and management are performed by all the nodes.

IV.   MOBILE AD HOC NETWORKS (MANET)

A Mobile Ad hoc Network (MANET) is an independent network of mobile devices that are connected over various wireless links. It works on a limited bandwidth. The network topologies are dynamic and may vary from time to time. Each node on a MANET may act as a router for transferring data among the connected devices. This network has the capability to operate by itself or it may be connected to a fixed network through an access point. The application of MANET can ranged from small, static networks that are limited by bandwidth and

power, to large-scale, mobile, highly dynamic networks [10].

Since a MANET does not require a fixed infrastructure, it is a highly suitable network in circumstances where fixed infrastructure is not available or is damaged due to a disaster and setting up of new infrastructure is not possible as it will be costly and time consuming.

The nodes on a MANET work as routers also and separate installation of routers is not required. This leads to quickly installation of the network with minimum user intervention. There is no central access point for the network and the topology is not fixed. Therefore, all the devices are free to move and can join and leave the network as per the requirement. MANETs can be connected to the Internet as different types of devices can be used in this network that can be made compatible with existing cellular network infrastructures to extend the coverage and interconnectivity.

V. IMPLEMENTATION OF MANETS FOR LEARNING

With the vast development of various technologies, learning today is no long confined in classrooms with lecture as the only method for conveying knowledge. Learning, which facilitates education using technology, has made learning possible from anywhere at any time by using the Internet, wide area networks, or local area networks. Mobile learning even allows people to learn on the move using portable devices, such as cell phones, personal digital assistants (PDAs), or laptops. The vision of mobile computing is that of portable computation with rich interactivity, total connectivity, and powerful processing. This small device is always networked, allowing easy input through pens and/or speech or even a keyboard when necessary and the ability to see high resolution images and hear quality sound. Mobile learning can be considered from two viewpoints: the first one is the technically oriented perspective regarding traditional behavioristic educational paradigm and tries to represent or to support them with mobile technologies. A main concern from this perspective is how to create, enrich, distribute and display learning material on mobile devices. The main benefits are to personalize the way of learning (where you want, when you want, what you want, as fast as you want, how you want etc.). The second one is pedagogical socio-cognitive and distributed cognition paradigm. In this viewpoint we explore traditional designs of teaching and learning to push community oriented learning like collaborative learning, problem based learning; informal and ad-hoc learning, etc.

Most of the learning arrangements focus on individual learning experiences. Participants are able to choose time and place where they want to precede the lessons. However, even in traditional leaning arrangements, where learning takes place in courses and learning groups, knowledge is spread among the group members and the net outcome, respectively the resulted knowledge gain for the group is greater than the sum of the individual gains due to network effects. Tools that support knowledge management in learning communities can be internet or intranet portals, wiki installations, forum software, classical online learning platforms, or other web 2.0 applications. The success of these applications, especially wikis and forums, strongly depends on network effects. The benefit for every single user who is contributing in such a community rises with the amount of members and the amount of postings. Usually, in common learning environments there is a limited number of participants. Therefore, network effects could hardly be realized. In many situations the need of being connected to a central server is a limiting factor for the growth of a learning community. Thus it is necessary to provide a network platform that can be used by members anywhere and anytime without the need of being connected to a central server. Most important is the way of communication that is used among participants sharing content without a continuous connection to the central repository. Mechanisms of ad hoc networking are used for off-course knowledge distribution.

VI. LEARNING SCENARIO IN A UNIVERSITY CAMPUS

In order to understand how learning system works in an adhoc network, we would set up an imaginary MANET in a university campus. A MANET consists of autonomous mobile nodes that are free to roam arbitrarily with no centralized controller such as router to determine the communication paths. Each node in the ad hoc network has to rely on each other in order to forward packets. This kind of nature of MANET requires mobile nodes to have good cooperation with each other to ensure that the initiated data transmission process is a success. This network is independent of any fixed infrastructure or centralized administration. A node communicates directly with nodes within its wireless communication range. Nodes that are part of the MANET, but beyond each other's wireless range communicate using a multi-hop route through other nodes in the network. These multi-hop routes changes with the network topology and are determined using a routing protocol. A node in an IP-based network is configured with an IP address, a netmask and a default gateway (the node to which packets for destinations not having an explicit entry in the routing table are sent). In a MANET, nodes should be able to enter and leave the network at will. Thus, the nodes should be capable of being dynamically configured by the network upon their entry into it. It may be argued that MANET nodes also belong to some home network, and could continue to use their home network IP address in the

MANET. However, in several instances a node does not permanently own an IP address: an IP address is assigned to the node when it boots up, and the node releases it on leaving the network.
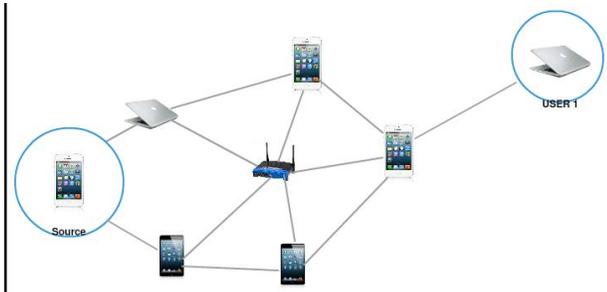

Figure 1: MANET IN A UNIVERSITY CAMPUS

Our example user, user1, is a computer science student. She is currently preparing for her and that covers several topic areas. At a particular time, she is at the campus cafeteria. She has brought her laptop along so that she can continue working. Before leaving home, she has downloaded the PowerPoint slides on a specific topic onto her laptop. After working through a few slides, she comes across an annotation mentioning a paper that explains a specific aspect in more detail. User1 tells her laptop that it should try to locate the paper somewhere and download it. User1 laptop is not connected to a fixed network. However, her laptop forms an ad-hoc network together with other nearby computers. Some of these computers (or rather their users) will have similar interests as User1 and might thus be able to provide the required information. Eventually User1 laptop finds another computer that not only possesses the paper in question but is also willing to allow downloading it. User1 works through the paper and then returns to the original slides. Even after going through all of them, she is not sure that she has quite understood the topic and feels that an example would greatly help her understanding. She asks the laptop to look for an example. It reports that while none of the computers currently participating in the ad-hoc network has stored the example, a computer that offers access to the fixed network has just joined. User1's laptop uses this computer's network connection to retrieve the example.

Thus we see here that using adhoc networks is a very useful method for implementing BYOD.

VII. CONCLUSION

The infusion of laptops, tablets and smartphones into our daily lives has brought a revolution in the process of how we communicate with the world and access information. The inception of the tablets and smartphones along with the communication technology like 4G makes the information revolution even more powerful and omnipresent in the lives of students and professionals alike. The education sector is currently experiencing the introduction of a digital wave that has a bright future ahead for technology based classroom learning. Bring your own device (BYOD) is a policy that brings the students closer to technology and makes them understand that the digital revolution is not just about social networking and entertainment but it is more important to enhance the learning process. It is important to teach the children how to effectively implement current technologies for their own betterment and for the betterment of the society and nation. By acknowledging the importance of mobile devices and other digital technology for the students the education sector is laying the foundation for a technologically sound workforce for the world.

The use of MANETs for education considers that the challenge for the future generation of educational systems is to develop environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion of users. The mobile telephone is becoming a trusted, personal device with Internet access, 4G/ LTE, and a range of possibilities for keeping the learner in touch with the institution's student support services, learning materials and fellow students and teachers even while on the move. By using MANETs for supporting BYOD, we can enhance the learning experience in a broad way. The students can access information stored at the central server of the university but this access to information is not limited to the centralized server only. The students can be a part of the adhoc network/ MANET which can be used for community study and information sharing among the peer groups.

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