

# [Survey of wireless computing 18595 essay](https://assignbuster.com/survey-of-wireless-computing-18595-essay/)

Survey of Wireless ComputingWireless technology can provide many benefits to computing including faster response to queries, reduced time spent on paperwork, increased online time for users, just-in-time and real time control, tighter communications between clients and hosts. Wireless Computing is governed by two generalforces: Technology, which provides a set of basic building blocks and User Applications, whichdetermine a set of operations that must be carried out efficiently on demand. This paper summarizestechnological changes that are underway and describes their impact on wireless computing developmentand implementation. It also describes the applications that influence the development andimplementation of wireless computing and shows what current systems offer. Wireless computing is the topic of much conversation today. The concept has been around for sometime now but has been mainly utilizing communication protocols that exist for voice basedcommunication. It is not intended to replace wired data communication but instead to be utilized inareas that it would be otherwise impossible to communicate using wires. Only recently has the industrybeen taking steps to formulate a standard that is more suitable to data transmission. Some the problemsto be overcome are:(1) Data Integrity – relatively error free transmission,(2) Speed – as close as possible to the speed of current wired networks,(3) Protection – making sure that the data now airborne is encoded and cannot be tapped by unwelcome receivers,(4) Compatibility – ensuring that the many protocols that sure to be created subscribe to a standard to allow inter-operability,(5) Environmentally safe – strengths of electromagnetic radiation must be kept within normal levels. In our study of the theories and implementation concerns of wireless computing, we found that it isbeing treated in an object oriented fashion. Scientists and development crews, including the IEEE, aredoing their best to implement wireless connectivity without changing the existing computer hardware. As a result, a lot of focus is on using existing computer hardware and software to convert data to aformat compatible with the new hardware which will be added to the computer using ports or PCMCIAconnections that already exist. This means that wireless communication will be transparent to the userif and when wireless computing is utilized on a wide scale. Wireless computing applications covers three broad areas of computing today. Replacement of normalwired LAN’s need to retain the speed and reliability found in wired LAN’s. Creation of semipermanentLAN’s for quick and easy setup without the need for running wires. This would be necessary for eventssuch as earthquakes. The last category is that of mobile computing. With advent of PCMCIA cards, notebook computers are being substituted for regular desktop machines with complete connectivity ofthe desktop machine. However, you lose the connectivity when out of the office unless you have awireless means of communicating. On the compatibility issue, the ability to mix wireless brands on a single network is not likely to comesoon. The IEEE Standards Committee is working on a wireless LAN standard — 802. 11, which is anextension of the Ethernet protocol. Because the field of wireless communication is so broad, the IEEEwas not able to set a standard by the time private researchers were ready to test their theories hoping toset the standard for others to follow. 2 MethodsThere are a few methods of wireless communication being theorized and tested. (1) Radio: This is the method that makes use of standard radio waves in the 902 MHz to 928 MHz frequency range. Although these frequencies are well used, methods have been developed to ensure data integrity. Spread spectrum transmission of data is a method where the transmitter will send information simultaneously out over many frequencies in the range increasing the change that all data will eventually reach the receiver. Frequency hopping is an additional measure that also enables data security. The 26 MHz range of frequencies is further divided in to channels. The transmitter then sends out data hopping from one channel to the next in a certain pattern known to the receiver. Within each channel, spread spectrum transmission can be used to maintain interference avoidance. Some of this transmission manipulation can be avoided by transmitting at a frequency that is less used. Some developers have tried transmitting in the gigahertz range. The disadvantages here are: 1) Higher frequencies mean shorter wavelengths and shorter wavelengths do not penetrate solid objects like walls and floors; 2) The same transmission strength employed by lower wavelength transmitters yields a shorter range at higher frequencies. This means that transmission strength will need to be boosted something hard to accomplish using portable tools and potentially dangerous to humans; 3) Transmission frequencies of 3 GHz and higher are licensed by the Federal Communications Commission. Developers in the range have the additional hassle of obtaining a license every time an installation is done. (2) Laser: Laser-based communication is the fastest way to communicate without wires. Information travels at the speed of light. The drawbacks however far outweigh the speed advantage and prevent this method from becoming the standard. The major drawback is that communication is restricted to line of sight. Also, very thick fog or blizzard conditions will diffuse the laser beam and causing interference and reducing data integrity. (3) Infrared: This method is similar to Laser. High speed communications are easy to achieve using this method. However, it suffers from the same problems that plague laser communications. It requires line of sight transmission and can be disrupted by strong ambient light. Infrared wireless computing exists more commonly in the form of peripheral connections in a small area. (4) Cellular connections although expensive to use now is the area of much development by private companies. Cellular computing can be likened to the current wire-based internet network. Data is packaged in to units, size of the unit is dependent on the actual hardware, and is sent to the nearest participating cell. That cell then forwards the packet to the next cell and so forth until the packet reaches its destination.(5) Microwave: This method of communication has been utilized for quite some time now. However this method has makes little provision for data aware transmission. It used extensively in Europe where wired transmission of any type including voice is poor. For data transmission, a lot of technology is utilized in packaging the data into a form that is compatible to voice communication. On the receiving end, the process is reversed. The advantage of this method however is that communication can be accomplished using existing satellite connections making worldwide connectivity possible. 3 StandardsThe IEEE 802. 11 committee has voted to create a minimum requirement for wireless computingconnections. In their consideration:(1) Use the frequencies 2. 4 to 2. 5 GHz. This is in the low end of the high frequency spectrum and is currently not licensed by the FCC. (2) Use spread spectrum technology. Compared to the current bandwidth 26 MHz, 902 MHz to 928 MHz, the range 2. 4 to 2. 5 GHz yields a bandwidth of 100 MHZ. Spread spectrum transmission now gives 385% percent increase in data reliability. (3) Many more sub-channels can be formed in a bandwidth of 100 MHZ. This increases the capability of frequency hopping which in turn yields greater data security. (4) Utilize Gaussian Frequency Shift-Keying. Frequency shift-keying is a form of frequency modulation in which binary signaling is accomplished by using two frequencies separated by some Df Hz. The frequency duration is small compared with the carrier frequency, fc. A signal received at frequency fc, would represent a digital low and signals received at frequency fc + Df, would represent a digital high. Note that this does not interfere with spread spectrum or frequency hopping capabilities since those function on frequencies separated by 1 MHz or more. As part of setting a wireless standard some modifications of the standard set by the IEEE 802. 3committee have been adopted. The most significant of these is the modification to the carrier sensemultiple access / collision detection, or CSMA/CD, protocol used in wired networks today. This is amethod whereby any machine at any time, wishing to send a message on the net, will first send a tokenout to ensure that a carrier exists (network ready). After establishing this, the message will be sent. Because any machine may send at any time, collisions of information will occur. If any machine detectsa collision, it will send out a jamming signal to all the others. All machines will then wait on a randominterval timer after which they will try to send again. For wireless networks however, since a machine is not in constant communication with the rest of theLAN, detecting a collision and notifying all other machines on the net is impossible. A modificationin the way of the collision handling had to be made. A method known as collision avoidance isemployed to create theCSMA/CA standard. In acollision avoidance strategy, thenet estimates the average timeof collisions and send ajamming signal at that time. Awireless transceiver will notonly sense a carrier but will alsolisten out for the jammingsignal. When all is clear it then send its message. This collision avoidance method has two drawbacks: 1) It cannot completely filter all collisions since it operates on estimated times of collisions; 2) and ifit did, it slows the network significantly by sending jamming signals whether or not a collision actuallyoccurs. 4 Physical LayerMuch of the focus of wireless computing development is centered on the physical and media accesscontrol layers of a system. It is on this level of the LAN protocol of which wireless products likemodems and transceiversOn the physical layer issue, the 802. 11 is focusing on the one proposed by Apple ComputerCorporation. The Apple physical-layer protocol appears the most robust of any considered to date in 802. 11. Apple’ssystem is a full-duplex, slow frequency-hopping protocol. By using a frequency-hop spread-spectrumradio, the system fits with the spread-spectrum methods of virtually all 802. 11 specifications. Apple splits the data-transport protocol into two layers:- The RF Adoption Layer is similar in some respects to cell-based data protocols, such asAsynchronous Transfer Mode and IEEE 802. 6 Switched Multimegabit Data Services; like ATM and802. 6, the RF Adoption Layer includes segmentation/reassembly functions and Protocol Data Unitgeneration functions, and it also includes Forward Error Correction (FEC) generation and verificationfunctions which substantially increase packet integrity in wireless environments but adds FEC overhead. – The RF Hopping Protocol Physical Layer consists of a transmission convergence sublayer includingheader generation, RF framing, and RF hopping protocol functions and the physical- medium-dependentsublayer, in which the actual characteristics of the RF channel are handled. In the RF Adoption Layer, a Protocol Data Unit is split into three segments, and two error-correctingdata units are added. The RF Hopping segments, and two error-correcting data units are added. The RFHopping Physical Layer builds special Burst Protocol Data Units out of the data and FEC units and usescarrier-sense methods borrowed from Ethernet to determine whether an RF Hop Group is clear fortransmission. Each hop group consists of five separate radio channels. The controller scans hop groupsvia state-machine operation with four states: scan, receive, carrier-sense, and transmit. In early tests atApple, the hop system showed 80-microsecond hop times, 57-microsecond clock recovery, and a5-microsecond lapse between the time an empty channel is sensed and transmission begins. Since eachcluster of wireless LANs can use different hop groups, multiple LANs could operate in the same areawithout interference. One concern is whether the overhead for error correction for each packet, whichcan be as much as 50% is too high to give the proposal a chance. The safety of those operating new equipment now plays a larger role in determining the direction oftechnological growth now more that ever. Factors under consideration are the effect of infrared andstrong electromagnetic radiation that would pervade the workplace on the workers. This limits thestrength of and communication device that would be used in accomplishing transmission. For the Personal Computer. The adapters have a small attached antenna through which they send andreceive network traffic as radio signals. Some wireless products are small boxes that attach to your PC’sparallel port. In either case, the signals may travel from PC to PC, forming a wireless peer-to-peernetwork, or they may travel to a network server equipped with both wireless and standard Ethernetadapters, providing notebook users a portable connection to the corporate network. In either case, wireless LANs can either replace or extend wired networks. Standards are lacking. Wireless networking is still a technology looking for a standard, which is whyvery few wireless products can work with one another. Each vendor uses a different protocol, radiofrequency, or signaling technology. If wired networks still operated like wireless, you would have touse the same brand of network interface card throughout your network. Right now you are, for the mostpart, tied to whichever brand of wireless LAN you pick. Most of the products in this comparison listedtheir wireless protocol as Ethernet carrier sense multiple access/collision avoidance (CSMA/CA), avariation of standard Ethernet. Unfortunately, each vendor has put its own spin on CSMA/CA, whichmeans even their protocols are incompatible. 5 Wireless servicesAs technology progresses toward smaller, lighter, faster, lower power hardware components, morecomputers will become more and more mobile. For space concerns this paper will exclude any furtherdiscussion of the hardware developments toward mobility except for devices directly related to wirelessconnectivity such as modems. A wireless computer is not connected via a wireline and thus has mobility and convenience. A wirelessLAN provides the convenience of eliminating the wires, yet is not necessarily mobile. (What is mobility?) Mobility is a characteristic where the wireless computer may connect, loose the physical communication (possibly due to interference) and reconnect (possibly to another sub-network) and retain its virtual connections and continue to operate its applications. The network protocols will be discussed later. (Then, what is portable?) Portable is defined that the wireless computer may connect, loose the connection and then re-connect, as well. However, the mobile unit will have to restart if it is reconnected to another sub-network, requiring that running processes be shut-down and windows closed. Mobility may be limited by the wireless service subscribed. Four basic service zones are described: Global/National service zone: Ubiquitous radio coverage throughout a region, country or the entire globe, low user densities, and minimal bandwidth requirements. Typically satellite systems. Mobile service zone: Radio coverage in urban, suburban and populated rural areas, medium to high user densities, low to medium bandwidth requirements (tens of Kbps), and high vehicular speed. Cellular (AMPS) system is a good example. Local/micro service zone: Radio coverage in densely populated urban areas, shopping malls, and transportation centers. High enduser densities,

medium bandwidth requirements, hand-held portable terminals, low-speed mobility. Indoor/pica service zone: in-building radio coverage, low to high user densities, medium to high bandwidth requirements (Mbps), very low mobility. Prior to the cellular phone network, base station radio covering a single cell geographic area with a fixednumber of channels was the only service available. The cellular phone service divides the service area into cells and assigns a subset of the availablechannels to any given cell. This way the channels can be reused and interference from neighboring cellsis reduced. The system tracks the active mobile unit, delivers calls, and maintains connections as unitsmove between cells (Hand-off: a realtime transfer of a call between radio channels in different cells). This system is called Advanced Mobile Phone Service (AMPS). Current cellular systems use analogFM technology. However, implementation of digital radio technology is being deployed now. Thesesystems utilize Time Division Multiple Access (TDMA) or Code Division Multiple Access (CDMA)to increase throughput up to ten times the previous analog system. Additionally, end users will accessa wider range of telecommunications as the implementation of integrated services digital network(ISDN) principles are utilized. Personal Communication Services, similar to the current cellular system, will soon be available from the larger telecommunication services, but with reduced price and wideravailability. WirelessAdvantagesLimitationsTraditional Cellular no restrictions on length or type of data transmission national coverage bill by minute potential line interruptions, congestions in urban areas limited throughputCDPD enhanced technology for data over cellular bill by message size integrated voice and data packet switching error correction techniques lack of applications development not fully developedDedicated packet switchedmobile networks integrated applications and communications no call setup time inherent reliability and security of packet switching coverage not full nationwide limited packet size require specialized modemsdata onlySpecialized mobile radio voice and data vehicle based limited coverageSatellite-enabled networks geographic reach expensive equipment and service costsThe application of the wireless computing system determines the type of wireless medium system to beemployed. Circuit switched or packet switched, both are available through wireless technology andprovide connectivity. Circuit switched systems provide a continuous connection established to thedestination by the switching system. The most popular examples are the wireline public switchedtelephone network (PSTN) and cellular telephones systems. This method of communication can berelatively expensive. If the phone systems offers voice grade bandwidth, then a standard modem canprovide speed of 14. 4 Kbps (at the time of this writing). However, if a digital line is provided thenhigher communication rates can be achieved with more specialized equipment. Packet switched systems provide a delivery system of information packets. The packet contains the dataand an address to the destination. Packet switching is far less expensive than circuit switching. Examples would be RAM, ARDIS, and Internet networks. Packet radio networks have been the targetof many studies since the military has a vested interest in the communication medium. Concerns suchas reliability, throughput optimization and re-routing of packets have been recent topics. Packet SwitchedSystemsARDISRAM MobileDataCircuit CellularCDPDNetworkCapacity1, 300 basestations inapprox. 325metro servicearea (MSA)840 base stationsin 210 MSAs8, 000 cell sitesin 734 metroareaspotentially entirecellular networkCoverage (citiesand towns)10, 7006, 300NANATransmissionspeed4. 8Kbps. 19. 2Kbpsupgrade in majormetro areas8Kbps38. 4Kbps to56Kbps19. 2KbpsMessagecapacity256 bytes512 bytesNA114 bytesNationalroamingcompleted bymid Sept 94yesnoyesIn-buildingcoverageyestop 20 MSAs byJune 1993limitedlimitedCellular Digital Packet Data technology (CDPD)utilizes the space between the voice segments oncellular (AMPS) network channels and inserts adata packet. The user pays only for the packetsent as opposed to a cellular circuit switchedconnection. CDPD cellular communicationssystems such as the Ubiquity 1000 from PCSI, offer packet burst rate of 19. 2 Kbps with fullduplex. This CDPD modem offers the option touse circuit switched cellular, wireline PSTN andvoice support. However, in a large urban areawith thousands of stations using any packetswitching service at current speeds, delay may beunacceptable. Satellite can be used as long distance links withinwireless networks. Three major projects havebeen proposed. The Teledesic system, composedof 840 low orbit satellites, was proposed by BillGates (Microsoft) and Craig McCaw (McCawCellular). Second, the Pentagon, solicited asystem, using 1, 000 smaller satellites, from TRW and Martin Marietta. Both the Teledesic and thePentagon systems cost around $9 billion. The third system, called Iridium, from Motorola, will use 66satellites to offer mobile phone service all over the globe. This project will begin this year and the restin place by 1996. 6 SoftwareSoftware concerns in a wireless computing environment can be broken into two areas, system andapplication. 7 System SoftwareNetwork operating systems must be able to handle the uniqueness of a wireless computer. Advancedoperating systems utilizing distributed technology must be adapted to the specific communicationmedia. The advancement of technology has provided that even mobile computer systems the size ofnotebooks are capable of internetworking as a host in global networks. Mobile host protocolscompatible with TPC/IP have been developed to allow continuous network connectivity where ever thehost may be. Due to the unpredictable nature of wireless connections, even operating systems may haveto be written to provide support services for mobile network. The WIN\*OS, a micro kernel for awireless-compatible operating system, was developed to “ support concurrent and composable objectsand coordinated communication among groups of objects through a process of agreements.” 8 Application SoftwareApplication software concerns in the wireless computing environment vary depending on the type ofapplication and wireless medium used. For example, E-mail software must know how to communicatewith the packet switched network as compared to the traditional cellular network. Software developerkits (SDK) and application programmers interfaces (API) are usually available by the service provider. Remote access software allows the remote user to connect to a host workstation to view the screen andcontrol the keyboard as if the user was there. The data does not have to be communicated to the remoteuser and thus allows processing locally. Carbon copy and PC anywhere are among the programs whichprovide remote access for microcomputers. High baud rate is needed especially when a graphical userinterface (GUI) is used. 9 Wireless Local Area Networks (WLAN)WLAN offers the same features as a wireline LAN but without the wires. Coverage can range from aroom to a building to a “ campus” (wide-spread, multi-building). Both stationary desktop systems andmobile notebook computers can connect using specialized wireless LAN adapter cards. Anotherconfiguration allows wireless additions to current networks. Wireless Hubs have been developed whichbridge the wireless units into the wireline network. As mentioned before, during the recent naturaldisasters in California, the Federal EmergencyManagement Agency (FEMA) set up field officeswith WLAN very quickly. Here is a great exampleof how WLAN can be used: An ETHERNETconnection over a radio link provided data from alow-power PC in a buoy to a PC on a ship. Thesystem provided a megabyte/sec data rate for fourdays while guaranteeing error-free delivery ofdata. Even more incredible is the MBARIacoustic LAN. Since under water, radio wavestravel only a few feet but sound waves can travelfor miles, the acoustic LAN uses the better carrierof wireless data signals. The acoustic LAN hastwo 5Kbps data channels and two slow-speedcommand channels. The LAN is used tocommunicate with tilt meters and buoys. Personal Data Assistants (PDA) are the newhandheld computers which also have wireless options. Using a pen-based GUI operating system, theapplications are accessed from local storage. Fax, data and voice can be transferred to and from thePDA via cellular phone system. The AT&T EO can run a program called Gnosis which when alsoloaded on a remote server host will allow the user to search for documents and have them downloadedin minutes including graphics. Even though all these nifty devices such as radiomodems and PDAs are developed and marketed, a recent study of mobile professionals shows thatcurrently relatively few spend time far from theirdesks. In fact, only 13 percent of mobile usersspend time outside their metro area and just 1percent outside the country. As the technologybecomes more common place, more users willfind themselves moving further out of their wiredareas and into the wireless field. 10 SecuritySecurity becomes essential in wirelesscomputing. Especially since the data isbroadcast to the receiving unit. InternationalStandards Organization (ISO) has publishedsecurity services which provide for secure dataand computer systems on standard wirelinenetworks. However, these must be modified tomeet the needs of mobile users and systems. Data encryption and Two possible solutions includeexchanging security information between a small number of entities, or even more complex involvingan information center. Infrared offers the least problem of security due fact that stations must be in the line-of-sight and thelimited area of coverage, usually one room. Spread spectrum RF transmissions spread the data over arange of frequencies making interception extremely difficult. Also, low power limits the coverage area, although the signal will penetrate walls. Cellular phone networks offer no security of their own. Eventhough listening to these transmissions has been made unlawful, the signals can be overheard by a radioscanner. Data encryption is left up to the connecting unit. Packet radio offers inherent data security byscrambling the data packets. Clipper chip will replace the digital encryption statndard (DES). The Clipper chip boasts to be 16million times stronger with 80-bits as compared to the old DES, which has a 56-bit binary key. Thischip will be used in many communication products, especially wireless. The Department of Justice andAT&T will be installing them in their telephone products. The controversy about these chips stems fromthe fact that they are programmed with a back door. The government can, with a court order, accessthe chip and monitor the communication. 11 ConclusionIn the relatively short time of the Information Revolution, the world has seen several technologies, firstintroduced as “ convenient”, become “ essential” the basic structure of the modern lifestyle. Theautomobile, telephone, and the refrigerator are easy examples to cite. The wireless revolution willtransform another “ convenience” to a necessity. “ Emerging wireless systems will provide the technologyto allow people and machines to communicate anytime, anywhere, using voice, [video,] data andmessaging services through telecommunications.” The wireless revolution began with the introductionof the cellular phone networks. This coupled along with the reduction in size of the microcomputer andan increase in the applicable technologies. After surveying the many aspects of wireless computing, several areas stand-out and appearently requirefurther research and development. Among those are mobile internetworking protocols, which wouldallow a mobile host to connect to any part of the network. Mobile “ aware” operating systems wouldfurther allow more features catering to mobile users. Features such as built-in APIs in the OS kernelavailable for specific applications which would provide services pertaining to suspend/resume and storeand forward operations. Standardized mobile networking protocol will allow interoperability betweenopen wireless systems. Advanded signal processing and speech coding techniques will allow moreefficient use of bandwidth and data transfer speed. Security research at all levels will continue to remainan issue and must stay one step ahead of the criminal elements. All of these areas will help to bringabout the wireless computing revolution. 12 About the authorsChristopher xxxxx Christopher xxxxx is a first year Computer Science graduate student of Florida International University. He is also an operations systems analyst for xxxxxxxx xxxxxxxx xxxxxxxxxxx xxxxx of Florida where he participates in the implementation of a DB2/Client-Server operating system. He graduated with a Bachelors in Computer Science from FIU in 1992. His current interests in research include mobile computing and visual object oriented programming. David R. Xxxxxxxxx David R. xxxxxxxxx is currently a Master’s degree candidate at Florida International University where he originally graduated with a Bachelors degree in Computer Science in 1986. He also designed cirriculum and taught lower and upper division computer classes for the School of Computer Science at FIU. For six years he has been employed at xxx xxxx xxxxx as Accounting/Informations systems manager. He is an avid user of mobile computers and advanced technology. 13 References” CDPD The future of cellular data communications”, PCSI, Inc., San Diego, CA, Noveber 1993. “ Infrastructure in the sky”, The Economist, March 26, 1994. “ Money Goin’ Out”, The Economist, March 5, 1994. “ Wireless standards firm up at IEEE meeting”, The Local Netter, Vol 13, No 9, 1993. Badrinath, Acharya, Imielinski, “ Impact of Mobility on Distributed Computations”, ACM OperatingSystems Review, Vol 27, No. 2, April 1993. Bantz, D., and Bauchot, F, “ Wireless LAN Design Alternatives”, IEEE Network, Vol 8, No 2, March/April 1994. Bhattacharjya, P., “ A microkernal for mobile networks”, Wireless Communications, April 1992. Buchholz, D., “ Wireless in-building network architechture and protocols”, Supercomm/ICC ’92, Chicago, Il, June 1992. Cohen, Raines, “ Moblie users are not as far away as you might think, study shows”, MacWeek, Vol 8, No 3, January 1994. 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