

## VoIP in Education

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**Özet:** Eğitim, bir topluluğun yatırım yapması gereken belki de en önemli ve verimli sektördür. Eğitim, herhangi bir başarı kazanımı için en temel etmenlerden biridir. Eğitimle ilgili önemin geçmişe göre daha fazla insan tarafından bilinmesi sebebiyle aileler çocuklarının eğitimi için daha fazla alternatif üzerinde tercihler yapmaktadır. Bu, tüm dünyadaki toplumları ilgilendirmekle birlikte, fark yaratacak adımları ilk olarak atmak önemlidir. Bu sebeple, VoIP (Voice over IP – İnternet üzerinden Ses iletimi) çevrimiçi eğitim sistemlerinin geleceği için çok önemli bir role sahiptir ve sahip olduğu yenilikçi teknolojiler ile hem öğrencilerin hem de öğretilerinin hali hazırda varolan yüksek teknoloji ürünü ders yönetim ve sunum malzemelerine göre üstünlükleri vardır. VoIP, öğrencilere daha fazla özgürlük ve fikir ve bilgi alış veriş imkanı sağlaması sebebiyle çevrimiçi eğitimi zenginleştirmektedir. Bunlara ek olarak, VoIP, çevrimiçi eğitim sistemlerinin içeriğinin zenginleştirilmesine de katkı sağlamaktadır. Bu çalışma, VoIP hakkında bilgiler vererek, varolan eğitim sisteminde olası kullanımlar ile nasıl gelişmeler sağlanabileceği konusunda bilgiler sunmaktadır.

**Anahtar Kelimeler:** IP üzerinden Ses İletimi, Eğitimde Telekomünikasyon Sistemleri, Teknolojiyle Zenginleştirilmiş Eğitim

**Summary:** Education is perhaps the most important and effective sector in which a community can invest. Because education is the seed for all success that is to come. As this realization permeates through more people than ever before, parents demand the high level of availability and accessibility of education that is fitting for their children's needs. Although the demand and explanations described above affects communities worldwide, it is important to take serious steps in making a difference. So that, Voice over Internet Protocol (VoIP) has very critical role for the future of online education, because this innovative technology empowers both instructors and students while other high end course management and presentation systems do not. Voice over Internet Protocol (VoIP) enriches online education by providing students with much more greater degrees of freedom in communication, exchanging ideas or information, and knowledge. In addition, Voice over Internet Protocol (VoIP) makes it possible to enrich the content of online courses. This paper refers how to use VoIP technology to improve current education systems and provide online education environment.

**Keywords:** VoIP (Voice over IP), Telecommunication Systems in Education, Technology Enhanced Education

### Introduction

Voice over Internet Protocol (VoIP) is a protocol designed for the transmission of voice over the internet or other networks. VoIP is also known as IP Telephony, Internet Telephony,

Broadband Telephony, Broadband Phone and Voice over Broadband. Another definition can be given as VoIP is a set of technologies that enable voice calls to be carried over the internet rather than the traditional telephone line system. Companies that provide VoIP service

are commonly called as providers, and protocols which are used to carry voice signals over the internet protocol network are commonly called as Voice over IP (VoIP) protocols. They could be represented as commercial realizations of the “Network Voice Protocol” which is invented for the Advanced Research Projects Agency Network (ARPANET) providers.

In the VoIP networks, some cost savings are needed to utilize a single network to carry both voice and data, especially where users have existing underutilized network capacity that can carry VoIP at no additional cost. For example, VoIP to VoIP phone calls are sometimes free due to providers’ policies.

### **VoIP Systems**

There are many kinds of VoIP system. For example, using voice chat in MSN messenger, Google Talk or Yahoo messenger could be called as VoIP based systems, commonly publicized Skype could be another example of application which used in this area. However these are all proprietary systems. To talk to someone using MSN messenger application, the person at the other end also needs MSN messenger application. The same reason is valid for Yahoo, Skype and etc. They use their own special system that is not open and will not connect to other systems easily and directly.

VoIP systems should really be based on the SIP (Session Initiation Protocol) system which is the recognized standard. Any SIP compatible device can talk to any other simultaneously and users do not even need to use a personal computer (PC). Any SIP telephone can call another over the internet and users do not need any additional equipments or even a phone provider. Plugging SIP phone into the internet connection and configuring it makes it possible to dial the other person over the internet.

In all VoIP systems, source voice is converted into packets of data, like small files, and then

transmitted to the recipient over the internet and decoded back into source voice at the other end (destination side). To make it quicker, these packets are compressed before transmission, just like zipping a file.

VoIP service can be given over wireless networks as well. Development of wireless VoIP has been rapid in the past few years. The major focus for such development has been in the area of wireless fidelity, which is based on the IEEE 802.11 wireless standard. There are a number of ways to build wireless VoIP. A software telephone can be integrated into a laptop and used in a wireless access point which is already a well established technology. Software telephones are also available for mobile computers and Personal Data Assistants (PDA) that use VoIP infrastructure. There are some considerable technical challenges in implementing Voice over wireless fidelity, including security concerns, battery problems in wireless fidelity handsets and voice call quality. Wireless networks allocate bandwidth due to which devices are nearest to the Wireless LAN access points that may cause interruption or any other problems for voice call quality. Some of the high education institutions have implemented wireless VoIP systems, which is based on the 802.11b standard and providing sufficient bandwidth for several personal computers and related VoIP services.

### **Issues of Security in VoIP Systems**

One of the first security issues concerned by organizations implementing VoIP is the issue of the confidentiality and authenticity of voice conversations. Unlike traditional telephone networks, which are circuit switched and relatively difficult to tap, voice traffic on converged networks is packet switched and vulnerable to interception with the same techniques used to sniff or eavesdrop other traffic on a LAN or WAN. Even an unsophisticated (amateur) attacker can intercept, penetrate and decode voice conversations.

Although this problem is real, generally, it is not the most important security threat VoIP faces. "Denial of Service" (DoS) attacks, whether they are intentional or unintended, are the most difficult VoIP related threat to defend against. So that, organizations, institutions or schools that deploy or plan to deploy VoIP networks will have to work harder at security than other systems. Security will cost more and it will require better trained administrators.

### **Traditional TCP/IP Versus VoIP Implementation**

There are some important differences between the VoIP implementation of TCP/IP and the traditional data implementation. First difference is in the application layer. In a VoIP call, the application layer utilizes the NTP (Network Time Protocol), RTP (Real-time Transport Protocol) and RTCP (Real-time Transport Control Protocol) protocols. All three of the application layer protocols combine, at  $10^{-9}$  sec. (nanosecond) speeds, to deliver VoIP voice packets. NTP (Network time protocol) enables timing, which helps ensure that the signals are transmitted and received within the proper timeframe to assure quality. RTP (Real-time transport protocol) provides end to end network transport functions for digital voice signals encapsulated in the VoIP packet. Lastly, RTCP (Real time transport control protocol) monitors voice signal delivery and provides minimal control functions to ensure the delivery of packets. The second difference between the traditional data implementation of TCP/IP and the VoIP implementation is in the transport layer. The biggest part of computer data networking uses the TCP protocol at the transport layer. For VoIP, the transport layer uses UDP, user datagram protocol. (UDP is used also for real-time videoconferencing networks). Because voice is a real time application, it is more important that the voice packets get to the receiver as quickly as possible. That is why UDP is chosen as favorite to provide the transport layer for VoIP networks.

### **Advantages and Benefits of VoIP Systems**

By using VoIP based systems, there are some important advantages. Firstly, VoIP technology leads to greater financial savings for its users (Schools, Colleges, Subscribers, etc.). This happens because there is only one network exists and this network carrying both the voice and data provided by only one supplier. If users have a broadband internet connection like DSL or cable, they can make PC to PC phone calls anywhere in the world for free. Another important concept to understand about VoIP is that unlike other alternative systems like PSTN (public switched telephone network), it is not distance or location dependent. As far as VoIP is concerned, users could be calling their suppliers far away. For example, students from Turkey are able to call their instructors or teaching assistants that live in Germany or vice versa. These calls do not make any difference at all in terms of connectivity and cost when it is compared with people calling each other in the same city.

### **Disadvantages and Drawbacks of VoIP Systems**

Like all systems using worldwide, VoIP systems have some disadvantages as well. Because VoIP relies on an internet connection, VoIP service will be affected by the quality, stability and reliability of the broadband internet service and usually by the limitations of the personal computers (PC). Poor Internet connections and possible connection losses may result in damaged or distorted voice quality. If users are using their computers at the same time as making a computer VoIP call, they may find that voice quality deteriorates dramatically.

This is more noticeable in highly congested networks or where there are long distances and internetworking between end points.

## **Voice Quality Concerns in VoIP Systems**

VoIP based systems have a bit to improve on Voice Quality, but not in all cases. VoIP systems QoS (Quality of Service) depends on so many factors such as broadband connection, hardware, the service provided by VoIP provider, the destination of call etc. A lot of people are using high quality of phone calls using VoIP, but still many users complain of hearing noises and having to wait a lot before hearing an answer etc. Another disadvantage of VoIP systems is that some VoIP services do not work during power outages and the service provider may not offer backup power. These possibilities may cause communication disruption.

## **VoIP Utilizations in Education Systems**

Voice over Internet Protocol (VoIP) has been chosen as the preferred communication solution for some colleges, higher education institutions and as well as K-12 schools. However many educators are not fully realize the advantage of VoIP in the classroom. This situation leads VoIP service providers to help instructors unlock VoIP's potential.

The result of merging voice and data networks creates a world of opportunities for better communication between instructors and parents, students, advisors, etc. The most important benefit of using such systems (VoIP based communication system) is to provide much better interaction between parents and instructors at the K-12 or high school level than old traditional techniques. Keeping parents in the education loop is a proven method for improving student performance, while building stronger and appropriate relations between education staff and students' families.

In the result of using VoIP systems, distance learning also makes things possible for educators to reach traditionally separated students, even if they are socioeconomically disadvan-

taged and geographically spread out or struggling with full time works and responsibilities.

VoIP based systems add a new dimension to online classes. Incorporating voice chat lets students experience a synchronous learning environment that provides a much more promising success than offline classes. In addition to this, separated students are able to work collaboratively on group projects, gaining important team management skills they will need in the real world ("real world" refers to after school life).

Another frequently revised area is the course content, virtual textbooks can include much richer multimedia and other contents on their pages than traditional print books and because it is so much cheaper to produce e-texts, students can easily produce their own books as the part of their homework or projects.

Lastly, one of the most exciting ways to use VoIP in the classroom is to take the class online, to the virtual world of education. So that, students have the chance to apply some of what they are learned by creating virtual scenarios, creating up engineering designs, testing social thoughts, and designing alternative and effective solutions to real world problems.

In addition to the benefits of VoIP which are mentioned above, VoIP (Voice Over Internet Protocol) is a full duplex voice communication protocol like a telephone over the internet. This technology has been around for a decade or more. Online tutoring though VoIP will be a common feature in the future, its past and present have been characterized by more exaggeration than practicability.

## **Drawbacks of VoIP Utilization in Education Systems**

On the other hand, there are also some drawbacks of VoIP utilization in education system. People are accustomed to being tutored in person, im-

plying the use of voice. Therefore, voice is assumed to be a “required” (obligation) element of tutoring which is not. Tutoring requirements for math and other subjects are the efficient communication of symbols (for example it is hard to describe the equations over the telephone or etc.), graphing and drawing ability, and text input.

Due to the reasons mentioned above, when students are being tutored effectively, there are long pauses while students and instructors are working through problems. The presence or absence of voice has no bearing on the length of these pauses. So, in some cases, VoIP systems neither increase the quality or efficiency of communication. In fact, VoIP systems can cause more problems which should be considered. Because there are some challenges of VoIP systems which are described below. Unless corporations or institutions build strong and well designed infrastructure for the VoIP system, it should be better not to use this system.

Lack of sufficient technical support may cause problems. The number of students needing help with headsets, microphones, sound cards, bandwidth, process capacity, related installations, and simply turning the volume up, is significant. Bandwidth is another concept. Using VoIP systems require more bandwidth than a typical chat room connection. Today, due to the increase in broadband penetration, this problem is not very essential, but it is still present in dial up and shared bandwidth connections. Another problem is the memory. Because a whiteboard tutoring session can be archived by saving a single image or series of images and when a voice track is added, the memory needed for archiving increases dramatically. Guaranteeing quality control is very important because a tutoring session saved as an image can be reviewed in a couple of minutes or less. A voice track requires the commentary to listen the whole tutoring. In addition to the possible problems described above, software installations are very essential for the reliable and stable VoIP transmissions. VoIP systems usually

require an installation of related program onto the students’ personal computers.

Voice quality is very critical metric for VoIP systems. For many users, VoIP can result in instructors and students talking over each other, waiting for the other to speak when the other does not realize it, and other barriers to the tutoring interaction. Students are usually tired of struggling their academic works, adding communication and technical problems make things worse for them.

Another point of view, online tutoring companies or institutions that use VoIP systems, require students to install software locally, sometimes give away headsets and microphones, and do not archive tutoring sessions. Installation of software requires a significant amount of consideration on the part of the student or end users. Shipping of computer accessories dramatically increases cost and also requires consideration. The lack of archiving affects quality control and dispute resolution procedures.

Students using services that provide on demand support is not make things easier for struggling students who typically do not have the time or the patience to go through a significant installation process at the same time that they are already struggling with their homework, projects or any other academic related works. Requiring such installation serves to limit rather than increase the number of students using these services.

### **Modern Usage of VoIP Systems in Education Sector**

Over the years, there has been discussion of the development of virtual universities in which lectures or services will be provided on demand through the network, and the location, registration and related operations of the institution will become more transparent. VoIP is one of the technologies that is likely to support to the development of a more virtual university platforms.

Today, especially in USA, VoIP technology trend means one or more of institutions or schools are making the move to VoIP based systems and enjoying the benefits. It also means that institutions or schools will be at a disadvantage if it doesn't undertake a strategic plan to convert. As collaborative colleges with a unified workforce satisfy their students and the parents in distinguished ways, they are going to increase their reputation in education sector. So that, colleges and high schools should not be able to afford to ignore VoIP technologies much longer.

Adopting advanced technologies such as voice over IP (VoIP) to seamlessly integrate the universities' voice and data network would increase overall efficiency and help to keep costs in line, enabling the universities to direct fiscal resources elsewhere while simultaneously maintaining their reputations as an educational institution on technology's cutting edge.

Nowadays, many institutions are also either considering or already implementing wireless networks, and due to running VoIP services over wireless networking is a key focus for its further development. A number of institutions have begun to investigate the integration of VoIP within their existing telephone systems or even the replacement of existing PSTN (public switched telephone network) voice systems with IP based technologies, particularly on new build campuses. New College Durham in UK can be given as an example, which has installed an integrated IP based network to deliver video, audio and data services, and is in the process of migrating applications from an array of separate networks over a single, integrated network. Another example is Brunel University that is an High Education institution which has implemented IP telephony upon its existing data network. Brunel University has implemented a VoIP system which has about 2,500 IP telephones on its network. It has also implemented an IP based centralized messaging system, using voicemail and unified messaging software supplied by manufacturer Cisco.

There are a number of collaborative projects that use Internet based voice. FlashMeeting is one of them that use VoIP technology to create an instant audio messaging system, to support small groups of distance learners and provide an alternative to traditional tutorials. The main goal of FlashMeeting project is to provide easy to use multimedia applications which support collaborative distance learning. In USA, other projects like FlashMeeting are under development that has the same purpose.

### **Conclusion**

Related to the things mentioned above, voice may be a requirement for effective live tutoring in some cases or topics. For example foreign languages, would seem to require voice. However, lack of voice had no adverse effects on student tutoring demand or satisfaction. Once VoIP systems become embedded into operating systems, browsers and voice input devices (headsets and microphones, etc) are standard computer accessories, it will be interesting to explore whether students and instructors choose to use, or not use VoIP based systems.

This becomes closer and closer to reality as more computers come with Bluetooth or infrared connections that can integrate with mobile phone easily. VoIP based systems are very successful and promising technology for the education sector, however today, VoIP serves to a limited part in education sector.

**Özgeçmiş:** Dr. Bülent Gürsel Emiroğlu; 2000 yılında Ortadoğu Teknik Üniversitesi'nden lisans, 2001 yılında İngiltere The University of Nottingham'dan yüksek lisans ve 2008 yılında da ODTÜ Bilgisayar ve Öğretim Teknolojileri Bölümü'nden doktora derecesini almıştır. 2002 yılından bu yana Atılım ve Başkent Üniversitelerinde lisans ve yüksek lisans programlarında İşletim Sistemleri, Bilgisayar Ağları, Algoritmalar, Çokluortam, İnternet, Web, Programlama, Bilgisayar – İnsan Etkileşimi, e-ış ve e-ticaret konularında dersler vermektedir.