

## Towards a Streamlined Wireless and Mobile Networking Course

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**Abstract:** This study attempts to look at the level of acceptability and applicability of a Wireless and Mobile Computing course. The students' views of the course over a few years are collected and analyzed. Some of the students would already have been working in industry and so could provide more meaningful feedback. The survey was conducted by the formulation of a questionnaire which was sent out via email to students who took the courses within the last three years. The aim of this study is to use the data gathered to revise syllabus/hours for a course that is relatively new worldwide. The findings are used and analyzed so that a more relevant course can be delivered and also other instructors may be able to use ideas here as a template for designing their own courses. Tertiary level schools in the Caribbean area may be able to benefit the most from this exercise. It should be noted that the initial ideas for the course came from ACM Computing Curricula.

**Key words:** Mobile computing, wireless computing, ACM curricula, syllabus, students

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### INTRODUCTION

This study attempts to look at the level of acceptability of a Wireless and Mobile Computing course. Data was gathered from students taking the course over a period of three years. Attempts were also made to contact the local service providers to gain information about relevant job vacancies and skills required. The old syllabus was then revised based on the data analysis. The revision process is ongoing and data is also being collected from future classes.

**Literature review:** The literature demonstrates the importance of the study of wireless and mobile computing in many studies (Vladimir and Clark, 2005) explained that wireless devices such as smart phones and PDAs were becoming increasingly popular due to the advantage of enhanced mobility and availability. They mentioned that in the field of education, where online teaching and Web services are well accepted and adopted, wireless access to student records, course content, course registration and other wireless Web services still were not available. They then went on to describe the analysis, design, architecture and experimental development of a Wireless Course Management System that provided wireless access to course information content. Bhagyavati *et al.* (2004) observed that due to the increasing growth in wireless networks, there was an urgent need for networking professionals to understand and implement emerging technologies. They explained that although most universities have risen to this challenge by adding wireless topics to their curricula, they have typically integrated these topics into their engineering programs.

Their study indicated that Computer Science programs have been slow to incorporate topics such as wireless programming and applications in their curricula. The study advocated the adoption of a strong wireless component in computer science curricula in the form of a separate course.

The rationale and benefits of such a course were presented along with an evaluation of an experimental course in wireless networking. Guidelines and recommendations were provided, which could be adopted by other institutions. This study is along the same lines. Mahmoud and Dyer (2007) describe their experience in integrating the RIM's BlackBerry handheld wireless device into programming and literacy courses at the University of Guelph and the University of Guelph-Humber.

The courses utilize labs heavily and students experiment with the wireless devices and develop and deploy applications for them. They believed that teaching computer programming in the context of simple wireless mobile applications provided a motivating framework for students and inspired them to work hard due to the practical experience they get which allows them to program their own cellular phones. The course and revised syllabus also teaches cell phone programming. Bhagyavati and McQueen (2004) explained that due to the explosion experienced by the communications industry, there would be a need for qualified programmers specializing in wireless applications. This had supported the importance of knowledge of wireless principles and confirms the idea that a separate course in wireless networking would be vital to computer science majors.

Again, the study supports this idea and refines the syllabus to better fit society and student needs.

#### **Previous syllabus**

**Rationale:** This course is recommended as an essential part of the Net-centric Computing component of the ACM Computing curricula (ACM Computing Curriculum, 2008). The current Computer Networks course deals generally with wired networking and the TCP/IP networking architecture.

An introduction to wireless networking is provided but there is insufficient time to delve into sufficient details of wireless technologies and protocols. Wireless hosts e.g., mobile phones, laptops, palmtops, PDAs, desktop computers as well as wireless links are becoming increasingly popular, hence there is the need to investigate the principles and protocols that make wireless communication possible. Bluetooth and 802.11 standards are among the topics to be discussed. The course closely follows the ACM Computing Curriculum (2008).

**Objectives:** Description of the main characteristics of mobile IP and how it differs from IP.

- Illustration of traffic routing with mobile IP
- Development of applications that rely on wireless data communications
- Investigation of current and emerging interests in wireless and mobile computing and current capabilities, limitations and potential of each

#### **Topics (ACM Computing Curriculum, 2008) (Hours in brackets):**

- History and Evolution of wireless standards (1 h)
- Special problems of wireless and mobile computing (1 h)
- Wireless local loops (1 h)
- Mobile internet protocol (1 h)
- Mobile aware adaptation (4 h)
- Mobile client/server networks (3 h)
- Mobile data access (3 h)
- Software support for mobile and wireless computing (14 h)
- The role of middleware (1 h)
- Performance issues (2 h)
- Emerging technologies (3 h)

**Data gathering:** Data gathering was done by use of a questionnaire that was emailed to students. Results were consolidated, analyzed and summarized. Web sites of wireless providers were visited for job specifications. Data is gathered and presented in appendix.

#### **Selected data responses**

##### **Section A: Expectations and intent:**

1. Why did you take the course Wireless and Mobile Computing?

I was told that it was an easy course and I needed credits to graduate.

Think it's a very interesting field also because its still developing.

It was a new course that looked interesting:

- (a) Wireless technology is a rapidly growing part of the computing world
- (b) A curiosity of how mobility is implemented for cell phones.
- (c) The practicality of the course when compared to other courses

It is an area in the computing field that is being developed so I thought it was a way To keep up with recent technology.

To make up credits.

Good telecommunications technology experience and aid in job seeking.

To learn how to set up a wireless network and understand how to trouble shoot one.

It seem interesting.

Telecommunications and wireless systems becoming more popular. Wanted to learn more. Also telecomm industry expanding in Trinidad. Would have made me more marketable.

My personal interest is that of networks therefore learning about all different aspects is top priority for me.

It seemed to be a very interesting course in terms of its coverage of recent happenings in the mobile arena.

I enjoyed Computer Networking (a pre-requisite to this course), so I decided I might

Enjoy this course also. Furthermore I was interested in Mobile applications.

To understand the fundamentals of existing Wireless technologies and to get hands on experience in configuring wireless devices add to my skill toolbox.

Interested in wireless networking and the underlying wireless devices that sit on the backbone of the Wireless Networking infrastructure.

I was/am intrigued by the nature of wireless applications and the hierarchy on which they operate

I am interested in networking

It was relevant to today's evolving technology

2. What did you expect to learn from this course?

A lot of Theory about wireless networks.

How wireless systems function and how to work with and set up different wireless devices.

How wireless technology was incorporated into the computer technology:

(a) To what degree wireless networks differ from wired networks

(b) How to set up a wireless LAN

(c) How cellular technology works

About wireless and mobile technology from the computer science perspective at the Theory level but more so the practical level.

To be able to do cool things with my phone and laptop etc.

To be able to understand mobile technologies and utilize wireless networks in a distributed environment.

How wireless hosts communicate and aspects of their communication with other wired and wireless hosts.

To complete the networking courses offered. Networking is fun and cool.

To learn how to set up a wireless network and understand how to trouble shoot one.

I expected to learn plenty about wireless and some of the inner workings of mobile.

Technology that I would be able to use in future career moves.

All about wireless networks, cellular systems, wireless technologies.

How to function in the ever changing environment of a wireless network.

A first hand knowledge of the major components of the mobile industry.

I expected to learn how wireless networks function and possibly how to set up a Wireless network. Also how to create mobile programs.

Understanding the various wireless technologies, configuring wireless devices, wireless security.

How the wireless network operates and how the devices on network interact with each other.

The environment in which mobile applications operate and how the platforms respond to the requests of the said applications.

What is behind wireless communication and how does it work.

3. Were your expectations met?

Yes to a certain extent.

Most were. I thought the course was focused mostly on mobile programming. However still appreciated it

Yes they were, wish all courses were interesting like this one.

Yes. This course was taught in a very practical manner and I understand how wireless technology works and how it is applied in the real world. It was also very nice doing MIDlet programming.

The theory part was very thoroughly covered and a lot of practical computing was done as well, however the practical expectation was not met because I expected more demonstrations of practical class room work on real life devices and applications.

Yes

Yes

Yes

Mostly

Most of it was met, stuff I took for granted with wireless was explained. Mobile I

Was hoping for a little more

Yes. As a student in the pilot class, I think the material covered went beyond what I Expected. The classes were very informative and interesting.

Yes for the most part maybe a little more practical approach in terms of uploading midlets and see how they interact with a server would have been helpful and good exposure.

Yes

Yes for the most part.

Yes

Yes. In both the WLAN and LAN courses.

To some extend. It is understandable that the course will be fairly limited in terms of its coverage but it was most informative in a holistic view.

Yes, actually went beyond my expectations with midlet programming.

Yes

4. Before taking this course, did you consider a career in the wireless and mobile computing field? If yes, do you believe your experience with this course will help you secure a job?

No.

Did not consider it before taking the course but afterwards I do think the experience can make a contribution to help secure a job. However, not sure on what 'wireless jobs' require

After taking this course it made me interested in wireless technology.

No, however this course has given me a foundation in wireless technology. I believe when applying for jobs with cellular companies like (TSTT and Digicel), knowledge gained from this course will be very useful.

No, I did not consider a career specifically in the field.

No not really

Yes, the experience in the course will be helpful, however not providing any certification.

No, did not consider career in this field.

Yes I wanted to be involved in wireless usage and I believe it will especially the gsm part.

Yes and yes I believe my experience will help.

I actually only considered a career in this field, while taking the course. I enjoyed It and realized it was a lucrative career.

Yes, the experience I have gained would help in my understanding of the wireless networking field and how I should function in it and understand the need to adapt due to its ever changing state.

Yes

Yes, it was a possible career choice as for securing a job, the wireless aspect of the course will aid in that however, the mobile apps part may not help regionally.

Yes, employers favor potential employees with a multitude of skill sets and I believe this course was an asset in securing employment.

I honestly did not consider it a career path. I was simply extremely interested in it. Now, I do site visits for wireless proposals and configure wireless devices along with other products situated on the LAN as well as the WLAN.

No I did not, however after taking the course my interest was peaked.

No

Yes, I believe it gave me a great foundation

**Section B: Prerequisites:** The prerequisite for this course is Computer Networks.

1. Do you think knowledge gained from the prerequisite was necessary for understanding the material in this course?

Computer Networks is not necessarily needed as a preq but definitely would alleviate the amount of work that would have to be done in the course.

Yes I do agree especially for students who started programming in C at year one.

Yes it was, it provides the basic understanding and underlying principles for the course.

Yes

Yes

Yes

Yes

Yes it was.

Yes I think all that was taught was adequate.

I believe it would help but its not necessary.

Yes

No

Yes

Yes the course material from the prerequisite was fundamental to understanding the wireless course.

Yes absolutely.

Thi I think it made understanding the course easier but I do not believe it was necessary in order to grasp the concepts

No. A better prerequisite would have been Object Oriented Programming

Yes

2. Do you recommend any alternative/additional prerequisites?

No

No

Not currently, maybe 20A if the class gets too large.

No

No

Not really

Prereq for the prerequisite theory of computing assistance in the finite state machines

Internet Technologies should be done alongside this course, not necessarily as a prerequisite

Nope

Some practical it setting up networks once time premits

Hmmn like I said, I basically did the course without any major knowledge about Networks and it was not a problem to understand the material and do well. I think More practical work could have been done as far as the mobile (cellular) aspect is concerned. Possibly some sort of interaction with a mobile partner like Digicel could be looked at?

No

No

Some form of basic JAVA or C programming.

No

Networking is vast in the number of different aspects you can get into. If it is basic networking this course meets the requirements.

Object oriented programming is a course that will help with understanding the way the even handlers, for example, operate however again it may not be absolutely necessary

No

**Section C:**

**Component**

**Basic theory**

Comments:

**WiFi practicals**

Enjoyed this and wish more in-depth was done

The WiFi practical was useful in understanding the importance of channel selection and the importance of the various threshold levels for example (Fragmentation threshold).

It was a great help to get hands on as it made the book content clearer

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**Research theory**

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Comments:

I am assuming Research Theory to be (the section on Application Aware/Transparent). This section provided useful knowledge on how the challenges associated with wireless technology are currently being overcome. For example (The use of Proxies).

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Did you have previous knowledge of any of the areas covered? If so, what was the source of this information?

**CCNA studies**

**WiFi Practical:** Create small home wireless networks  
Wireless LANs self taught.

No

No

No

Yes, DSL modem and router setup

Prereq and internet technologies

Yes, hands on stuff.

None

No

No

Yes, the sources: the internet and my brother.

Yes on Wireless links and Network Characteristics and wireless LANs from previous work experience and research on the internet

I had no previous information

No

No

No

**Section D: Afterthoughts and recommendations**

1. Are there any topics that were not covered that you think might be useful?

Multimedia programming for mobile devices.

No

Mobile computing could be a little more in depth.

Off the top of my head, I think Security Issues in Wireless Networks will be a useful topic.

Everything was covered in depth but very theoretical.

Not at this point in time

No

No I don't think so.

Windows Mobile Development

No

None comes to mind.

Wireless/Network security

Now that I am in the industry, there are so many aspects. I am not sure if we went into too much detail in WAN technologies. Storage on the network is great also. There is also security on both wired and wireless aspects but just touched on these.

No

2. Do you have any other recommendations regarding this course?

Too much emphasis was made on research material which seemed really distantly related to the rest of the course. More relevant material can be added while this could be reduced.

The practicals can be a little more in-depth

Try to make it realistic to the real world meaning, relate the topics on technology that is being used in the country and internationally.

If it is possible. It will be nice to simulate some of the problems with wireless networks in lab. For example simulate:

- (a) Two wireless LANs on the same channel
- (b) Interference of a LAN by a cordless phone
- (c) Hidden Terminal (This may be technical to simulate)

Make the demonstration of the executed MIDlet on an actual phone an integral part of the course. Assignments/projects can be more practical and applicable to real life situations, example demonstrating mobile IP by having students check the IP address of their portable laptop at different locations eg campus or and then explaining the reason(s) for similarities/differences and why.

No

No

Nope

Include some material on security mobile security especially.

Show some practical scenarios at work like cell phones interacting with a server using midlets that we wrote.

If there is any additional practical that can be done, it should be included in the

Course.

Have more practical labs

I have Cisco certifications and did a good bit of Cisco exams and courses. The Cisco CCNA course syllabus is

very similar to the Networking courses I did in UWI but entails a great bit. This course can be a great reference including the books.

As a demonstration a full wireless network should be implemented.

No, very balanced course

Note that the above comments are used for a revised syllabus.

**JOB SPECIFICATIONS**

One of the providers had a job involving the detection and prevention of service affecting the entire communication network. Students pursuing the wireless and mobile course would understand the architecture of the system and have some insight into how to track down problems at MSOs (Mobile Switching Offices), cellular towers etc.

Working with the actual hardware and radio devices is also important and this can be covered in a wireless course by the electrical and computer engineering department. Remember that one department may look at technology from a different perspective from others.

The position is also responsible for maintaining the integrity and availability of data and/or reports from the systems in a timely and accurate manner as well as assist new Digicel markets in setting up and maintaining their Network Management systems.

Another vacancy required a manager responsible for the operations and maintenance of the IP/GPRS network. These networks are covered between the networking course and the wireless and mobile computing course.

Another vacancy was for an Application Developer with the wireless carrier. Skills like MIDlet creation and deployment, servlets, Bluetooth programming etc. would be quite useful in this case.

It should be noted that many useful application e.g., for rural communities and farmers can be developed using SMS. The new syllabus therefore spends more time on learning these tools. Vacancy information was obtained from (<http://www.digiceltt.com>).

**DATA AND ANALYSIS**

Figure 1 shows the average career relevance of the major topics. All topics received an average of 6 or above. Multimedia programming for mobile devices is a main topics to be included. Programs would be written to play Mp3 and audio files in the next running of the course. More network simulations would also be done.

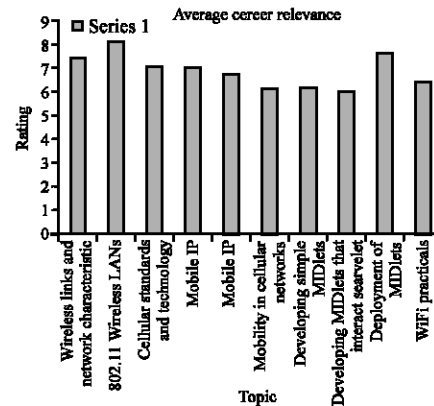


Fig. 1: Average career relevance

**CONCLUSION**

A survey has been conducted using information from 3 years of cohorts from a Wireless and Mobile Computing course. The comments showed that the existing syllabus remains relevant to the local student population examined with room for some basic improvements which would be incorporated in the next sitting of the course. Institutions running similar courses can benefit from the content of this study. Instead of using trial and error, they can use the original syllabus and the incorporate the changes recommended by students. However, with the dynamics of computing overall and rapid developments in the field of wireless computing in particular, one has to always be looking at current trends with a view to revising what is offered.

**APPENDIX**

**Section A: Expectations and intent:**

1. Why did you take the Wireless and Mobile Computing course?

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2. What did you expect to learn from this course?

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3. Were your expectations met?

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4. Before taking this course, did you consider a career in the wireless and mobile computing field? If yes, do you believe your experience with this course will help you secure a job?

**Section B: Prerequisites:** The prerequisite for this course is Computer Networks.

1. Do you think knowledge gained from the prerequisite was necessary for understanding the material in this course?

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2. Do you think knowledge gained from the prerequisite was adequate for understanding the material in this course?

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3. Do you recommend any alternative/additional prerequisites?

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**Section C: course content:** Please rate the following topics in the various categories on a scale from 1-10, 10 being the highest.

Component	Interesting	Challenge	Useful/relevant to personal life	Relevant to career goals
<b>Basic theory</b>				
Wireless links and network characteristics				
802.11 Wireless LANs				
Cellular standard and technologies				
Mobile IP				
Mobility in cellular networks				
Comments:				
<b>Programming</b>				
Developing simple MIDlets				
Developing MIDlets that interact serv lets				
Deployment of MIDlets				
Comments:				
<b>WiFi practicals</b>				
Comments:				
<b>Research theory</b>				
Comments:				

Did you have previous knowledge of any of the areas covered? If so, what was the source of this information?

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**Section D: Afterthoughts and Recommendations:**

1. If you had not considered a career in this field before taking the course would you consider it now?

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2. If you considered a career in this field before taking this course have your goals changed?

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3. Are there any topics that were not covered that you think might be useful?

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4. Do you have any other recommendations regarding this course?

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