الكلية الذكية للتعليم الحديث
SMART COLLEGE FOR MODERN EDUCATION

دائرة الدبلوم المهني المتوسط

اسم البرنامج الدراسي : دبلوم الأمن السيبراني

مقترح مشروع التخرج

اسم الطالب	الرقم الجامعي
علاء محمد عبد الحلايقة	22110082
ياسمين عبد المعز محمد عطا الله النتشة	22110117
سندس يحيى فايز ابو شخيدم	22110007

اسم المشرف : المهندس أنس أبوتبانة

عنوان مشروع التخرج

INSTANT MESSAGING

التاريخ : 25 \ 5 \2023

فلسطين – الخليل – الحرس

الإهداء

لله الفضل من قبل ومن بعد.....

إليك أمي يا من سهرتي الليالي لراحتي

وذرفت الدمع لأجلي

إليك أبي يا من أشعلت شموع المحبة بعطفك

وأضأت نور دربي بحنانك

إليك يا من حرمت من ملذات الحياة لمستقبلي

إليكم أخوتي وأخواتي إليكم

إلى كل من علمنا بأن الشمعة لا تحترق لتذوب وإنما لتنير الدروب للآخرين ...

مدرسينا

إلى كل من سهر لنا ولراحتنا ... أهلينا

إلى الوردة التي إسمها خلف السطور وعبيرها أمام الكلمات

إلى كل من يعلم من نحن ... ويهتم لأمرنا ... وينظر لراحتنا

كليتنا الذكية التي أنارت لنا دربنا وغيرت حياتنا

نهديكم جميعاً هذا العمل المتواضع.

شكر وتقدير

الشكر أولاً وأخيراً لله عز وجل ، ثم لوالدينا على كل مجهوداتهم منذ ولادتنا إلى هذه اللحظات، أنتم كل شيء نحبكم في الله أشد الحب .

نتقدم بالشكر والتقدير الى كليتنا الكلية الذكية للتعليم الحديث التي احتضنتنا لاكمال دراستنا وحصولنا على درجة الدبلوم، وإلى الهيئة التدريسية والادارية في دائرة تكنولوجيا المعلومات التي ما بخلت علينا بعطاياها ونخص بالذكر المهندس والمربي الفاضل أنس أبوتبانة الذي ساعدنا في هذا العمل وأشرف على المشروع منذ البداية وحتى النهاية والذي كان له الدور البارز لاخراج هذا المشروع بأبهى صورة بفضل توجيهاته وملاحظاته والشكر موصول بكل من ساهم في المشروع وأنار لنا الطريق.

ملخص المشروع:

يهدف المشروع الى تصميم نظام مراسلة فورية متزامن لخدمة أساتذة وطلبة الكلية الذكية للتعليم الحديث باستخدام تقنية الويب الامن (**HTTPS**) حيث سيتم تخصيص حساب منفصل لكل أستاذ او طالب مع كلمة مرور مشفرة باستخدام تقنية **AES** للتشفير .

تكمن أهمية المشروع في تسهيل عملية الاتصال والتواصل بين الأساتذة والطلبة المسجلين والمنتظمين في الكلية الذكية للتعليم الحديث حيث تزودهم هذه التقنية بمزايا عديدة أهمها إمكانية متابعة الأمور الأكاديمية في أوقات العطل الرسمية ونهاية الأسبوع وتمثل حلاً مقترحاً لمشكلة الاتصال والتواصل في حالة الكوارث الطبيعية أو الجوائح مثل ما حدث قبل عدة أعوام في جائحة كورونا.

Abstract:

This project aims to design a synchronous instant messaging system to serve professors and students of the Smart College of Modern Education using secure web technology (HTTPS), where a separate account will be allocated for each professor or student with an encrypted password using AES encryption technology.

The importance of the project lies in facilitating the process of communication between professors and registered students in the Smart College of Modern Education, as this technology provides them with many advantages, the most important of which is the ability to follow up academic matters during official holidays and weekends, and it represents a proposed solution to the problem of communication in the event of natural disasters or pandemics such as what happened several years ago in the Corona pandemic.

Table of Contents:

Reference And Appendices:

Index of Tables

Index of Figures

CHAPTER 1

Introduction

1.1 Overview:

This project aims to design a synchronous instant messaging system to serve teachers and students of the Smart College for Modern Education using secure web technology (HTTPS), where a separate account will be allocated for each teacher and student with an encrypted password using Secure Hash Algorithm 1 (SHA) encryption technology.

Instant messaging (IM), form of text-based communication in which two persons participate in a single conversation over their computers or mobile devices within an Internet-based chatroom. IM differs from "Chat," in which the user participates in a more public real-time conversation within a chatroom where everyone on the channel sees everything being said by all other users.

In its simplest form, instant messaging (IM) seeks to accomplish two goals: monitoring presence for the purpose of sending presence-based alerts to users in the chatroom and messaging. The software relies on a central server or servers to monitor presence. When a user logs on to an IM system, the login is recognized, and other online users who have that address listed as a "buddy," or friend, are notified of the user's presence. The software establishes a direct connection between users so they can talk to each other synchronously.

To start chatting clients should get connected to a server where they can practice two kinds of chatting, public one (message is broadcasted to all connected users) and private one (between any 2 users only).

1.2 The study problem:

The problem lies in the difficulty of communication between teachers and students in the smart college for modern education especially in the weekend, holidays and Disaster time or suddenly when the college are closed due to political situations in Palestine, so that with the spread of technology, our idea to solve this problem is creating a website has emerged to facilitate communication between teachers and students that will work at all scenarios.

1.3 Project Objectives:

This project aims to:

1. Possibility to pursue academic matters during official holidays and weekends.
2. Facilitate the process of communication between teachers and students especially for students those have a weakness in using Gmail.
3. Represents a proposed solution to the problem of communication in the event of natural disasters and epidemics, such as what happened several years ago during the Corona pandemic.

1.4 The importance of the project:

1.4.1 The importance of the project for the team work:

1. Increase the programming and cybersecurity capabilities in the field of computer networks.
2. Completion of graduation requirements for the Cybersecurity diploma in Smart College for Modern Education.

1.4.2 The importance of the project for the smart college for modern education:

The importance of the project lies in facilitating the process of communication between teachers and registered students in the Smart College for Modern Education, as this technology provides them with many advantages, the most important of which is the ability to follow up academic matters during official holidays and weekends and disaster times.

1.5 Literature Review

This study aimed to investigate the impact of using Short Message Service (SMS) as learning support tool on students' learning in an introductory programming course. In addition, the study examined students' perceptions of the advantages and disadvantages of the use of SMS as a learning support tool in their class. The participants in this study were 52 students who were enrolled in two sections introductory programming course. For the purpose of the study, nonrandomized control group, pretest-posttest and qualitative interview designs were used. The control group consisted from 23 students, while the experimental one consisted from 29 students. A total number of 36 SMS messages were sent to each student, in the SMS group,

over a period of 12 weeks. The messages contained different types of information, i.e., short review of programming concepts, hints to solve assignments, and triggering questions. At the end of the experiment, semi-structured interviews were conducted with ten students from the SMS group. The analysis of the collected data showed that the use of SMS as learning support tool contributed significantly in improving students' learning. All the interviewed students believed that the use of SMS technology as learning support tool has more advantages than disadvantages. Based on the findings, this study provided some recommendations regarding the implementation of the SMS in the Jordanian higher education settings.[1]

The Short Message Service (SMS) technology is one of the most powerful mobile technologies in current usage. Most students own a mobile phone with free SMS which can be used for learning. In this text we explain how we used SMS for teaching and learning languages (first and foreign languages). The experiment conducted presents a range of opportunities for integrating text into teaching and learning strategies and for demystifying the use of SMS in educational contexts. Via SMS technology we can deliver several learning activities to students easily and immediately. The research findings showed that students had positive perceptions about the experiment and SMS use for learning improvement and the use of their own mobile phone as a learning tool. [2]

This article examined how higher education students used text and instant messaging for academic purposes with their peers and faculty. Specifically, comfort level, frequency of use, usefulness, reasons for messaging and differences between peer-to-peer and peer-to-instructor interactions were examined. Students noted that they were very comfortable with using both text and instant messaging. Text messaging was used weekly with instructors and daily with peers. Instant messaging was used rarely with instructors but weekly with peers. Students rated text messaging as very useful and instant messaging as moderately useful for academic purposes. Key reasons cited for using both text and instant messaging included saving time, resolving administrative issues, convenience and ease of use. Text messaging appears to be the preferred mode of communication for students with respect to communicating with both peers and instructors. It is concluded that both text and instant messaging are useful and viable tools for augmenting student's communication among peers and faculty in higher education.[3]

Mobile instant messaging (MIM) has become the most popular means for young people to communicate. MIM apps typically come with a myriad of features that educators may leverage to increase student learning. However, it remains poorly understood to what extent and

in what aspect MIM can facilitate student engagement. We address the gap by comparing the effects of using MIM and asynchronous online discussion (AOD) on student online engagement, using a quasi-experimental study involving a historical cohort control group. Understanding which communication mode can better promote student online engagement is particularly important during the current widespread use of online learning. Specifically, we examined engagement from the behavioral, emotional, and cognitive dimensions. The results showed that the MIM group was more behaviorally engaged in discussion activities, producing more messages, more words, and higher rates of participation, task completion, and interaction. Emotionally, no statistically significant difference was found in students' affective evaluation of course interaction and satisfaction between the two groups. However, MIM appeared to help students with improved intimacy and interpersonal relationships. Cognitively, the MIM group was more engaged than the AOD group. In particular, MIM seemed to facilitate interactive idea exchange and thus contributing to more "creating" activities. We conclude by providing suggestions for future instructional practice and research directions.[4]

Instant messaging has changed the way we communicate, especially with young people who have become accustomed to using mobile devices to stay connected. This phenomenon has gained relevance within the academic context due to the positive and negative implications it can bring to the training process. The research aims to analyze the advantages of using an instant messaging application in the communication between teachers and students to solve questions in a programming course. With the research, we analyzed different general variables such as the time and space gap, the level of confidence in using the tool, and the collaborative learning by supporting each other in resolving questions. Our conclusions show that the use of instant messaging allows having a fluid communication adapted to the new ways of communication of the students. Collaboration was a relevant factor within the WhatsApp group because it generated a friendly and cordial environment that generated confidence when asking questions and obtaining feedback. We recommend the continued use of instant messaging and student groups because of their positive results as a form of interaction between teachers and students.[5]

This study explores the communication patterns and learning effectiveness developed by students using two basic synchronous and asynchronous communication tools in e-learning environments, specifically business simulation games. Design/methodology/approach the authors conduct a quasi-experiment research with 478 online business students, 267 of whom used online discussion forums and 211 interacted via an instant messaging app. The application

of learning analytics and text mining on natural language processing allows us to explore the student communication patterns with each of tools and their effectiveness in terms of learning. Findings The results confirm the complementarity of the communication tools, asynchronous tools being especially the suitable for task-related communication and synchronous ones for speeding up and facilitating student social interactions. Originality/value The main value of this research lies in the use of data analytics and text mining to access and analyses the content of student interactions to assess the learning process in greater depth, comparing synchronous and asynchronous learning modes, considering that little is known about the impact of online synchronous interaction or instant messaging, and even less about the different features, content and performance that emerge when these two learner interaction modalities are compared.[6]

The popularity of Mobile Instant Messaging (MIM) has prompted educators to integrate it in teaching and learning in higher education. WhatsApp® is a multi-platform instant messaging application widely used worldwide, however, there is still little applied research on its use as a platform for educational activities in management higher education. In this article, the authors present a quantitative and qualitative assessment of a concrete experience of WhatsApp® use that involved 140 undergraduate management students. Data were collected through questionnaires answered by the participants after the end of the experience of use, and also via content analysis of their conversations inside their WhatsApp® groups. The results indicate five main educational affordances of MIM that can be considered in management education: interactivity, knowledge sharing, sense of presence, collaboration and ubiquity. The article also explores the limitations of this tool and provides suggestions of good practices of MIM use for teaching and learning.[7]

In the past, instant messaging (IM) was considered "a teen thing" rather than a serious tool for education. As teenagers who rely on IM as a communication tool arrive on college campuses, however, IM usage will become more prevalent in higher education. IM has generated increasing awareness of its value for educational purposes despite its slow adoption in educational settings. Cohn urged universities and faculty members to adopt IM and train themselves in using it, as IM use by prospective and current college students has become pervasive. Walther, meanwhile, expressed some pessimism about the readiness of adults, including faculty, to use IM. Schools can use IM for emergency communication needs, as well. Research on IM in educational settings is growing. Based on a study of 30 students Nicholson reported that students who used IM services found it easier to communicate, felt a stronger sense of community, and had more venues for informal and social communication about class

material, the school, and their common degree program. Farmer briefly addressed IM's benefits and drawbacks in educational settings. Benefits include a heightened "social presence" for distance-education students and a growth in collaborative opportunities, due to its millions of users everywhere. Drawbacks include adding additional layers to the learning environment, a growing expectation among students of unlimited access to instructors, and the related time issues for faculty. Farmer went so far as to describe the drawbacks as a "potential faculty nightmare." This article presents the author's findings from a study of IM use in both local and distance courses, focusing on student-instructor interactions. Surveyed students appreciated not having to wait for answers to questions and the more informal context of IM conversations. They felt that the potential for IM to be useful in the distance-learning environment was high. (Contains 1 table and 7 endnotes) [8]

In this study, the use of the mobile instant messaging (MIM) tool GroupMe was explored in the higher education context. The tool was used to facilitate online course discussions, small group work, and other course communications in face-to-face and online sections of two graduate educational technology courses. Over 900 postings were generated from 29 participants, then coded and analyzed by the researchers. Qualitative data was also obtained through an e-mail follow-up questionnaire. Findings indicate that the MIM platform afforded students opportunities to engage in productive course-relevant conversations and provided additional ways for learners to exhibit online social presence through tool features. Recommendations for the use of MIM to support teaching and learning and suggestions for further scholarly inquiry are discussed.[9]

Smartphones could be the fastest spreading technology in human history. These mobile devices change the way we communicate and enable mobile and ubiquitous learning at a different level. This study evaluated the use of mobile instant messaging tools to support teaching and learning in higher education. A total of 61 undergraduate students enrolled at a teacher-training institute in Hong Kong who have smartphones with WhatsApp were assigned into experimental and control groups. Besides the traditional classroom learning for both groups, the experimental group was also supported with bite-sized multimedia materials and teacher-students interaction via WhatsApp outside school hours. The participants of the control group used WhatsApp only for academic communication. Pre-test scores were used as the covariate. The marginal means on the post-test scores showed that the participants in the experimental group performed better than those in the control group. The intervention of WhatsApp improved the learning achievement of the participants. The strength of the

intervention between the two groups was medium to large. A questionnaire designed by the author was administered at the end of the study. The participants showed positive perception and acceptance of the use of WhatsApp for teaching and learning. The participants slightly rejected the view that receiving instructional materials and questions outside school hours could interfere with their private lives. The typical usability issues on mobile learning were found to be valid. The experience learnt in this research was discussed.[10]

WhatsApp instant messaging has potential to bridge information divides between educators and students. Its capacity to create personalized environments was harnessed to share collectively generated educational resources among previously disadvantaged students (PDS) students at a South African university. Data analysis combined mobile instant messaging-mediated (WhatsApp) interactions among students and educators and student evaluations of WhatsApp's value using blogs. Results suggest that students conceived WhatsApp as a lever for bridging access to peer-generated resources, heightening on-task behavior and promoting meaningful context-free learning. [11]

This article reviews the body of research on the use and role of instant messaging (IM) in campus life, and how IM is a key part of university students' communication. IM is a synchronous form of communication, and its speed, availability of information, and support for multiple conversations have made it appealing for young people. With university students, in particular, showing a heavy reliance on IM, researchers have shown great interest in how university students use IM and how it is integrated in their social and academic life. While studies are emerging in various disciplines, no attempt has been made to integrate the disparate findings and approaches. This article synthesizes key findings, provides a map of the literature, and discusses conceptual problems inherent in the study of IM and other information and communication technologies (ICTs) that will help researchers identify key areas of study and opportunities for future investigation. [12]

Smartphones could be the fastest spreading technology in human history. These mobile devices change the way we communicate and enable mobile and ubiquitous learning at a different level. This study evaluated the use of mobile instant messaging tools to support teaching and learning in higher education. A total of 61 undergraduate students enrolled at a teacher-training institute in Hong Kong who have smartphones with WhatsApp were assigned into experimental and control groups. Besides the traditional classroom learning for both groups, the experimental group was also supported with bite-sized multimedia materials and

teacher-student interaction via WhatsApp outside school hours. The participants of the control group used WhatsApp only for academic communication. Pre-test scores were used as the covariate. The marginal means on the post-test scores showed that the participants in the experimental group performed better than those in the control group. The intervention of WhatsApp improved the learning achievement of the participants. The strength of the intervention between the two groups was medium to large. A questionnaire designed by the author was administered at the end of the study. The participants showed positive perception and acceptance of the use of WhatsApp for teaching and learning. The participants slightly rejected the view that receiving instructional materials and questions outside school hours could interfere with their private lives. The typical usability issues on mobile learning were found to be valid. The experience learnt in this research was discussed. [13]

1.6 Time Planning

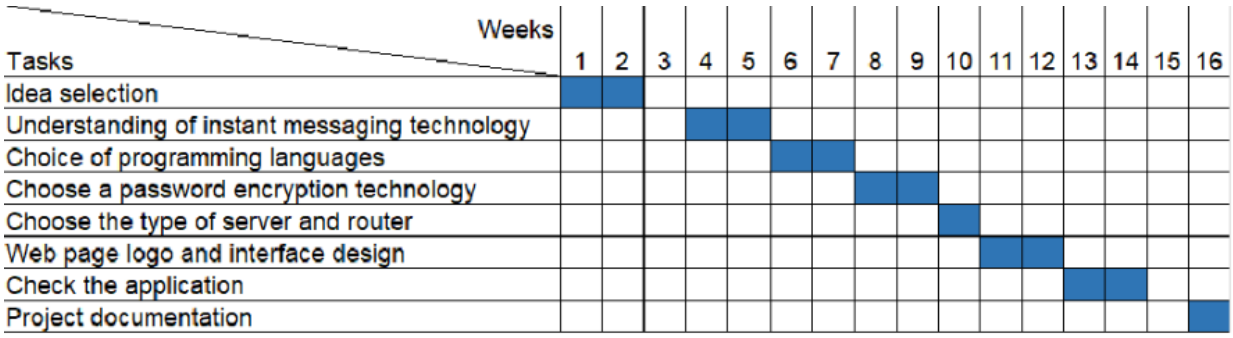


Table 1.1: Time planning for the project

1.7 Cost Estimation

Software Components	Price ($)
Initial Set-up of Server	**120**
Monthly Maintenance	**20**
Cloud Services	**10/Month**

Table 1.2: Cost estimation for software components

CHAPTER 2

Theoretical background

2.1 Instant Messaging.

2.1.1 Introduction.

Instant messaging (IM)technology is a type of online chat allowing real-time text transmission over the Internet or another computer network. Messages are typically transmitted between two or more parties, when each user inputs text and triggers a transmission to the recipient(s), who are all connected on a common network. It differs from email in those conversations over instant messaging happen in real-time (hence "instant"). [14]

Most modern IM applications (sometimes called "social messengers", "messaging apps" or "chat apps") use push technology and also add other features such as emojis, file transfer, chatbots, voice over IP, or video chat capabilities.[14]

Instant messaging systems tend to facilitate connections between specified known users (often using a contact list also known as a "buddy list" or "friend list"), and can be standalone applications or integrated into e.g., a wider social media platform, or a website where it can for instance be used for conversational commerce. IM can also consist of conversations in "chat rooms". [14]

Depending on the IM protocol, the technical architecture can be peer-to-peer (direct point-to-point transmission) or client–server (an IM service center retransmits messages from the sender to the communication device). It is usually distinguished from text messaging which is typically simpler and normally uses cellular phone networks.[14]

2.1.2 Theories.

a. Social Presence Theory.

"Social presence" means the extent to which the medium enables the perception of others' presence, which is a subjective quality of the communication medium (Short, Williams, and Christie, 1976). Social presence relates to the social psychology concepts of intimacy (determined by physical distance, eye contact, smiling, and personal topics of conversation) and immediacy (determined by the medium's capacity in transmitting information) (Short et al., 1976). Media

capable of providing a greater sense of intimacy and immediacy will be perceived as having a higher social presence. Based on this theory, communication media such as face-to-face meetings are considered to have higher social presence than computer-mediated communication media and written documents. [14]

Social presence influences the perception of media, the reception of information systems, and the choice of communication partners. Communication is effective if the communication medium has the appropriate social presence required for the level of interpersonal involvement. Thus, media with high social presence contributes to building a close interpersonal relationship.[14]

b. Media Richness Theory.

Richness (or leanness) is an intrinsic objective property of information technologies that serve as communication media. Media or information richness is defined as the ability of information to change understanding within a certain time interval (Daft and Lengel, 1986). Communication media varies in the capacity to process rich information. The reasons for richness differences include a medium's capacity for immediate feedback, the number of cues and channels utilized, personalization, and language variety (Daft et al., 1986; Rice, 1992). In the continuum of richness, face-to-face communication has the highest richness and a numeric document has the most leanness. for resolving equivocal.[14]

c. Critical Mass Theory.

The concept of critical mass indicates that the speed of adopting or using a new technology suddenly accelerates when a certain minimum amount of usage is achieved. In the communication media selection, critical mass is particularly important because an individual's use of the technology shall be consistent with that of his/her communication partner's (Markus, 1987). [14]

The benefits of using a communication technology, such as IM, cannot be achieved if the parties involved in a communication adopt different technologies (Li et al., 2005). However, an individual may use a communication technology based on the perception of the number of users rather than the actual number (Luo and Luo, 2000). Therefore, we use the subjective measure of critical mass, which is the perceived critical mass (Markus, 1987). Perceived critical mass in

this study refers to the perceptions of whether IM has attracted a critical mass of users.[14]

d. Motivation Theory.

The motivation theory describes why and how human behaviors are activated and directed. In general, behaviors can be extrinsically and intrinsically motivated (Herzberg, Mauser, and Snyderman, 1959). Extrinsic motivation refers to performance of an activity, because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself (Davis, Bragozzi, and Warsaw, 1992).[14]

In contrast, intrinsic motivation focuses more on the pleasure and satisfaction of being involved in an activity (Deci and Ryan, 1985). According to Davis et al. (1992), perceived enjoyment can be described as a typical example of intrinsic motivation, whereas perceived usefulness is an example of extrinsic motivation in the contexts of technology adoption or technology continuance usage (e.g., Thong, Hong, and Tam, 2006).[14]

E. IS Continuance Model.

IS continuance describing behavioral patterns reflecting continued usage of a particular IS in the post-adoption phase (Limaye, Hirt, and Cheung, 2007). It is widely recognized that the continued IS usage has profound implications with regard to the ultimate success of the system (Bhattacharjee, 2001). More factors were identified in previous studies on continuance, such as perceived usefulness, conformation, and satisfaction (Bhattacharjee, 2001); perceived ease of use and usage experience (Kim and Malhotra, 2005); perceived enjoyment (Thong, Hong, and Tam, 2006); affective factors such as pleasure and arousal (Kim, Chan, and Chan, 2007). Perceived usefulness and perceived enjoyment are two important antecedents of IS continuance intention.[14]

2.1.3 Models.

IM applications are often standalone applications, such as WhatsApp. They can also be embedded applications with multiple purposes. Instant messaging programs can differ based on the platform they are embedded in. For example, an instant messaging tool can be embedded into the following:

a. Social media: For example, Facebook Messenger has a list of Facebook friends that users can open a chat with in a pop-up window. On a mobile device, Facebook Messenger is a separate app that imports contacts from Facebook and displays them as a list.

b. Video conferencing: Zoom has a small chat window in the side of the video that can be used to chat with the whole group or an individual.

c. Gaming and streaming: Twitch is a streaming platform where users can stream live video and gameplay, alongside a chat window where they can interact with other users.[15]

2.1.4 Features and Specifications.

a. Availability: Presence technology enables users to see the availability of their contacts. Many apps show if contacts are online or offline and if they have set their status to free or busy. Some clients let users set an away message and provide detail about their availability. In an active session, many apps indicate in real time when a user is typing.[15]

b. Images: Many clients let users insert images and emojis into messages.

c. File transfer: Sending and sharing files is also a standard part of many IM apps. Facebook Messenger even lets users send money via IM.[15]

d. Switching to other communication modes: Numerous instant messaging apps let IM users move to other modes of communication such as group chat, voice calls and video conferencing within the app. [15]

2.2 Encryptions.

2.2.1 Introduction.

Encryption is the principal application of cryptography; it makes data incomprehensible in order to ensure its confidentiality. Encryption uses an algorithm called a cipher and a secret value called the key; if you don't know the secret key, you can't decrypt, nor can you learn any bit of information on the encrypted message—and neither can any attacker.[16]

When we're encrypting a message, plaintext refers to the unencrypted message and ciphertext to the encrypted message. A cipher is therefore composed of two functions: encryption turns a plaintext into a ciphertext, and decryption turns a ciphertext back into a plaintext. But we'll often say "cipher" when we actually mean “encryption.” [16]

2.2.2 Theories.

a. A5/1 is a synchronous stream cipher based on linear feedback shift registers (LFSRs). It has a 64-bit secret key. AGSM conversation is transmitted as a sequence of 228-bit frames (114 bits in each direction) every 4.6 mil- second. Each frame is exored with a 228-bit sequence produced by the A5/1 running-key generator. The initial state of this generator depends on the 64-bit secret key, K, which is fixed during the conversation, and on a 22-bit public frame number [17]

b. replaced with a different letter to form the ciphertext. The cipher used by Julius Caesar, known as the Caesar cipher, replaced every letter in a message with the letter 3 places to the right of it in the alphabet. For example, the letter A would be replaced by D and the letter B by E. [18]

c. Polyalphabetic substitution ciphers use multiple alphabets to conceal the contents of a message. A well-known example is the Vigenère cipher. The Vigenère cipher uses 26 distinct alphabets. The first alphabet comprises all the letters shifted one place to the left. In the second alphabet, the letters are shifted two places and similarly for the remaining 24 alphabets. The alphabets are used in conjunction with a keyword, which is written above the message and repeated as required depending on the message length. Each letter in the keyword determines which alphabet is used to encrypt the corresponding message letter.[18]

2.2.3 Common Encryption Algorithms.

a. Triple DES.

Triple DES was designed to replace the original Data Encryption Standard (DES) algorithm, which hackers eventually learned to defeat with relative ease. At one time, Triple DES was the recommended standard and the most widely used symmetric algorithm in the industry. Triple DES uses three individual keys with 56 bits each. The total key length adds up to 168 bits, but experts would argue that 112-bits in key strength is more accurate. Despite slowly being phased out, Triple DES has, for the most part, been replaced by the Advanced Encryption Standard (AES).[16]

b. AES.

The Advanced Encryption Standard (AES) is the algorithm trusted as the standard by the U.S. Government and numerous organizations. Although it is highly efficient in 128-bit form, AES also uses keys of 192 and 256 bits for heavy-duty encryption purposes.

AES is largely considered impervious to all attacks, except for brute force, which attempts to decipher messages using all possible combinations in the 128, 192, or 256-bit cipher.[16]

c. RSA Security.

RSA is a public-key encryption algorithm and the standard for encrypting data sent over the internet. It also happens to be one of the methods used in PGP and GPG programs. Unlike Triple DES, RSA is considered an asymmetric algorithm due to its

use of a pair of keys. You've got your public key to encrypt the message and a private key to decrypt it. The result of RSA encryption is a huge batch of mumbo jumbo that takes attackers a lot of time and processing power to break.[16]

d. SHA.

(Secure Hash Algorithm 1) is a hash function which takes an input and produces a 160-bit (20-byte) hash value known as a message digest – typically rendered as 40 hexadecimal digits. It was designed by the United States National Security Agency, and is a U.S. Federal Information Processing Standard. The algorithm has been cryptographically broken but is still widely used.[16]

e.Twofish.

Computer security expert Bruce Schneier is the mastermind behind Blowfish and its successor Twofish. Keys used in this algorithm may be up to 256 bits in length, and as a symmetric technique, you only need one key. Twofish is one of the fastest of its kind and ideal for use in hardware and software environments. Like Blowfish, Twofish is freely available to anyone who wants to use it.[16]

2.2.4 Features and Specifications.

Encryption uses cybersecurity to defend against brute-force and cyber-attacks, including malware and ransomware. Data encryption works by securing transmitted digital data on the cloud and computer systems. There are two kinds of digital data, transmitted data or in-flight data and stored digital data or data at rest.[16]

2.2.5 Common Encryption Protocols.

a. **TLS/SSL**: TLS/SSL is the most common encryption protocol, which is used every day on the Internet. TLS/SSL stands for Transport Layer Security/ Secure Sockets Layer, which is an encryption protocol that ensures communications between a client and server are kept secure. When your web browser connects to a website, if the connection is secured with TLS/SSL, then a padlock and the word “https” is shown in the search bar. TLS/SSL does not do the encryption itself, it instead uses a variety of encryption algorithms, like RSA or AES, to encrypt the communications. This is why SSL/TLS is considered an encryption protocol. Using TLS/SSL to encrypt communications is very common, as a number of different encryption algorithms are used with it. TLS/SSL can be used for user authentication, traffic encryption, and showing that data has not been modified in transit. The way TLS/SSL works is that an asymmetric key pair is utilized in a “Handshake” process to secure the initial connection between the client and server. That “Handshake” is where the specific

protocol version to be used is selected, the TLS/SSL certificates of both server and client are verified, the algorithm for the "Record" process is selected, and the shared key is generated with symmetric encryption. The shared key is then used in the next step of the communication, the "Record" protocol. In this, packets shared between the two users are encrypted with the shared key to ensure the safest form of communications.[19]

b. **IPsec:** IPsec, or Internet Protocol Security, is an encryption protocol which utilizes encryption algorithms like 3DES, AES, SHA, and CBC to encrypt data in applications, routing, or Virtual Private Networks, most commonly. Using its two modes, tunneling and transport mode, IPsec protects data moving from one location to another. Transport mode encrypts only the payload of the message, not the header. As some information can be gained from the header, this is only used for simple data transfer situations such as connecting to a server or workstation. Tunneling mode, on the other hand, encrypts and authenticates both the payload and header. Tunneling mode is most often used with Virtual Private Networks, or VPNs. Though using VPNs with IPsec is generally faster, as IPsec is quicker to set up a connection, other parts of TLS/SSL make it the preferred method of data-in-transit encryption and authentication.[19]

c. **SSH**: Secure Shell, also known as SSH, is another type of encryption protocol. The way SSH works is similar to a VPN. By creating an encrypted tunnel, users can use SSH to securely and remotely connect to computers, transfer files, port forward, and more. SSH works on 3 different levels: the transport level, the user authentication level, and the connection level. The transport level is the layer which securely connects two parties, securely encrypts any data sent between them, authenticates the users to each other, and ensures that the data shared between the users is not changed in any way in-transit. To exchange keys, the two parties in the SSH connection are connected and the keys of the client and server are traded via the Diffie-Hellman key exchange. During this phase of SSH, the symmetric algorithm, asymmetric algorithm, message authentication algorithm, and the hash algorithm to be used in the transfer of data and messages are chosen. At the authentication level, the client authenticates its identity via a supported authentication method specified by the server from the transport layer. The authentication method in question can be anything, from a password to a digital signature. The connection level handles all of the connections

created between the server and client. A different channel is opened for every communication between the server and client. [19]

d. **PGP**: OpenPGP, also referred to as PGP, is an encryption protocol which allows users to encrypt their messages and digitally sign them, giving the message sender a stronger method of both authentication and data integrity protection. Mainly, PGP is used for the purpose of protecting sensitive email information. PGP was developed in the 90's in an attempt to make it a globally used and interoperable system. PGP is free to use and integrate into a number of different email clients. Different encryption algorithms are available for use with PGP, such as RSA and DSA for asymmetric encryption, AES, 3DES, and two fish for symmetric encryption, and SHA for hashing. Different vulnerabilities have been found for PGP throughout the years, but these flaws have always been addressed with updates or recommendations. [19]
e. **S/MIME:** Secure/Multipurpose Internet Mail Extensions, or S/MIME, is a competitor to OpenPGP as an email-based encryption protocol. Just like PGP, S/MIME allows users to encrypt and sign email data to further protect it from attackers. The difference with PGP and S/MIME is that S/MIME uses different encryption algorithms to secure data. [20]
f. **Kerberos:** The encryption protocol Kerberos works by acting as a single sign-on authentication protocol. The protocol authenticates its users against a central authentication and key distribution server. Users of the protocol are given "tickets", once authenticated, allowing them to use the different services within the network. When a client with a "ticket" reaches out to a server, that server verifies the "ticket" and grants the user access. Kerberos' main use is on Local Area Networks (LANs) and for establishing shared secrets. Kerberos is a well-known and often used encryption protocol, but both the client and server must include code to utilize Kerberos, which turns some organizations away from its usage.[20]

2.3 HTML Programming Language.

2.3.1 Introduction.

HTML is an acronym for Hypertext Markup Language. HTML documents, the foundation of all content appearing on the World Wide Web (WWW), consist of two essential parts: information content and a set of instructions that tells a computer how to display that content. The instructions—the "markup," in editorial jargon—comprise the HTML language. It is not a programming language in the traditional sense, but rather a set of instructions about how to display content. The computer application that translates this description is called a Web browser. Ideally, online content should always look the same regardless of the browser used or the operating system on which it resides, but the goal of platform independence is achieved only approximately in practice. [21]

2.3.2 HTML Theories.

a. Six standard Classes of theorem-objects are instructed in theorem. Modes, though you could add your own. These are theorem, definition, example, proof, sunproof, and remark. Each theorem-object also has a TYPE, which usually the word used in the heading. So, you could have TYPEs "Theorem" and "Lemma" (which would normally be of CLASS theorem) and TYPEs "Argument" and "Demonstration" (which might be of CLASS proof). The standard module theorem. Modes provides tags "theorem", "definition", "example", "proof", "subprop", "remark" to define theorem objects with types "Theorem", "Definition", "Example", "Proof", "Sub proof", "Remark" and classes "theorem", "definition", "example", "proof", "sub proof", "seamark" respectively. The module theorem-English. Modes defines many more such tags (specifically "proof comment", "lemma", "proposition", "corollary", "question", "examples", "exercises", "moral", "rule") and can be used as a model to show you how you can define your own.[22]

b. Several language-driven methods try to validate strategy requirements into dominant dictionaries for recycling. An example is HTML5, which are language developments with execution to back them up over the former version. Amin & Valdmanis (2021) buttressed Micro formats and numerous semantic webs presents like FOAF (Bickley and Miller, 2010), and respectable relations (Azad et al., 2021) embed extra specific vocabularies surrounded by HTML. Other categories like HTML Microdata (Hickson and Hyatt, 2011), and (Dra (Adidas et al., 2008) try to offer manners to drive in extensible lexes in the interior of HTML. Instead, a novel approach for expression

offers a modest manner to link previous expressions prepared from ISON and HTML structure embedded methods that tend to handle issues related to the shared programming pattern of the web. A template that sails (Tauber and Suzumori, 2009) spontaneously pressed template procedures into the client-side. Sync tool (Benson et al., 2010a) reiterated a modest pattern for spontaneously synchronizing and continuing rational data on the client-side. Other contexts in the rear, given that programmed server-side tenacity of alterations that arise in the client-side (Cannon and Willstatter, 2010). Intellect production methods emerge or flood the web presently, helping the operator to better comprehend and act on it. Kits like WEB Crystal (Chang and Myer, 2012) and Fire crystal (Onley and Meyers, 2009) support the writer comprehending why a piece of a web page seems or acts as it does so that they can repurpose it.[22]

c. Conventional web pages are packed with an HTML framework whose only goal is to make available a system that cascading style sheets utilizes to produce the page project. Immediately this project is completed, its vestiges moderately motionless. But the programmer can continue to update and modify the HTML content of the web page either by adding news articles, etc. as well as paddle through HTML design to complete this assignment. In a scenario of buying a website template, which is a huge business on the net, the template will come as HTML files. At this juncture, the responsibility of the buyer is to brand to his/her taste. But with a cascading cache layer, the web template will arrive in 3 folds namely, a content document, a mockup, and a tree sheet that connects each of them. Any content management will be carried out within the confines of the content document, and any bug fixes or style updates will be handled by the mockup (Ahmed & Ganapathy, 2021). The intricacy storing to the operator relies on the framework to the content proportion of the document. Hence, for a widget that consists n content field, in such case [23]

d. a cascading cache layer needs an average of (n+1) DOM nodes to ensure the mapping for each field and a container to hold them when likened to a more subjective design-oriented number in a conventional HTML. For subsequent updates by a writer who chooses to shift to a diverse template requires not to temper on their content document rather they will just use a new tree to plot their content into a new mockup.[23]

2.3.4 HTML Versions.

There are many models' version of HTML and these table contains the versions of HTML:

Year	Version
1992	The first version of HTML
1995	HTML 2.0
1996	HTML 3.0 & 3.2
1997	HTML 4.0
1999	HTML 4.01
2008	HTML 5

Table 2.1: HTML Versions [21]

2.3.5 Features and Specifications.

a. **User Friendly & Simple:** You can write HTML using annotations called tags. Tags give HTML a structure and make it easy for humans and browsers to read the document efficiently. They also enable a browser to apply CSS (Cascaded Style Sheets) to the digital document, making it a powerful visual combination. While HTML comes with 100s of tags inbuilt, only a handful of them that a developer needs to learn for everyday use. Of course, all tags hold value; most of them don't find usage in normal development [21].

b. **Semantic Structure:** HTML5 defines unique tags to annotate different elements for their specific purposes. The <article> tag, for example, is used to annotate content on a page. The <aside> tag represents some content that is indirectly related to the document's primary content. Other noteworthy elements are <header>, <footer>, , the paragraph tag <p>, and the one most used for navigation between pages, the <a> tag [21].

c. **SEO – Search Engine Optimization is** by far the biggest USP (Unique Selling Point) of HTML5. With the advent of search engines like Google, Yahoo!, DuckDuckGo etc., you have so much information literally at your fingertips. These search engines accumulate information on the World Wide Web using computer programs that crawl the internet (also called web crawlers) and map keywords with respective documents in which they find it. These web crawlers can assimilate this data only because HTML is well structured, and you can optimize your web pages for searchability [21].

d. **local Storage & Indexed DB – Client-side data storage:** HTML5 comes with essential improvements in storage capabilities on the client's side. The local Storage and session Storage are crucial features that help developers store information on the client's side. These are essential advancements in browser storage capabilities because cookies limit data storage size on the client side. One can store small pieces of information like authentication tokens or usernames on the client using cookies. Still, local Storage API is where storage comes in handy for users when they revisit the web application. Imagine not having to repeatedly load some standard information on the client, which saves a lot of resources for both client and server. The session Storage API enables a developer to persist information just for that session. Meaning, the data is wiped out as soon as the user closes that tab. This feature comes in handy for browser-based games or high-security applications that have a limited session [21].

e. **Offline Capabilities (PWA) with Cache API & Service Workers:** Service Workers act as a proxy between the user's machine and the internet. They can store files locally and fetch them when needed via the Cache API and can also bring information from the Indexed DB to provide the application with data. So, when there's no internet on a user's device, the Service Worker intercepts these requests and serves them from the locally stored data. You can configure your service worker to update these files periodically or on-demand [21].

f. **Canvas for Game Development:** You can use HTML5 to build some simple games; however, if you're looking to make a good video game, you can utilize the <canvas> element along with CSS and JavaScript [21].

2.3.6 Security in HTML.

The definition of security is very complicated. Technology purists (and security experts) will tell you that it concerns the Confidentiality, Integrity and Availability (CIA) of information.

We therefore learn that html security is severely lacking in terms of current web systems (see also comments on web page encryption and the dangers of believing that SSL actually can be relied upon to protect web page (html) information) and that you cannot possibly place reliance upon information that you receive from html web pages unless they have additional protection measures that provide assurance that the information really does come from the apparent or claimed source and that it has not been altered by others prior to your inspecting it. Given the prevalence of so-called 'phishing' attacks – messages created to induce you to divulge secret information that will enable someone else to impersonate you, you have proof positive that there is little html security implemented in current web systems, if any. So, html security is a target, in fact a highly desired target, that almost no systems today achieve. People using Protector HTML Security are able to provide their users (customers) with the assurance that their web content is real, reliable, and correct – it is what they actually published and not what a hacker has decided to provide instead. But whilst the vast majority of web sites prefer to provide html without security there will be many users who will be bitterly disappointed relying on what they thought was the correct web site, when in fact it was nothing of the kind. HTML security needs serious promotion in order to stamp out the current failures to ensure that the html you receive and process can truly be relied upon.[23]

2.4 PHP Programing Language.

2.4.1 Introduction.

The PHP programming language is a compiled language. However, the compilation is done by default each time a certain PHP file is requested. This means that the compilation has to be fast and hence can't do much analysis and checks. Most of the checks are thus made at runtime. The purpose of this tool is to allow the developer to check its work for runtime-errors, without actually running its application [24].

2.4.2 Theories.

a. The Principle of Least Astonishment (POLA): The Principle of Least Astonishment suggests that the behavior of PHP should align with users' expectations, making code intuitive and easy to understand. In the context of PHP, this theory implies that PHP functions and features should work in a way that is familiar to developers, minimizing surprises or unexpected behavior.[25]

b. Don't Repeat Yourself (DRY): The DRY principle advocates for avoiding code duplication and promoting code reuse. In PHP, this theory encourages developers to modularize code, extract reusable functions and classes, and use include files or libraries to avoid duplicating code snippets across multiple files. By adhering to the DRY principle, code maintenance becomes easier, and changes can be applied uniformly.[25]

c. Separation of Concerns (SoC): The SoC theory emphasizes the importance of separating different aspects of an application, such as presentation logic, business logic, and data access. In PHP, developers can achieve this by using design patterns (e.g., Model-View-Controller), organizing code into different directories or modules, and employing frameworks that support a clear separation of concerns. This approach enhances code maintainability and allows for easier collaboration among developers.[25]

d. Object-Oriented Programming (OOP) Principles: PHP supports object-oriented programming, which is based on several fundamental principles. These principles include encapsulation, inheritance, polymorphism, and abstraction. By applying these principles, PHP developers can create modular, reusable, and more maintainable code.[25]

e. Continuous Integration and Continuous Deployment (CI/CD): CI/CD is a set of practices aimed at automating the process of integrating code changes, running tests, and deploying applications. By adopting CI/CD in PHP development, developers can ensure that changes are regularly validated, errors are caught early, and deployments are smooth and efficient. Tools like Jenkins, Travis CI, or GitLab CI/CD can be used to implement CI/CD pipelines for PHP projects.[25]

2.4.3 Features and specifications.

a. Server-side scripting:

PHP was originally designed to create dynamic web content, and it is still best suited for that task. To generate HTML, you need the PHP parser and a web server to send the documents. Lately, PHP has also become popular for generating XML documents, graphics, Flash animations, PDF files, and more.[26]

b. Command-line scripting:

PHP can run scripts from the command line, much like Perl, awk, or the Unix shell. You might use the command-line scripts for system administration tasks, such as backup and log parsing.[26]

c. Client-side GUI applications:

Using PHP-GTK (http://gtk.php.net), you can write full-blown, cross-platform GUI applications in PHP.[26]

2.4.4 Security.

PHP is safer than ever online. The fact is, security is important even in local apps, for two main reasons. The first is the perennial problem of “typical user” behavior The second reason security is important is that for most machines, many non-web applications aren’t really “offline.” Even when a desktop app or a system daemon doesn’t interact with the Web, local network, or other external services itself, the machine it is connected to will invariably have an Ethernet cable plugged into it or a Wi-Fi/3G/4G connection active.[27]

Your software will not run in its own cosy little realm, insulated from the world outside (perfectly sandboxed virtual machines notwithstanding, of course, if such a thing exists). Software security is the topic of a whole other book (of which others have written

plenty; see the “Further Reading” section), and many of the same principles apply to CLI software as to web software, so you will be able to use your existing knowledge of web-based PHP security practices to guide you. [27]

2.5 Networking Background.

2.5.1 Introduction.

Networking is referred to as connecting computers electronically for the purpose of sharing information. Resources such as files, applications, printers and software are common information shared in a network. The advantage of networking can be seen clearly in terms of security, efficiency, manageability and cost effectiveness as it allows collaboration between users in a wide range. Basically, a network consists of hardware components such as computers, hubs, switches, routers and other devices which form the network infrastructure. These are the devices that play an important role in data transfer from one place to another using different technology such as radio waves and wires. There are many types of networks available in the networking industries and the most common networks are Local Area Network (LAN) and Wide Area Network (WAN). A LAN network is made up of two or more computers connected together in a short distance usually at home, office buildings or school. WAN is a network that covers a wider area than LAN and usually covers cities, countries and the whole world. Several major LANs can be connected together to form a WAN. As several devices are connected to the network, it is important to ensure data collision does not happen when these devices attempt to use the data channel simultaneously. A set of rules called Carrier Sense Multiple Access / Collision detection are used to detect and prevent collision in networks [28].

2.5.2 Network Components.

a. Router: Routers are devices on the network which are responsible for forwarding data from one device to another. This data is sent in packets (basic units of information) from one device to another. The router reads the network information on the packets to determine the destination it should be routed to. Routers are vital in business as they connect your employees to the internet and to your local network where most of your vital business services will take place. Without routers, most businesses wouldn’t be able to operate. Routers can be a security risk if they are not set up correctly but when configured in the right way, they can offer your business protection against outside threats. Routers can contain built-in firewalls and filtering that protects your network against malicious code [28].

b. Switch: An internet is a switched network in which a switch connects at least two links together. A switch needs to forward data from a network to another network when required. The two most common types of switched networks are circuit-switched and packet-switched networks [28].

c. Network Hub: A network hub is another networking device that connects multiple peripherals on a network making them act as a single segment, however, other than a switch or router; a hub broadcasts data across each connection instead of routing it to a specific device [29].

d. Wireless access point: A Wireless Access Point is simply a device that allows for wireless connections. The access point acts as a router by routing data from one device to another by using wireless frequencies. The most common protocol used is IEEE 802.11 (Wi-Fi) which underpins wireless networking applications [29].

e. Network Cables: Networking cables are used to physically connect the networking device to another. Different types of cables may be used depending on the devices being connected, the network topology and the size of the network. For instance, in a small office network, an Ethernet cable is the primary network cable used to connect to devices over a short distance whereas fiber optic cables are preferred for transmitting data over a larger distance such as the connection from the internet service provider to the client [29].

f. Network Server: A network server is the main computer on the network. This computer is commonly known as the repository of data and programs which exists on the network. The server provides functionality (services) for all other devices on the network and these devices are known as “clients” [29].

g.Network Interface Cards (NIC): For a device to be able to connect to a network, it requires a network interface card (NIC). The NIC, also known as a network adapter, enables the device to send and receive data via the network either through the use of an Ethernet cable or Wireless Connection. Without a NIC installed a device will not be able to connect to a network.[29]

2.5.3 Wireless Network.

2.5.3.1 Introduction.

A wireless network is a computer network that uses wireless data connections between network nodes. Wireless networking is a method by which homes, telecommunications networks and business installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Admin

telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical layer of the OSI model network structure. Examples of wireless networks include cell phone networks, wireless local area networks (WLANs), wireless sensor networks, satellite communication networks, and terrestrial microwave networks [30].

2.5.3.2 Components.

a.Clients: What we tend to think of as the end user devices are typically called clients. As the reach of Wi-Fi has expanded, a variety of devices may be using Wi-Fi to connect the network, including phones, tablets, laptops, desktops, and more. This gives users the ability to move about the area without sacrificing their bridge to the network. In some instances, mobility within an office, warehouse, or other work area is necessary. For example, if employees have to use scanners to register packages due to be shipped, a wireless network provides the flexibility they need to freely move about the warehouse [32].

b. Access Point (AP): An access point (AP) consists of a Wi-Fi that is advertising a network name (known as a Service Set Identifier, or SSID). Users who connect to this network will typically find their traffic bridged to a local-area network (LAN) wired network (like Ethernet) for communication to the larger network or even the internet.[32]

2.5.3.3 Wireless Network Protocols and Technology.

a. 802.11ax Protocol (Wi-Fi 6): The most recent release of the 802.11 protocol is 802.11ax, also called Wi-Fi 6. It accommodates a growing number of devices and applications by increasing network efficiency to meet mobile and IoT devices. Bands between 1 GHz and 6 GHz. speed restriction 600–9608 Mbit/s [31].

b. 802.11ac Protocol (Wi-Fi 5):802.11ac, also known as Wi-Fi 5, added Dual Band support to its tool chest. It can use the 2.4 GHz band and the 5 GHz band at the same time. 802.11ac is approximately three times faster than 802.11n. This protocol provides support for eight streams, up from four in 802.11n. 802.11ac uses only the 5 GHz band, speed restriction 6.39 Gb/s [31].

c.802.11n Protocol (Wi-Fi 4):802.11n uses multiple-input/multiple-output (MIMO) technology and a wider radio frequency channel than its predecessors. It increases a wireless local area network (WLAN) speed and improves

reliability. Operating at 600 Mbps, it offers 10 times the speed of 802.11g and uses both the 2.4 GHz and 5 GHz bands [31].

d. **802.11g Protocol**: The 802.11g standard improves on 802.11b. It uses the same crowded 2.4 GHz shared by other common household wireless devices, but 802.11g is faster and capable of transmission speeds up to 54 Mbps. Equipment designed for 802.11g still communicates with 802.11b equipment. However, mixing the two standards is not usually recommended with a speed restriction54 Mb/s [31].

e. **802.11a Protocol**: The 802.11a standard operates in a different frequency range. By broadcasting in the 5 GHz range exclusively, 802.11a devices run into less competition and interference from household devices. 802.11a is capable of transmission speeds up to 54 Mbps like the 802.11g standard [31].

f. **802.11b Protocol**:802.11b was the first wireless standard to be widely adopted in homes and businesses. Its introduction is credited with the rise in popularity of hotspots and staying connected during travel. Equipment using 802.11b was comparatively inexpensive and built into many laptops speed restriction 11 Mb/s. [31]

2.5.4 Network Protocols.

2.5.4.1 Internet Protocols.

The network layer in version 4 can be thought of as one main protocol and three auxiliary ones. The main protocol, Internet Protocol version 4 (IPv4), is responsible for packetizing, forwarding, and delivery of a packet at the network layer. The Internet Control Message Protocol version 4 (ICMPv4) helps IPv4 to handle some errors that may occur in the network-layer delivery. The Internet Group Management Protocol (IGMP) is used to help IPv4 in multicasting. The Address Resolution Protocol (ARP) is used to glue the network and data-link layers in mapping network-layer addresses to link-layer.[28]

2.5.4.2 Routing Protocols.

A routing protocol specifies how routers communicate with each other to distribute information that enables them to select routes between nodes on a computer network. Routers perform the traffic directing functions on the Internet; data packets are forwarded through the networks of the internet from router to router until they reach their destination computer. Routing algorithms determine the specific choice of route. Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the

network. This way, routers gain knowledge of the topology of the network. The ability of routing protocols to dynamically adjust to changing conditions such as disabled connections and components and route data around obstructions is what gives the Internet its fault tolerance and high availability.

The specific characteristics of routing protocols include the manner in which they avoid routing loops, the manner in which they select preferred routes, using information about hop costs, the time they require to reach routing convergence, their scalability, and other factors such as relay multiplexing and cloud access framework parameters. Certain additional characteristics such as multilayer interfacing may also be employed as a means of distributing uncompromised networking gateways to authorized ports.[1] This has the added benefit of preventing issues with routing protocol loops. Many routing protocols are defined in technical standards documents called RFCs [32].

2.5.4.3 Server Protocols.

A communications protocol that provides a structure for requests between client and server in a network. For example, the Web browser in the user's computer (the client) employs the HTTP protocol to request information from a website on a server. See HTTP, TCP/IP and OSI model [28]. There are three main types of network protocols:

a.Communication protocols include basic data communication tools like TCP/IP and HTTP [32].

b. Management protocols maintain and govern the network through protocols such as ICMP and SNMP [32].

c.Security protocol HTTPS: include HTTPS Hypertext Transfer Protocol Secure (HTTPS) is widely used to secure request data in motion, but the user data may be at risk i.e., data breach if the processing code is not fully isolated from everything else including the operating system on the host machine.[33]

d. DNS protocol: The Domain Name System (DNS) is an Internet service, which helps in translating domain name to Internet Protocol (IP) address. All the devices/systems on internet are identified with unique IP address that helps the internet users to access that device or system. The DNS service for easier access eliminates the need for users to remember IP addresses (IPv4) or complex alphanumeric IP addresses (IPV6). The DNS resolution converts a hostname into a computer understandable IP address format. When an internet user tries to access any webpage, a translation occurs from the DNS name to the machine understandable address [34].

e.Security protocol FTP: principle of operation FTP uses a TCP control and data connection. The TCP control connection is used for opening /closing an FTP session and for transferring commands from client to server.

f. The data connection is used for transferring individual files between client and server. Every file transfer uses a separate data connection.[35].

2.5.5 Security.

2.5.5.1 End device.

Endpoint security is the practice of securing endpoints or entry points of end-user devices such as desktops, laptops, and mobile devices from being exploited by malicious actors and campaigns. Endpoint security systems protect these endpoints on a network or in the cloud from cybersecurity threats.[36]

An endpoint protection platform is a vital part of enterprise cybersecurity for several reasons. First of all, in today's business world, data is the most valuable asset of a company —and to lose that data, or access to that data, could put the entire business at risk of insolvency. Businesses have also had to contend with not only a growing number of endpoints, but also a rise in the number of types of endpoints. These factors make enterprise endpoint security more difficult on their own, but they're compounded by remote work and BYOD policies—which make perimeter security increasingly insufficient and create vulnerabilities. The threat landscape is becoming more complicated, as well: Hackers are always coming up with new ways to gain access, steal information or manipulate employees into giving out sensitive information. Add in the opportunity, cost of reallocating resources from business goals to addressing threats, the reputational cost of a large-scale breach, and the actual financial cost of compliance violations, and it's easy to see why endpoint protection platforms have become regarded as must-haves in terms of securing modern enterprises.[36]

2.5.5.2 Server security.

Server security focuses on the protection of data and resources held on the servers. It comprises tools and techniques that help prevent intrusions, hacking and other malicious actions. Server security measures vary and are typically implemented in layers. They cover:

a.The base operating system - focusing on security of critical components and services.

b. Hosted applications - controlling the content and services hosted on the server.

c.Network security - protecting against online exploits, viruses and attacks.[37]

2.5.5.3 Router security.

Network security is most often thought of as something that protects machines on a network. To do this, companies put up firewalls, configure VPNs, and install intrusion detection systems. Router security, however, involves protecting the network itself by hardening or securing the routers. Specifically, it addresses preventing attackers from:

a.Using routers to gain information about your network for use in an attack (information leakage).

b. Disabling your routers (and therefore your network).

c. Reconfiguring your routers.

d. Using your routers to launch further internal attacks.

e. Using your routers to launch further external attacks.[38]

2.5.5.4 Switch security.

A security switch is a hardware device designed to protect computers, laptops, smartphones and similar devices from unauthorized access or operation, distinct from a virtual security switch which offers software protection. Security switches should be operated by an authorized user only; for this reason, it should be isolated from other devices, in order to prevent unauthorized access, and it should not be possible to bypass it, in order to prevent malicious manipulation. The primary purpose of a security switch is to provide protection against surveillance, eavesdropping, malware, spyware, and theft of digital devices. Unlike other protections or techniques, a security switch can provide protection even if security has already been breached, since it does not have any access from other components and is not accessible by software. It can additionally disconnect or block peripheral devices, and perform "man in the middle" operations [citation needed]. A security switch can be used for human presence detection since it can only be initiated by a human operator. It can also be used as a firewall.[28]

2.6 Internet.

The Internet is the global system of interconnected computer networks that uses the Internet protocol suite (TCP/IP) to communicate between networks and devices. It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries a vast range of information resources and services, such as the interlinked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and file sharing [28].

The communications infrastructure of the Internet consists of its hardware components and a system of software layers that control various aspects of the architecture. As with any computer network, the Internet physically consists of routers, media (such as cabling and radio links), repeaters, modems etc. However, as an example of internetworking, many of the network nodes are not necessarily internet equipment per se, the internet packets are carried by other full-fledged networking protocols with the Internet acting as a homogeneous networking standard, running across heterogeneous hardware, with the packets guided to their destinations by IP routers.[28]

Chapter 3

System Design

3.1 Introduction

In this chapter, we explain our system, that are instant messaging system to serve smart college for modern education, we discuss the general system design, and do analysis design for our system in details. We explain the details block diagram for each part of the system, then we describe the sub system flow chart for the IM system in details.

3.2 Analysis Design

In this scheme, this system is consisting of 14 different networks, 10 networks dedicated for students, 3 networks dedicated for teachers, with 14 routers of TP-Link 802.11.n (TL-WR841N)), 1 server (HPE ProLiant ML 110 Gen 10), 13 laptops of HP ProBook 440 G8 Notebook PC.

Assumptions:

we assume that our system consists of 10 students & 3 teachers, we assume also that each user of them have the following features:

Maximum capacity server = 96 TB

User capacity = Maximum server capacity / Number of users

= 96 TB / 13

= 7.3 TB

In real case normally we will have approximately about 500 students & 60 teachers so that the total number of users will be 560 users

User capacity = Maximum server capacity / Number of users

= 96 * 1000 GB / 560

= 171 GB.

For more information you can see appendices for more details about the devices in the Appendices 1.

3.3 General System Design Block Diagram

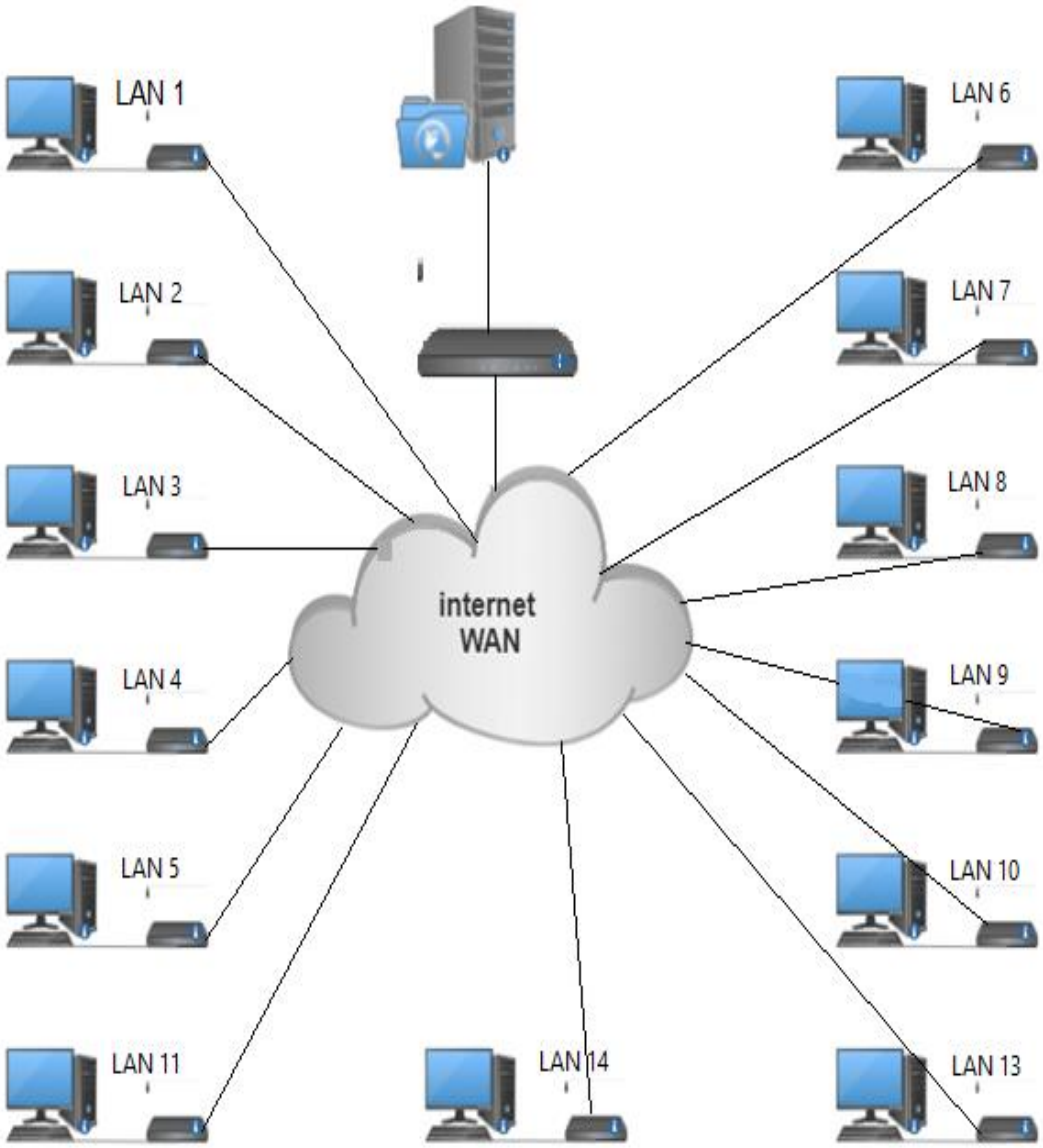


Figure 3.1: General System Design Block Diagram

3.4 Detailed System Design Block Diagram

3.4.1 Server Block Diagram:

Figure 3.2: Server Block Diagram

Server IP: 10.10.2.0

Router IP: 10.10.2.1

Subnet Mask: 255.255.255.0 /24

Default Gateway: 10.10.2.1

3.4.2 LAN 1 Block Diagram:

Figure 3.3: LAN 1 Block Diagram

PC1 IP: 192.168.1.2

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.168.1.1

3.4.3 LAN 2 Block Diagram:

Figure 3.4: LAN 2 Block Diagram

PC2 IP: 192.167.1.4

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.167.1.1

3.4.4 LAN 3 Block Diagram:

Figure 3.5: LAN 3 Block Diagram

PC3 IP: 192.166.1.5

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.166.1.1

3.4.5 LAN 4 Block Diagram:

Figure 3.6: LAN 4 Block Diagram

PC4 IP: 192.165.1.6

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.165.1.1

3.4.6 LAN 5 Block Diagram:

Figure 3.7: LAN 5 Block Diagram

PC 5 IP: 192.164.1.7

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.164.1.1

3.4.7 LAN 6 Block Diagram:

Figure 3.8: LAN 6 Block Diagram

PC 6 IP: 192.163.1.8

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.163.1.1

3.4.8 LAN 7 Block Diagram:

Figure 3.9: LAN 7 Block Diagram

PC7 IP: 192.162.1.9

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.162.1.1

3.4.9 LAN 8 Block Diagram:

Figure 3.10: LAN 8 Block Diagram

PC8 IP: 192.161.1.10

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.161.1.1

3.4.10 LAN 9 Block Diagram:

Figure 3.11: LAN 9 Block Diagram

PC9 IP: 192.160.1.11

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.160.1.1

3.4.11 LAN 10 Block Diagram:

Figure 3.12: LAN 10 Block Diagram

PC10 IP: 192.159.1.12

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.159.1.1

3.4.12 LAN 11 Block Diagram:

Figure 3.13: LAN 11 Block Diagram

PC11 IP: 192.158.1.13

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.158.1.1

3.4.13 LAN 12 Block Diagram:

Figure 3.14: LAN 12 Block Diagram

PC12 IP: 192.157.1.14

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.157.1.1

3.4.14 LAN 13 Block Diagram:

Figure 3.15: LAN 13 Block Diagram

PC13 IP: 192.156.1.15

Subnet Mask: 255.255.255.0 /24

Default Gateway: 192.156.1.1

3.5 System Flow Chart

3.5.1 Server Algorithm Flow Chart:

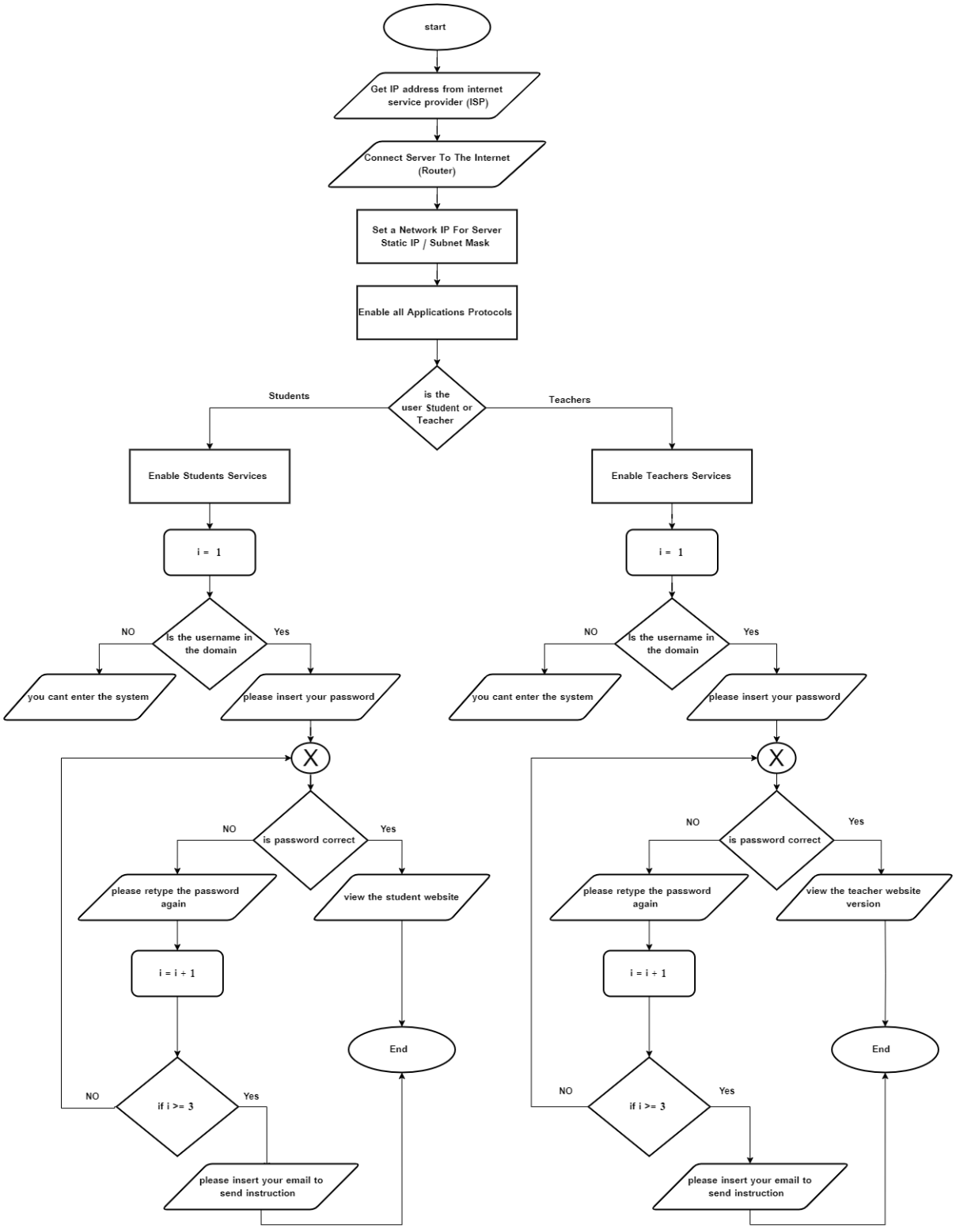


Figure 3.16: Server Algorithm Flow Chart

3.5.2 Student Algorithm Flow Chart:

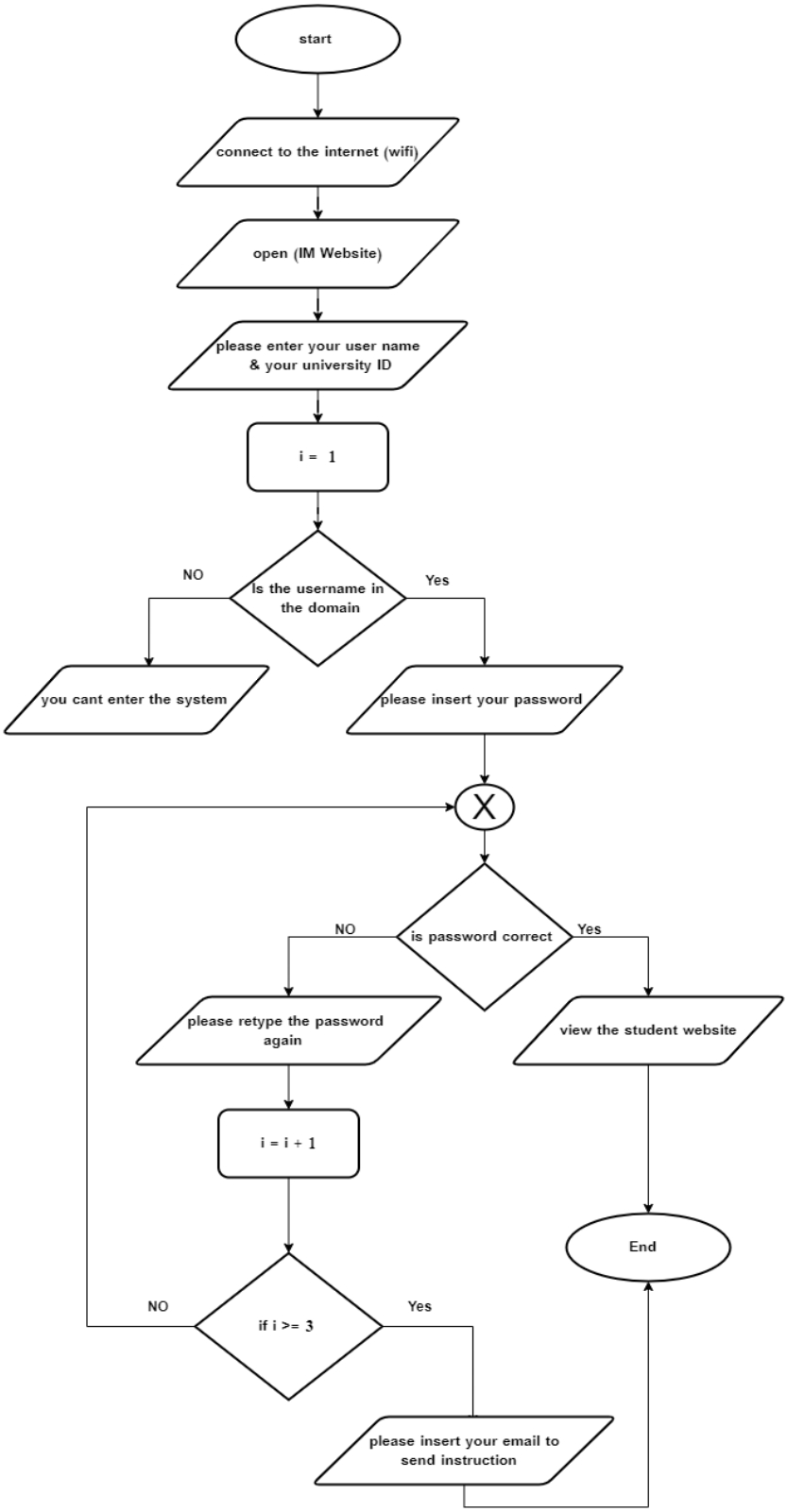


Figure 3.17: Student Algorithm Flow Chart

3.5.3 Teacher Algorithm Flow Chart:

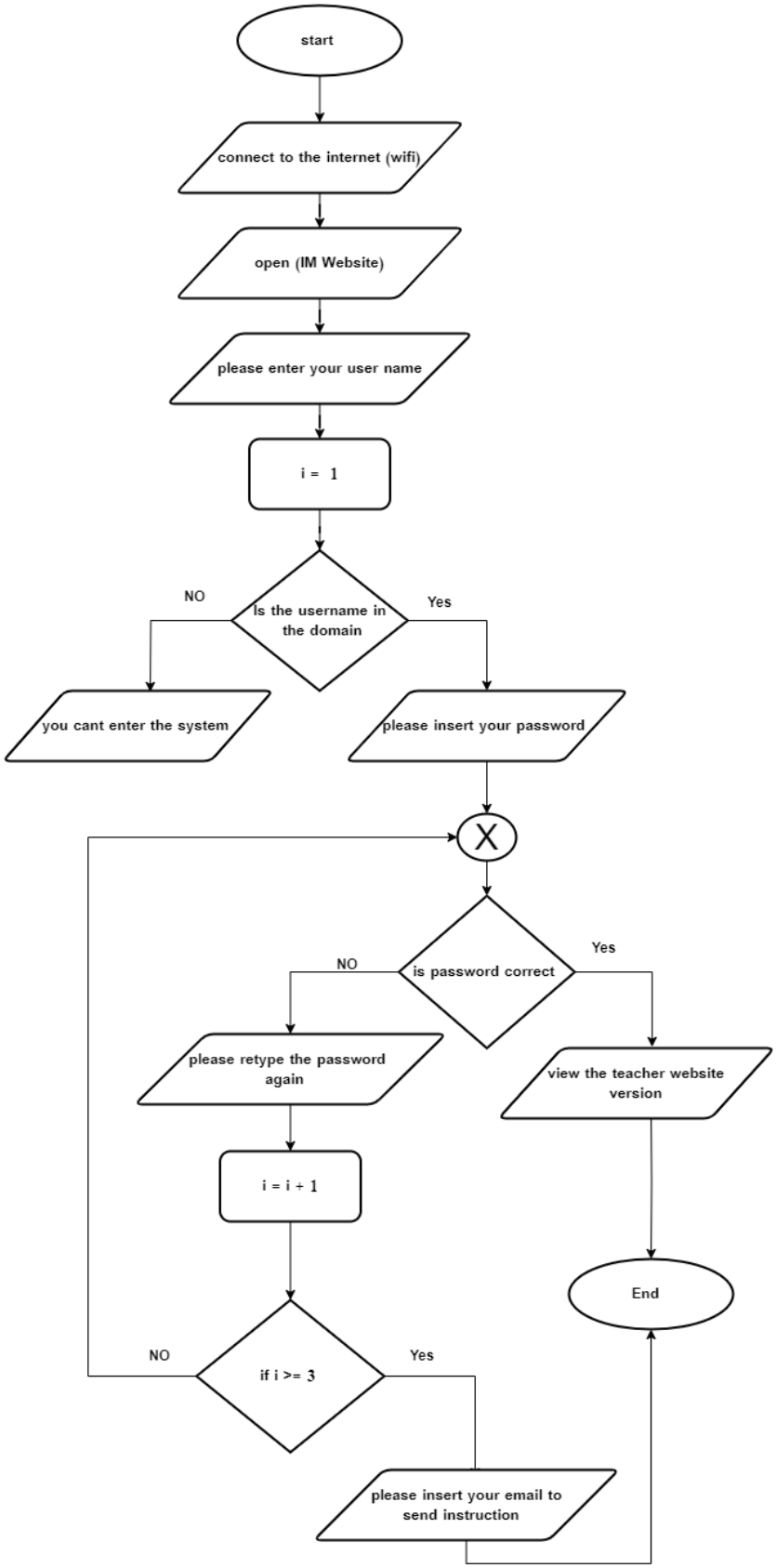


Figure 3.18: Teacher Algorithm Flow Chart

CHAPTER 4

Practical Results

4.1 Introduction

In this chapter, we will explain the practical results of the project and how the IM website works and its features.

4.2 Practical Results

After doing the code work on the VS code program using the PHP and HTML programming languages, an interface was obtained for the site in which the username and password appear. after clicking on the login page and entering the user email and password, a main page of the site appears containing a public chat and a private chat and so that when using the public chat, the message is sent to all users on the site, while using the private chat the message will go to the selected destination.

4.2.1 User Login Page:

To use the system, each user should enter his username (Email Address) and password to start using the system as shown in the below figure.

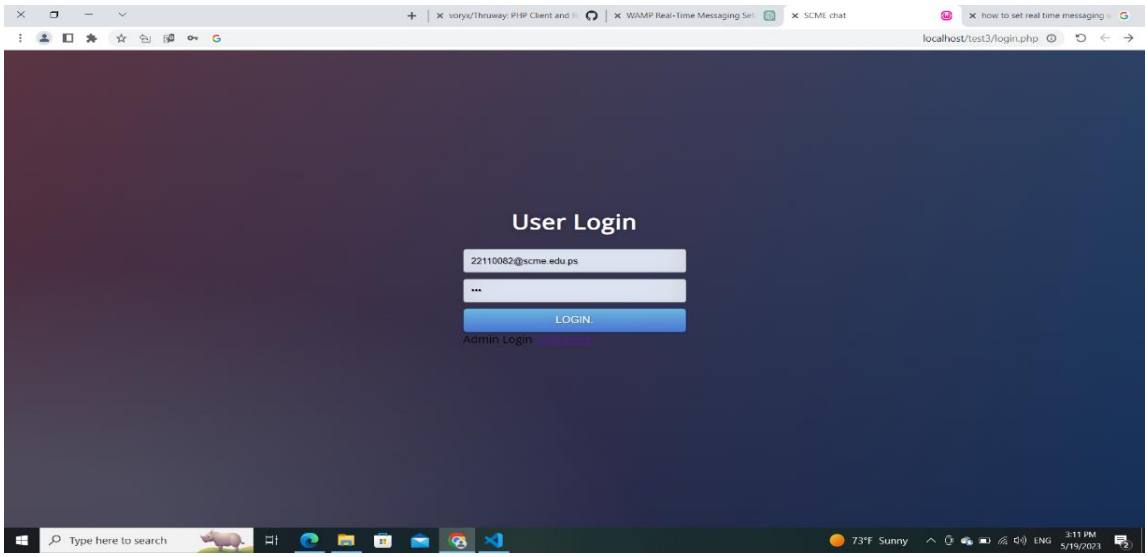


Figure 4.1: Login interface

4.2.2 IM Information Page:

After logging in on the site, a page appears with the user's personal information, public chat icon, private chat icon and password change icon as shown in the below figure.

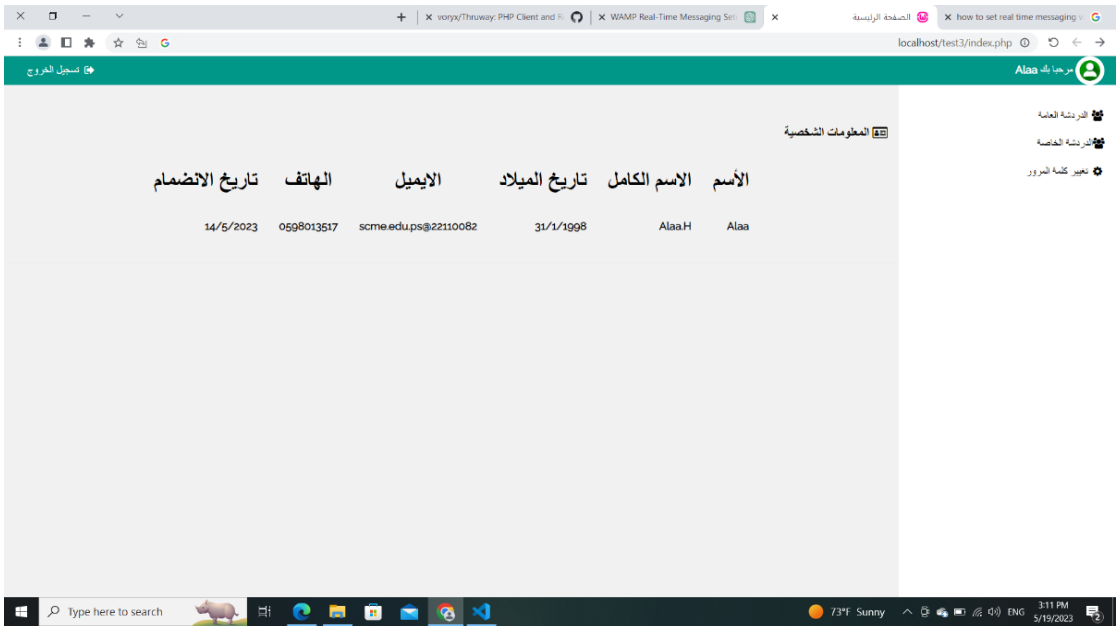


Figure 4.2: IM information Page

4.2.3 Public Chat:

In the public chat scenario , a user, whether it’s a student or a teacher, can send a message to all users inside the domain and each user within the domain can see the message that was sent.

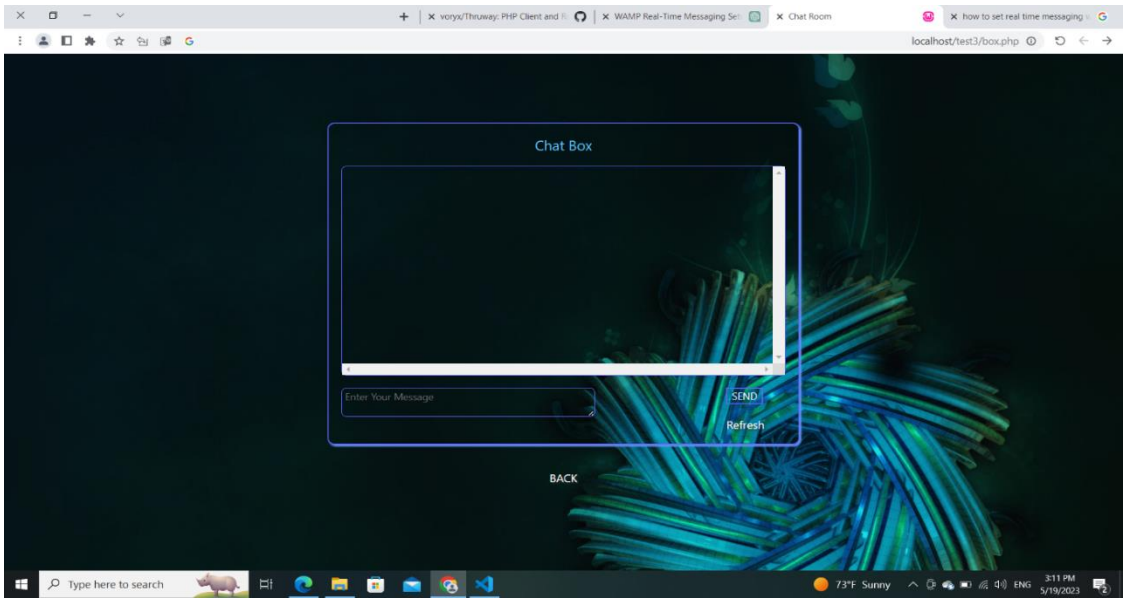


Figure 4.3: Public Chat

4.2.3.1 Teacher Public chatting:

In this case, a teacher can send a message to all users inside the domain and each user can see the message that was sent.

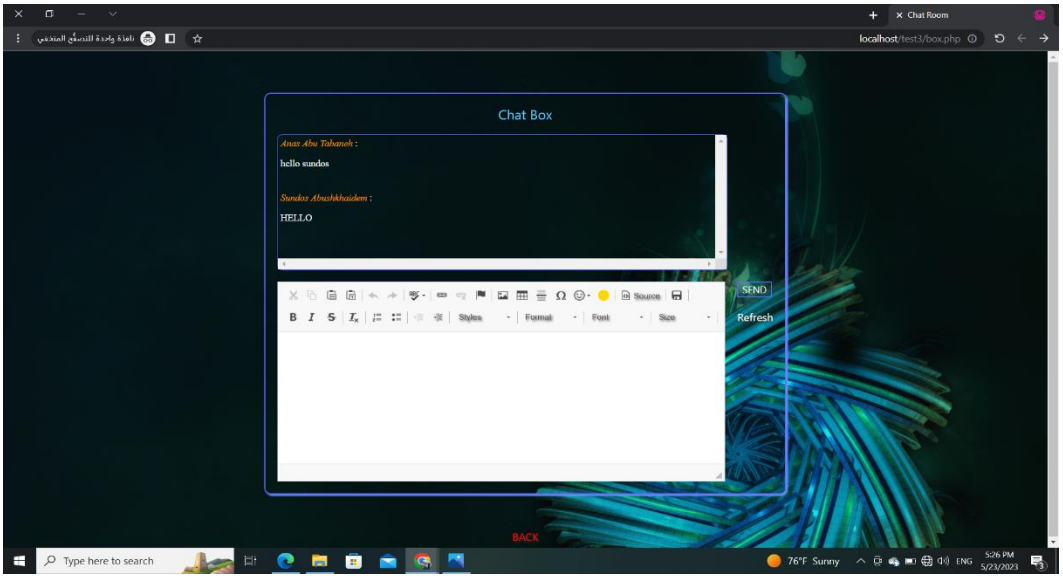


Figure 4.4: Teacher Public chat

4.2.3.2 Student Public chatting:

In this case, a student can send a message to all users inside the domain and each user can see the message that was sent.

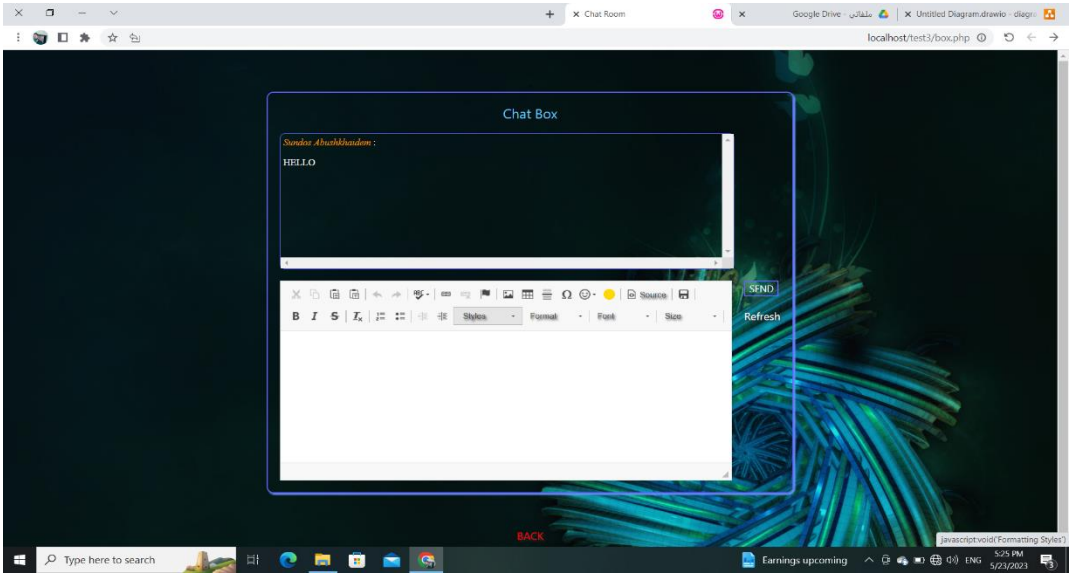


Figure 4.5: Students Public chat

4.2.4 Private Chat:

In this scenario, the student or teacher can send private message to either a student or a teacher as shown in the below figure.

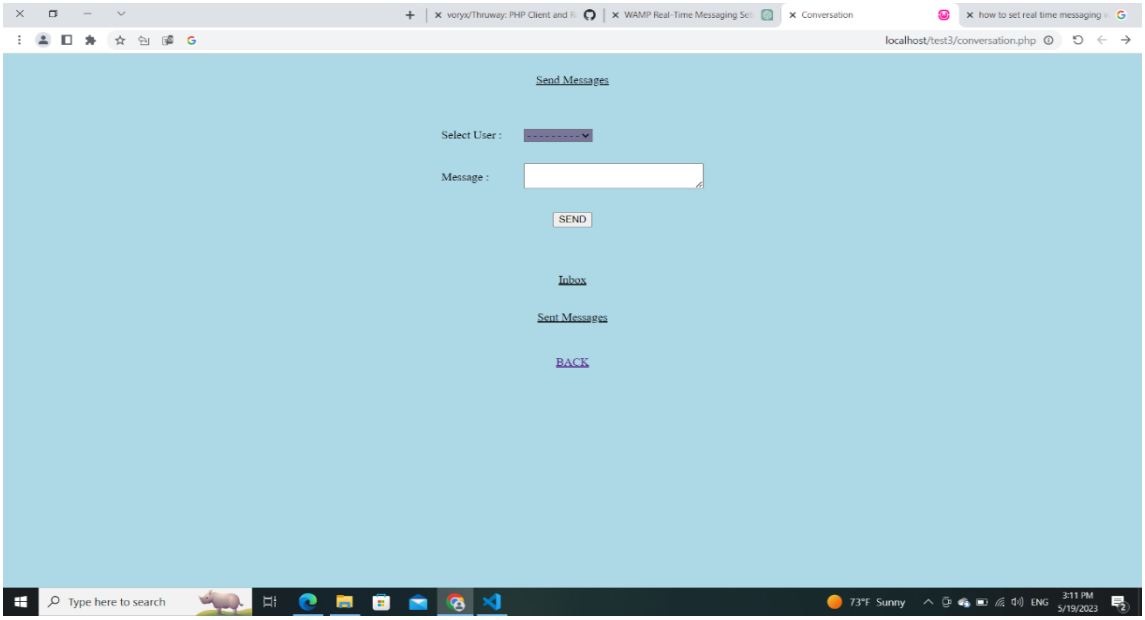


Figure 4.6: Private chat interface

4.2.4.1 Student- Student private chatting:

In this case, the student can send private message to a student as shown in the below figure.

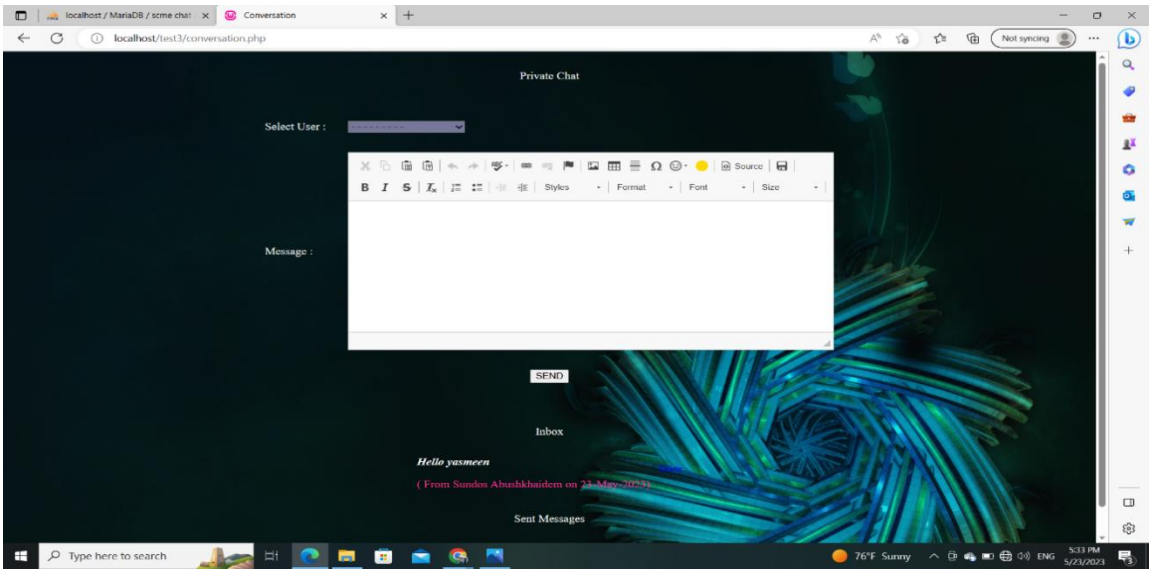


Figure 4.7: Student- Student private chat

4.2.4.2 Student – Teacher private chatting:

In this case the student can send private message to a teacher as shown in the below figure.

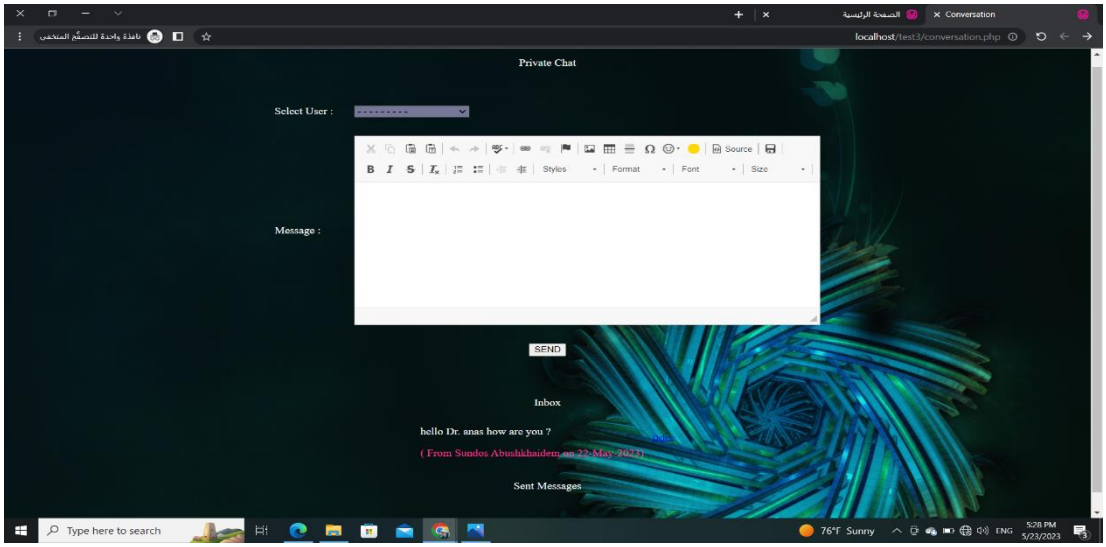


Figure 4.8: Student- Teacher private chat

4.2.4.3 Teacher – Teacher private chatting:

In this case, the teacher can send private message to a teacher as shown in the below figure.

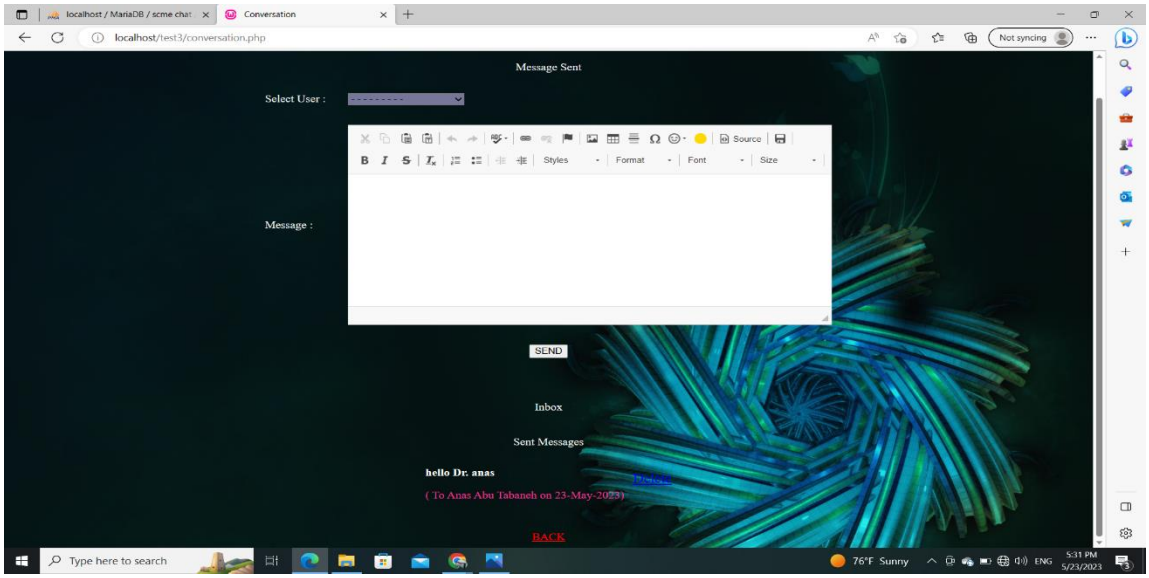


Figure 4.9: Teacher – Teacher private chat

4.2.4.4: Teacher- Student private chatting:

In this case the teacher can send private message to a student as shown in the below figure.

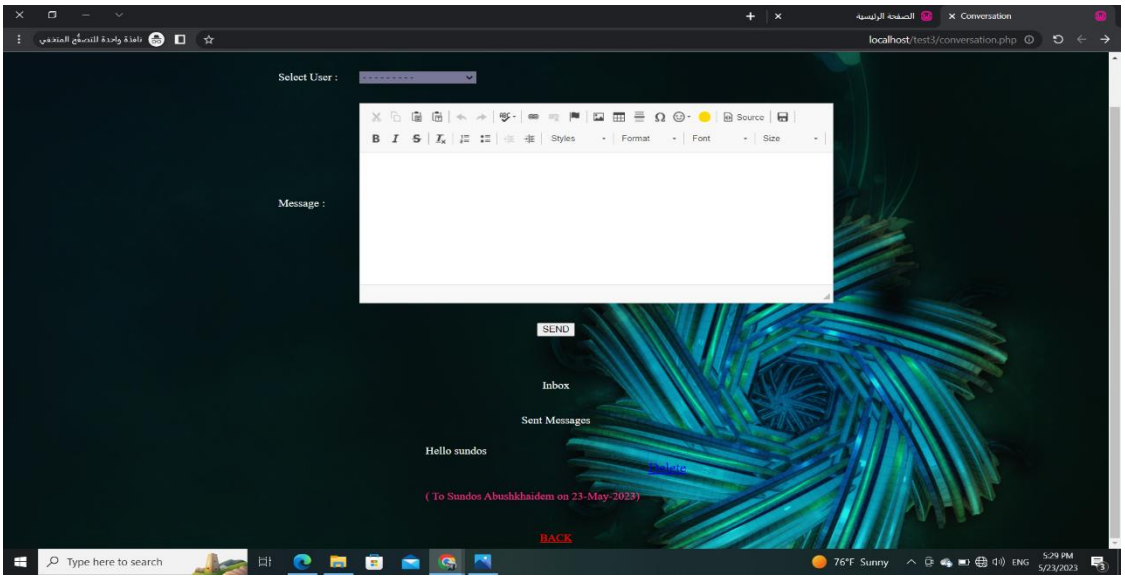


Figure 4.10: Teacher – Student private chat

4.2.5: Changing the user Password:

In the password change interface, the user can change the password as shown in the below figure.

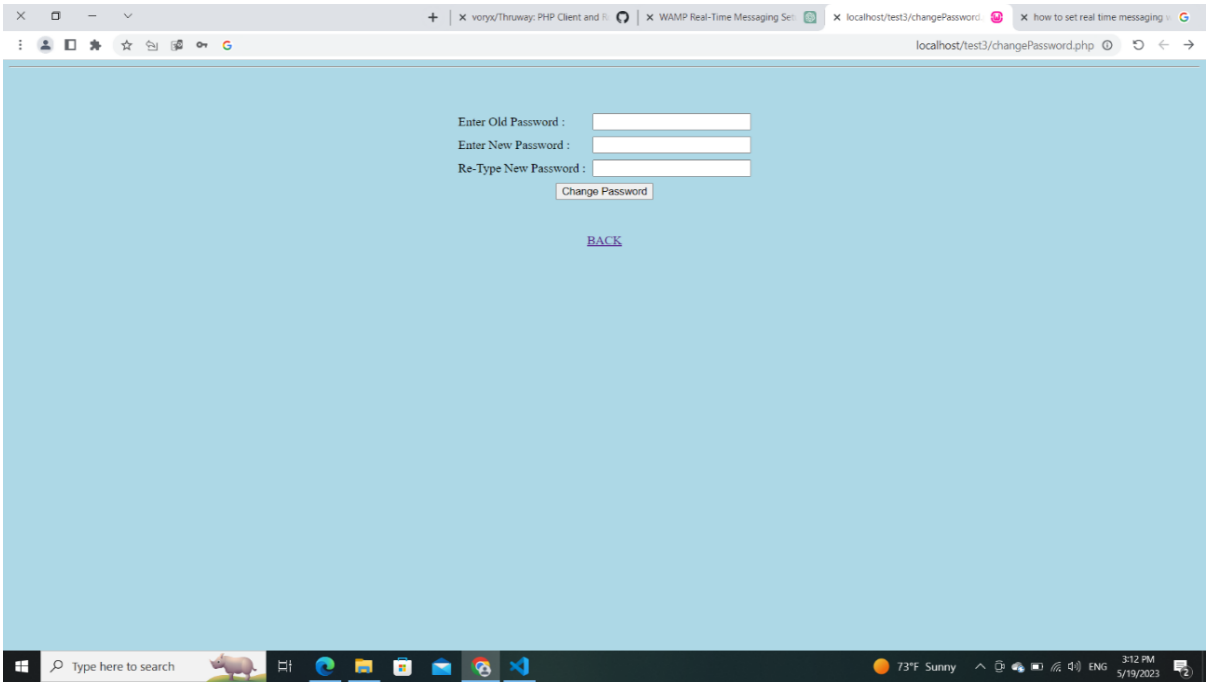


Figure 4.11: Password change interface

CHAPTER 5

Conclusion & Challenge

5.1 Introduction

This chapter contains the summary of the project and the challenges and difficulties that we faced, and we mentioned what we aspire to do in the future to develop the project to serve the smart college for modern education.

5.2 Conclusions

1. The website was created using the technology of instant messaging and building a correspondence Page between students and teachers so that students and teachers can access the website and communicate with each other.
2. First, we design the login page using HTML, then the index page, the public and private chat page, and the password change feature using PHP.
3. The system design support instant messaging in multi scenario's including:
    a. Student Public chatting.
    b. Teacher Public chatting.
    c. Student- Student private chatting.
    d. Student – Teacher private chatting.
    e. Teacher – Teacher private chatting.
    f. Teacher- Student private chatting.
4. In the case if the user forgot his password, he can access the password feature using PHP.

5.3 Challenges

We faced several difficulties during the work, as some parts did not work as required, but after several attempts all the problems were solved and the project was completed correctly and completely.

These challenges include:

1. The lack of skills in PHP and HTML programming languages and the lack of sufficient time to learn it.
2. in addition to our inability to connect the PHP code to the database.
3. We face a problem to implement the project as Hardware due to high cost of the equipment's.
4. We not implement the password Reset algorithm as we mention in chapter three because it need more time and effort.

5.4 Future work

Based on the construction of an instant messaging site to be used by students and teachers, a set of Future Works has been developed.

These works include:

1. Increase the number of users that can use the IM system to support i.e. 1000 users.
2. Develop the encryption algorithm for IM chatting system.
3. Developing a phone application to use the site through a mobile phone.
4. Develop the proposed system to support IM in all Palestinian universities.
5. Connect System to the GSM system to support users to reset the forgotten password via SMS.
6. Modify the system to support ZOOM meeting services to all users in the system.
7. Modify the code in case if the user enters the password 3 times incorrectly, the IM system will send him instruction reset via email.

References

[1] The Impact of Using SMS as Learning Support Tool on Students Learning, Al-Mothana M. Gasaymeh & Osamah M. Aldalalah, International Education Studies; Vol. 6, No. 10; 2013 ISSN 1913-9020 E-ISSN 1913-9039 Published by Canadian Center of Science and Education, (2013).

[2] Mobile Learning: Using SMS in Educational Contexts, Adelina Moura, Ana Amélia Carvalho, University of Minho, Campus de Gualtar, Braga, Portugal, (2010).

[3] Exploring the use of text and instant messaging in higher education classrooms, Sharon Lauricellaa, and Robin Kayb, Canada, (2013).

[4] Effects of using mobile instant messaging on student behavioral, emotional, and cognitive engagement: a quasi-experimental study, Article number: 3, (2022).

[5] Use of Instant Messaging to Improve Communication Between Teachers and Students, (2023).

[6] Game learning analytics of instant messaging and online discussion forums in higher education, Ana Beartiz Hernandez, Alexandre Perera- LIuna, Enric Serradell Lopez, 2021.

[7] Results of Whatsapp® Used in Higher Education, Amarolinda Zanela Klein, José Carlos da Silva Freitas Junior, Juliana Vitória Vieira Mattiello Mattiello da Silva, Jorge Luis Victória Barbosa, Lucas Baldasso, International Journal of Distance Education Technologies Volume 16 Issue 2 April-June 2018.

[8] Instant Messaging in On-Site and Online Classes in Higher Education, Wooseob Jeong, 2007.

[9] GroupMe: Investigating Use of Mobile Instant Messaging in Higher Education Courses, Susie Gronseth, Waneta Hebert, 2018.

[10] Mobile Instant Messaging Support for Teaching and Learning in Higher Education, Simon Wing Wahso, 2016.

[11] Deyao Tan, Proceedings of the 2013 International Conference on Advanced ICT and Education, 2013.

[12] Anabel Quan-Haase,The Information Society, 2020.

[13] Alfred Rovai,The Internet and Higher Education, 2009.

[14] Baoxiang Song, Wei Wang, Instant messaging continuance: A media choice theory perspective, (2011).

[15] Ling Liu, M. Tamer Özsu, Encyclopedia of Database Systems, (2018).

[16] Jean – Phillippe Aumasson, "Serious Cryptography: A Practical Introduction to Modern Encryption", (2017).

[17] Henk C.A van Tilborg Sushil Jajodia, "Encyclopedia of Cryptography and Security", Second Edition, (2005).

[18] JohnV. McCanny and Maire McLoone, "System-On-Chip Architectures and Implementations for Private-Key Data Encryption", (2003).

[19] Worcester Polytechnic Institute and KOHSUKE KAWAGUCHI ACM Transactions on Internet Technology,November (2005).

[20] Henk C. A. van Tilborg, Sushil Jajodia, Encyclopedia of Cryptography and Security, (2011).

[21] Hermann Maurer, Nick Scherbakov, Zahran Halim, Zaidah Razak, HyperText Mark-up Language (HTML), (1998).

[22] Erik Wilde, International Computer Science Institute, Hypertext Markup Language (HTML), (1999).

[23] Ali Farazmand , Florida Atlantic University, Boca Raton, USA , Global Encyclopedia of Public Administration, Public Policy, and Governance , (2023) .

[24] Etienne Kneuss, Static Analysis for the PHP Language, (2010).

[25] Alex C. Michalos, Encyclopedia of Quality of Life and Well-Being Research, (2014)

[26] Rasmus Lerdorf، Kevin Tatroe, Programming PHP, (2002)

[27] Rob Aley, Pro Functional PHP Programming, (2017)

[28] Behrouz A. Forouzan, Data Communications and Networking, (2007)

[29] Claire Smith, Department of Archaeology, Flinders University, Adelaide, Australia, Encyclopedia of Global Archaeology, (2014).

[30] Xuemin (Sherman) Shen, Xiaodong Lin, Kuan Zhang, Encyclopedia of Wireless Networks, (2020).

[31] Mark Ryan M. Talabis, D. Kaye, Information Security Analytics (2015)

[32] Amine Dahane، Nasr-Eddine Berrached, "A New Clusterings Algorithm for Wireless Sensor Networks", (2021).

[33] Gordon King, Hans Wang, HTTPS Attestable Protocol, (2014)

[34] Mukesh Kumar Bansal, M. Seth Madhavan, Futuristic Trends in Networks and Computing Technologies, (2019).

[35] Peter R, FILE TRANSFER PROTOCOL (FTP), (2015)

[36] Xuemin (Sherman) Shen, Xiaodong Lin, Xiaodong Lin, Encyclopedia of Wireless Networks, Encyclopedia of Wireless Networks, Adaptive Medium Access Control for Internet-of-Things-Enabled MANETs, (2020)

[37] Mary Ann Fitzgerald، Robert Maribe Branch, Educational Media and Technology Yearbook, (2013).

[38] Alan Holt, Chi-Yu Huang, 802.11 Wireless Networks, (2010).

Appendices

Hewlett Packard Enterprise

HPE ProLiant ML110 Gen10 Server

ProLiant ML Servers

What's new

- New SMB focused offers regionally released as “Smart Buy Express” in the U.S. and Canada, “Top Value” in Europe, and “Intelligent Buy” in Asia Pacific and Japan.
- Supports Intel® Xeon® Scalable processors up to 14 cores and up to 105W.
- Supports up to 8 LFF non-hot plug SATA/SAS hard disk drives.
- Optional support for redundant fans and up to two graphic processing units (GPUs)

Overview

Are you searching for a tower server with exceptional value to meet the requirements of your small-to-midsized business? The HPE ProLiant ML110 Gen10 server is an enhanced tower with performance, expansion, and growth at an affordable price. It meets most small- and mid-sized businesses’ needs as well as accelerates your business compute. The ProLiant ML110 Gen10 is a single processor tower form factor that can also be placed in a rack server cabinet using 4.5U of rack space. It includes up to five PCIe slots with room to grow with eight large form factor (LFF) or 16 small form factor (SFF) disk drives. It provides six DDR4 DIMM slots supporting HPE DDR4 SmartMemory with a

- Protect, detect and remover with built-in security features such as Silicon Root of Trust, Runtime Firmware Validation and Secure Recovery.

maximum capacity of 192 GB. The HPE ProLiant ML110 Gen10 server also offers optional redundant fan and redundant power supply to satisfy automatic fail-over needs, making this the ideal server for small- to mid-sized businesses and remote offices and branch offices.

Features

Right-sized, With the Balance of Performance To Meet Growing SMB Requirements

The HPE ProLiant ML110 Gen10 Server is compact with less than a 19-inch depth, quiet, and affordable that can deliver the performance needed for the compute demands of a growing office small- to mid-sized business.

Supports industry standard technology leveraging the Intel Xeon Scalable Processors operating with speeds of up to 3.6 GHz and up to 14 cores offering improved performance.

Supports up to two optional graphic processing units (GPUs) allowing one double wide and one single wide card to boost performance in graphic and Virtual Desktop Infrastructure (VDI) applications such as financial services, education, scientific research and medical imaging.

The embedded HPE Dynamic Smart Array S100i Controller for SATA disk drives supports boot, data and media needs. These enhanced HPE Smart Array Controllers provide the flexibility to choose the optimal 12 Gbps controller most suited to your environment, as well as operate in both SAS and HBA modes.

Build a fully functional server with ClearOS Software from Hewlett Packard Enterprise that is just right for you at no upfront cost.

Expandability To Fit the Needs of Growing, Budget-conscious Businesses

The HPE ProLiant ML110 Gen10 Server offers up to six DIMM slots with support for up to 192 GB of HPE DDR4 SmartMemory, helping to prevent data loss and downtime with enhanced error handling while improving workload performance and power efficiency.

Support optional redundant fan and redundant power supplies reducing data loss and downtime, making your server more reliable. Flexible expansion capacity with five PCIe expansion slots, eight USB ports and one optional serial port.

HPE SmartDrives delivers enhanced performance, capacity, and reliability to meet various customer segments and workload requirements at the right economics. Support up to eight large form factor (LFF) disk drives or 16 small form factor (SFF) disk drive options.

Security Innovations

The HPE ProLiant ML110 Gen10 Server is part of the Hewlett Packard Enterprise offering of industry-standard servers with major firmware anchored directly into the silicon. With security protection built-in across the server lifecycle starting with Silicon Root of Trust.

Secure Recovery allows server firmware to roll back to the last known reliable state or factory settings after detection of compromised code.

Millions of lines of firmware code run before server operating system boots and with Run-time Firmware Validation, enabled by HPE iLO Advanced Premium Security Edition, the server firmware is checked every 24 hours verifying validity and credibility of essential system firmware.

Industry-Leading Services and Ease of Deployment

The HPE ProLiant ML110 Gen10 Server comes with a complete set of services from HPE Pointnext, delivering confidence, reducing risk, and helping you realize agility and stability.

HPE Pointnext Services simplifies all stages of the IT journey. Advisory and Transformation Services professionals understand customer challenges and design an enchanced solution. Professional Services enables rapid deployment of solutions and Operational Services provides ongoing support.

Services provided under Operational Services include: HPE Flexible Capacity, HPE Datacenter Care, HPE Infrastructure Automation, HPE Campus Care, HPE Proactive Services and multi-vendor coverage.

HPE IT investment solutions help you transform to a digital business with IT economics that align to your business goals.

Technical specifications — HPE ProLiant ML110 Gen10 Server

Processor family	Intel® Xeon® Scalable 5100 series Intel® Xeon® Scalable 4100 series Intel® Xeon® Scalable 3100 series
Processor core available	4 or 6 or 8 or 14
Processor cache	8.25 MB L3 11.00 MB L3 16.50 MB L3 19.25 MB L3
Processor speed	3.6 GHz maximum
Power supply type	One HPE ML110 Gen10 350W ATX FIO Power Supply Kit or One HPE ML110 Gen10 550W ATX Power Supply Kit or One HPE 800W Flex Slot Platinum hot plug power supply kit
Expansion slots	5 PCIe 3.0, for detailed descriptions reference the QuickSpecs
Maximum memory	192 GB
Memory slots	6 DIMM slots
Memory type	HPE DDR4 SmartMemory or HPE DDR4 Standard Memory
System fan features	2 non-hot plug, non-redundant
Network controller	HPE Ethernet 1Gb 2-port 332i Adapter
Storage controller	HPE Smart Array S100i SR Gen10 SW RAID
Minimum dimensions (W x D x H)	44 x 19.5 x 48.05 cm
Weight	Minimum: 13.5 kg Maximum: 25.0 kg
Infrastructure management	Included: HPE iLO Standard with Intelligent Provisioning (embedded), HPE OneView Standard (requires download) Optional: HPE iLO Advanced, HPE iLO Advanced Premium Security Edition
Warranty	3/3/3 - Server Warranty includes three years of parts, three year of labor, three year of onsite support coverage. Additional information regarding worldwide limited warranty and technical support is available at: http://h20564.www2.hpe.com/hpsc/wc/public/home. Additional HPE support and service coverage for your product can be purchased locally. For information on availability of service upgrades and the cost for these service upgrades, refer to the HPE website at http://www.hpe.com/support

Additional resources

QuickSpecs

hpe.com/h20195/v2/GetDocument.aspx?docname=a00021851enus

HPE Pointnext

HPE Pointnext leverages our breadth and depth of technical expertise and innovation to help to accelerate digital transformation. A comprehensive portfolio that includes—Advisory, Professional, and Operational Services is designed to help you evolve and grow today and into the future.

Operational Services

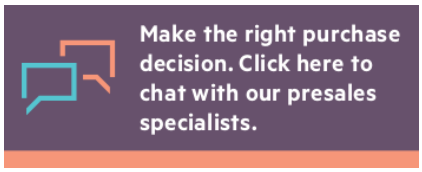
- **HPE Flexible Capacity** is a new consumption model to manage on-demand capacity, combining the agility and economics of public cloud with the security and performance of on-premises IT.
- **HPE Datacenter Care** offers a tailored operational support solution built on core deliverables. It includes hardware and software support, a team of experts to help personalize deliverables and share best practices, as well as optional building blocks to address specific IT and business needs.
- **HPE Proactive Care** is an integrated set of hardware and software support including an enhanced call experience with start to finish case management helping resolve incidents quickly and keeping IT reliable and stable.
- **HPE Foundation Care** helps when there is a hardware or software problem offering several response levels dependent on IT and business requirements.

Advisory Services includes design, strategy, road map, and other services to help enable the digital transformation journey, tuned to IT and business needs. Advisory Services helps customers on their journey to Hybrid IT, Big Data, and the Intelligent Edge.

Professional Services helps integrate the new solution with project management, installation and startup, relocation services, and more. We help mitigate risk to the business so there is no interruption when new technology is being integrated in the existing IT environment.

Call to action:

marketplace.hpe.com/category?catId=15351&reqCatId=1010192782&catlevelmulti=15351_241434_3328424_1010192782&country=US&locale=en



Sign up for updates

© Copyright 2018 Hewlett Packard Enterprise Development LP.The information contained herein is subject to change without notice.The only warranties for Hewlett Packard Enterprise products and services are set forth in the express warranty statements accompanying such products and services.Nothing herein should be construed as constituting an additional warranty.Hewlett Packard Enterprise shall not be liable for technical or editorial errors or omissions contained herein.

Hewlett Packard Enterprise

TP-LINK®

300Mbps Wireless N Router

TL-WR841N

Features:

- Wireless N speed up to 300Mbps makes it ideal for bandwidth consuming or interruption sensitive applications like video streaming, online gaming and VoIP
- Backward compatible with 802.11b/g products
- WDS wireless bridge provides seamless bridging to expand your wireless network
- Easily setup a WPA encrypted secure connection at a push of the WPS button
- Wi-Fi On/Off Button allows users to simply turn their wireless radio on or off
- Bandwidth control allows administrators to determine how much bandwidth is allotted to each PC
- Parental control allows parents or administrators to establish restricted access policies for children or staff
- Supports virtual server, special application and DMZ host ideal for creating a website within your LAN
- Easy Setup Assistant provides quick & hassle free installation
- TP-LINK Tether App lets you manage your network with ease
- Compatible with the more recent Internet Protocol version (IPv6)

Description:

The TP-LINK 300Mbps Wireless N Router TL-WR841N is a combined wired/wireless network connection device integrated with Internet-sharing router and 4-port switch. TL-WR841N's exceptional and advanced wireless performance make it overcome the interface and signal degradation when travelling long distances or through physical barriers. Now you can enjoy more kinds of bandwidth consuming applications like HD video streaming wirelessly which cannot be accommodated by 11g products, from anywhere in your entire home or even the yard, imagine all the possibilities with TL-WR841N wireless!

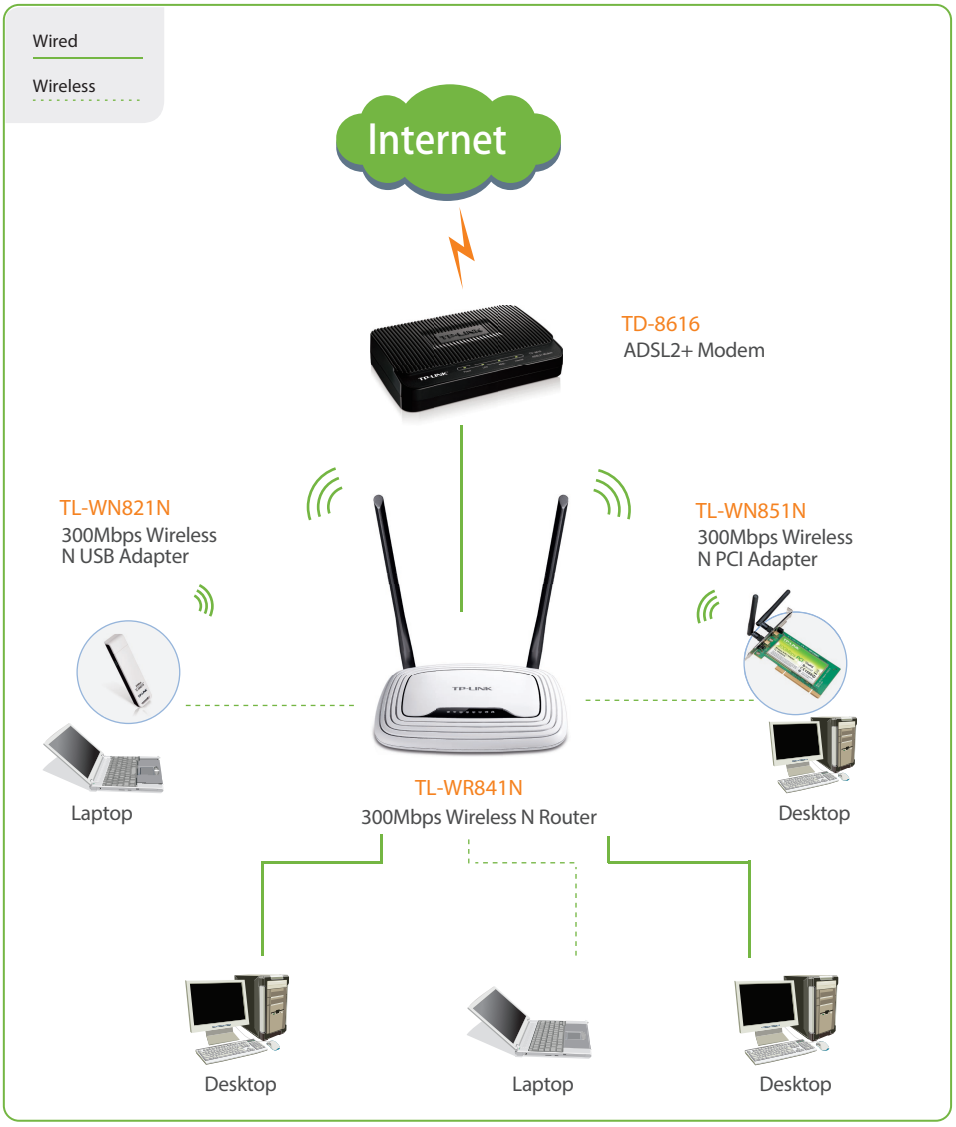
Specifications:

HARDWARE FEATURES	
Interface	4 10/100Mbps LAN Ports 1 10/100Mbps WAN Port
Button	WPS/Reset Button Power On/Off Button WiFi On/Off Button
External Power Supply	9VDC / 0.6A
Wireless Standards	IEEE 802.11n, IEEE 802.11g, IEEE 802.11b
Antennas	2*5dBi Detachable Omni Directional Antenna (RP-SMA)
Dimensions (W x D x H)	7.6 x 5.3 x 1.3 in. (192 x 134 x 33 mm)
WIRELESS FEATURES	
Frequency	2.4-2.4835GHz
Signal Rate	11n: Up to 300Mbps(dynamic) 11g: Up to 54Mbps(dynamic) 11b: Up to 11Mbps(dynamic)
EIRP	CE: <20dBm, FCC: <30dBm
Reception Sensitivity	270M: -70dBm@10% PER 130M: -74dBm@10% PER 108M: -74dBm@10% PER 54M: -77dBm@10% PER 11M: -87dBm@8% PER 6M: -90dBm@10% PER 1M: -98dBm@8% PER
Wireless Functions	Enable/Disable Wireless Radio, WDS Bridge, WMM, Wireless Statistics
Wireless Security	WEP, WPA / WPA2, WPA-PSK / WPA2-PSK
Guest Network	2.4GHz guest network × 1
SOFTWARE FEATURES	
WAN Type	Dynamic IP/Static IP/PPPoE/ PPTP(Dual Access)/L2TP(Dual Access)/BigPond
DHCP	Server, Client, DHCP Client List, Address Reservation
Quality of Service	WMM, Bandwidth Control
Port Forwarding	Virtual Server, Port Triggering, UPnP, DMZ
Dynamic DNS	DynDns, Comexe, NO-IP
VPN Pass-Through	PPTP, L2TP, IPSec (ESP Head)
Access Control	Parental Control, Local Management Control, Host List, Access Schedule, Rule Management
Firewall Security	DoS, SPI Firewall IP Address Filter/MAC Address Filter/Domain Filter IP and MAC Address Binding
Management	Access Control Local Management Remote Management
Protocols	Supports IPv4 and IPv6

Specifications:

OTHERS	
Certifications	CE, FCC, RoHS, Wi-Fi
System Requirements	Microsoft Windows 10/8.1/8/7/Vista/XP/2000/NT/98SE, MAC OS, NetWare, UNIX or Linux.
Environment	Operating Temperature: 0℃~40℃ (32℉~104℉) Storage Temperature: -40℃~70℃ (-40℉~158℉) Operating Humidity: 10%~90% non-condensing Storage Humidity: 5%~90% non-condensing

Diagram:



Package:

- 300Mbps Wireless N Router TL-WR841N
- Power Adapter
- RJ-45 Ethernet Cable
- Resource CD
- Quick Installation Guide

Data sheet

HP ProBook 440 G8 Notebook PC

Modern design for today's workstyles

With a new compact design, the HP ProBook 440 Laptop PC delivers commercial performance, security, and durability to professionals at growing companies who move from desk to meeting room to home.

*Product image may differ from actual product

HP recommends Windows 11 Pro for business

A new design for wherever work takes you

- The compact, light, slim chassis with aluminum components is easy to carry from place to place. An optional high-brightness display[3] provides an over 87-percent screen-to-body ratio and a new keyboard delivers a quiet and responsive experience.

Protected by HP Wolf Security

- HP Wolf Security for Business creates a hardware-enforced, always-on, resilient defense. From the BIOS to the browser, above, in, and below the OS, these constantly evolving solutions help protect your PC from modern threats.[1]

Power that lasts

- Equipped with the latest optional quad-core Intel® processor[2,4] with breakthrough Intel® Iris® Xᵉ graphics[5] and fast, upgradeable dual channel SODIMM memory[6], the HP ProBook 440 drives performance with long battery life and high-speed solid-state drives.
- Enjoy the consistent feel and extremely quiet typing experience of the redesigned keyboard with rubber dome keys.
- You will appreciate the style of the lightweight chassis with aluminum components and the confidence that comes from 120,000 hours of the HP Total Test process and MIL-STD 810H testing.[7,8]
- Help speed up demanding business applications with an optional quad-core 11th Gen Intel® Core™ processor.[2,4]
- Get going fast with Connected Modern Standby and wake your PC from the optional match-on-sensor fingerprint sensor.[3]
- Firmware attacks can completely devastate your PC. Stay protected with HP Sure Start Gen6, the self-healing BIOS that automatically recovers itself from attacks or corruption.[9]
- The portability of your PC and the reliability of a fast connection determines where you can work. Get a fast and reliable connection in dense wireless environments with gigabit-speed Wi-Fi 6.[11,12]
- Instantly block prying eyes by making your screen appear dark and unreadable from the side with optional HP Sure View Gen3.[13]
- Get peace-of-mind with a built-in HP Privacy Camera that blocks the lens of your camera.[14]
- Easily stay connected even when a LAN connection is needed thanks to a built-in RJ-45 port. Connect your devices with two USB Type-A ports and enjoy the speed and versatility of the USB Type-C® 3.1 Gen 2 port.

HP recommends Windows 11 Pro for business

HP ProBook 440 G8 Notebook PC Specifications Table



*Product image may differ from actual product

Available Operating Systems	Windows 11 Pro[1] Windows 11 Home – HP recommends Windows 11 Pro for business[1] Windows 11 Home Single Language[1] Windows 11 Pro (Windows 11 Enterprise or Windows 10 Enterprise available with a Volume Licensing Agreement)[1] FreeDOS (Device comes with Windows 10 and a free Windows 11 upgrade or may be preloaded with Windows 11. Upgrade timing may vary by device. Features and app availability may vary by region. Certain features require specific hardware (see Windows 11 Specifications).)
Processor family[6]	11th Generation Intel® Core™ i7 processor; 11th Generation Intel® Core™ i5 processor; 11th Generation Intel® Core™ i3 processor
Available Processors[3,4,5,6]	Intel® Core™ i5-1135G7 (2.4 GHz base frequency, up to 4.2 GHz with Intel® Turbo Boost Technology, 8 MB L3 cache, 4 cores, 8 threads); Intel® Core™ i7-1165G7 (2.8 GHz base frequency, up to 4.7 GHz with Intel® Turbo Boost Technology, 12 MB L3 cache, 4 cores, 8 threads); Intel® Core™ i3-1115G4 with Intel® UHD Graphics (3.0 GHz base frequency, up to 4.1 GHz with Intel® Turbo Boost Technology, 6 MB L3 cache, 2 cores, 4 threads)
Maximum memory	32 GB DDR4-3200 SDRAM[7] Both slots are accessible/upgradeable by IT or self-maintainers only. Supports dual channel memory.
Memory slots	2 SODIMM
Internal storage	up to 512 GB Intel® PCIe® NVMe™ QLC M.2 SSD with 32 GB Intel® Optane™ memory H10[8,9,10] 128 GB up to 1 TB PCIe® NVMe™ M.2 SSD TLC[8] 256 GB up to 512 GB PCIe® NVMe™ Value M.2 SSD[8]
Display size (diagonal, metric)	35.56 cm (14")
Display	35.6 cm (14") diagonal, FHD (1920 x 1080), IPS, narrow bezel, anti-glare, 1000 nits, 100% sRGB, HP Sure View integrated privacy screen; 35.6 cm (14") diagonal, FHD (1920 x 1080), IPS, narrow bezel, anti-glare, 400 nits, low power, 100% sRGB; 35.6 cm (14") diagonal, FHD (1920 x 1080), IPS, narrow bezel, anti-glare, 250 nits, 45% NTSC; 35.6 cm (14") diagonal, HD (1366 x 768), narrow bezel, anti-glare, 250 nits, 45% NTSC; 35.6 cm (14") diagonal, FHD (1920 x 1080), touch, IPS, narrow bezel, anti-glare, 250 nits, 45% NTSC[12,14,15,16]
Available Graphics	Integrated: Intel® Iris® Xᵉ Graphics; Intel® UHD Graphics[12,44] Discrete: NVIDIA® GeForce® MX450 (2 GB DDR5 dedicated)[41] (Support HD Decode, DX12, and HDMI 1.4b.)
Audio	Dual stereo speakers, dual array microphone
Memory card device	1 microSD (optional)
Ports and Connectors	3 SuperSpeed USB Type-A 5Gbps signaling rate (1 charging, 1 power); 1 HDMI 1.4b; 1 headphone/microphone combo; 1 AC power; 1 RJ-45 ; (HDMI cable sold separately.); Optional Ports: 1 SuperSpeed USB Type-C® 10Gbps signaling rate (USB Power Delivery, DisplayPort™ 1.4)
Input devices	HP Premium Keyboard – spill resistant, optional backlit keyboard[13]; Clickpad with multi-touch gesture support;
Communications	Realtek 10/100/1000 GbE NIC[43]; Realtek 802.11a/b/g/n/ac (2x2) Wi-Fi® and Bluetooth® 5 combo; Intel® Wi-Fi 6 AX201 (2x2) and Bluetooth® 5 combo, vPro®; Realtek Wi-Fi 6 RTL8852AE 802.11a/b/g/n/ax (2x2) and Bluetooth® 5.2 combo[11,42];
Camera	720p HD camera; IR Camera (select models)[12]
Software	HP Connection Optimizer; HP Image Assistant; HP Hotkey Support; HP Noise Cancellation Software; HP Support Assistant; Buy Office (Sold separately); HP Power Manager; myHP; HP Privacy Settings; HSA Fusion for Commercial; HSA Telemetry for Commercial; Touchpoint Customizer for Commercial; HP Notifications; Xerox® DocuShare® 30 day free trial offer;[17,18,36]
Available software	HP Smart Support[57]
Security management	Absolute persistence module; HP DriveLock and Automatic DriveLock; HP Secure Erase; Preboot authentication; TPM 2.0 embedded security chip shipped with Windows 10 (Common Criteria EAL4+ Certified); HP Sure Click; Windows Defender; HP BIOSphere Gen5; HP Sure Sense; BIOS Update via Network; Master Boot Record Security; Support for chassis padlocks and cable lock devices; HP Sure Start Gen6; HP Sure Admin; HP Client Security Manager Gen7;[23,24,25,26,27,28,29,30,31,32,35]
Security Software Licenses	HP Wolf Pro Security Edition HP Pro Security Edition is available preloaded on select HP PCs and includes HP Sure Click Pro and HP Sure Sense Pro. 3-year license required. The HP Pro Security Edition software is licensed under the license terms of the HP End User License Agreement (EULA) that can be found at: https://h30670.www3.hp.com/ecommerce/common/disclaimer.do#EN_US as modified by the following: "7. Term. Unless otherwise terminated earlier pursuant to the terms contained in this EULA, the license for the HP Pro Security Edition (HP Sure Sense Pro and HP Sure Click Pro) is effective upon activation and will continue for thirty-six (36) months thereafter ("Initial Term"). At the end of the Initial Term you may either (a) purchase a renewal license for the HP Pro Security Edition from HP.com, HP Sales or an HP Channel Partner, or (b) continue using the standard versions of HP Sure Click and HP Sure Sense at no additional cost with no future software updates or HP Support." HP Pro Security Edition is optimized for the SMB environment and ships pre-configured - manageability is optional. The HP Pro Security Edition supports a limited tool set that can be used by the HP Manageability Integration Kit which can be downloaded from http://www.hp.com/go/clientmanagement.
Fingerprint reader	Fingerprint sensor (select models)
Management features	HP Driver Packs; HP System Software Manager (SSM); HP BIOS Config Utility (BCU); HP Client Catalog; HP Manageability Integration Kit Gen3[21,22]
Power	HP Smart 65 W External AC power adapter; HP Smart 45 W External AC power adapter; HP Smart 65 W USB Type-C® adapter[37]
Battery type	HP Long Life 3-cell, 45 Wh polymer[34]
Battery life	Up to 12 hours and 45 minutes[45]
Dimensions	32.19 x 21.39 x 1.99 cm
Weight	Starting at 1.38 kg; (Weight will vary by configuration.)
Ecolabels	ENERGY STAR® certified; EPEAT® Gold registered. EPEAT® registered where applicable. EPEAT registration varies by country. See www.epeat.net for registration status by country.[39]
Sustainable impact specifications	Low halogen; TCO Certified[40]
Warranty	1 year standard parts and labor limited warranty (1-1-0), depending on country (upgrades available). 1 year limited warranty on primary battery.

HP ProBook 440 G8 Notebook PC

Accessories and services (not included)

HP 3 year Next Business Day Onsite Hardware Support for Notebooks

Receive 3 years of next business day onsite HW support from an HP-qualified technician for your computing device, if the issue cannot be solved remotely.
Product number: UK703E

HP recommends Windows 11 Pro for business

HP ProBook 440 G8 Notebook PC

Messaging Footnotes

[1] HP Wolf Security for Business requires Windows 10, includes various HP security features and is available on HP Pro, Elite, Workstation, and RPOS products. See product details for included security features and OS requirements.
[2] Multicore is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload and your hardware and software configurations. Intel's numbering, branding and/or naming is not a measurement of higher performance.
[3] Optional feature that must be configured at the factory.
[4] Quad-core processor sold separately or as an optional feature.
[5] Intel® Iris® Xᵉ graphics requires Intel® Core™ i5 or i7 processor.
[6] Dual channel memory is sold separately or as an optional feature. Due to the non-industry standard nature of some third-party memory modules, we recommend HP branded memory to ensure compatibility. If you mix memory speeds, the system will perform at the lower memory speed.
[7] HP Total Test Process testing is not a guarantee of future performance under these test conditions. Any accidental damage requires an optional HP Accidental Damage Protection Care Service.
[8] MIL STD testing is not intended to demonstrate fitness for U.S. Department of Defense contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage requires an optional HP Accidental Damage Protection Care Service.
[9] HP Sure Start Gen6 is available on select HP PCs.
[11] Wireless access point and internet service required and sold separately. Availability of public wireless access points limited. Wi-Fi 6 is backwards compatible with prior 802.11 specs. The specifications for Wi-Fi 6 (802.11ax) are draft and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the PC to communicate with other 802.11ax devices.
[12] Wi-Fi® supporting gigabit speeds is achievable with Wi-Fi 6 (802.11ax) when transferring files between two devices connected to the same router. Requires a wireless router, sold separately, that supports 160MHz channels.
[13] HP Sure View Gen3 integrated privacy screen is an optional feature that must be configured at purchase and is designed to function in landscape orientation.
[14] HP Privacy Camera only available PCs equipped with HD or IR camera and must be installed at the factory.

Technical Specifications Footnotes

[1] Not all features are available in all editions or versions of Windows. Systems may require upgraded and/or separately purchased hardware, drivers, software or BIOS update to take full advantage of Windows functionality. Windows is automatically updated and enabled. High speed internet and Microsoft account required. ISP fees may apply and additional requirements may apply over time for updates. See http://www.windows.com .
[3] Multicore is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload and your hardware and software configurations. Intel's numbering, branding and/or naming is not a measurement of higher performance.
[4] Processor speed denotes maximum performance mode; processors will run at lower speeds in battery optimization mode.
[5] Intel® Turbo Boost performance varies depending on hardware, software and overall system configuration. See www.intel.com/technology/turboboost for more information.
[6] In accordance with Microsoft's support policy, HP does not support the Windows 8 or Windows 7 operating system on products configured with Intel and AMD 7th generation and forward processors or provide any Windows 8 or Windows 7 drivers on http://www.support.hp.com.
[7] Due to the non-industry standard nature of some third-party memory modules, we recommend HP branded memory to ensure compatibility. If you mix memory speeds, the system will perform at the lower memory speed.
[8] For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 30 GB (for Windows 10) is reserved for system recovery software.
[9] Intel® Optane™ memory system acceleration does not replace or increase the DRAM in your system. Requires 8th Gen or higher Intel® Core™ processor, BIOS version with Intel® Optane™ supported, Windows 10 64-bit, and an Intel® Rapid Storage Technology (Intel® RST) driver.
[10] Intel® Optane™ memory H10 only for Intel® PCIe® NVMe™ QLC M.2 SSD.
[11] Wireless access point and internet service required and sold separately. Availability of public wireless access points limited. Wi-Fi 6 is backwards compatible with prior 802.11 specs. The specifications for Wi-Fi 6 (802.11ax) are draft and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the PC to communicate with other 802.11ax devices.
[12] HD content required to view HD images.
[13] Backlit keyboard is an optional feature.
[14] Resolutions are dependent upon monitor capability, and resolution and color depth settings.
[15] HP Sure View integrated privacy screen is an optional feature that must be configured at purchase and is designed to function in landscape orientation.
[16] Actual brightness will be lower with touchscreen or Sure View.
[17] HP Connection Optimizer requires Windows 10.
[18] HP Support Assistant requires Windows and Internet access.
[19] HP Driver Packs not preinstalled, however available for download at http://www.hp.com/go/clientmanagement.
[20] HP Manageability Integration Kit can be downloaded from http://www.hp.com/go/clientmanagement.
[21] Absolute firmware module is shipped turned off and can only be activated with the purchase a license subscription and full activation of the software agent. License subscriptions can be purchased for terms ranging multiple years. Service is limited, check with Absolute for availability outside the U.S. Certain conditions apply. For full details visit: https://www.absolute.com/about/legal/agreements/absolute/
[22] HP Manageability Integration Kit can be downloaded from http://www.hp.com/go/clientmanagement.
[23] Absolute firmware module is shipped turned off and can only be activated with the purchase a license subscription and full activation of the software agent. License subscriptions can be purchased for terms ranging multiple years. Service is limited, check with Absolute for availability outside the U.S. Certain conditions apply. For full details visit: https://www.absolute.com/about/legal/agreements/absolute/
[24] HP Drive Lock & Automatic Drive Lock is not supported on NVMe drives.
[25] HP Secure Erase For the methods outlined in the National Institute of Standards and Technology Special Publication 800-88 "Clear" sanitation method. HP Secure Erase does not support platforms with Intel® Optane™.
[26] Firmware TPM is version 2.0. Hardware TPM is v1.2, which is a subset of the TPM 2.0 specification version v0.89 as implemented by Intel Platform Trust Technology (PTT).
[27] HP Sure Click requires Windows 10 Pro or Enterprise and supports Microsoft Internet Explorer, Google Chrome™, and Chromium™. Supported attachments include Microsoft Office (Word, Excel, PowerPoint) and PDF files in read only mode, when Microsoft Office or Adobe Acrobat are installed.
[28] Windows Defender Opt In, Windows 10, and internet connection required for updates.
[29] HP BIOSphere Gen5 is available on select HP Pro and Elite PCs. See product specifications for details. Features may vary depending on the platform and configurations.
[30] HP Sure Sense requires requires Windows 10 Pro or Enterprise.
[31] HP Client Security Manager Gen7 requires Windows and is available on the select HP Pro and Elite PCs.
[32] HP Sure Start Gen6 is available on select HP PCs.
[34] Actual battery Watt-hours (Wh) will vary from design capacity. Battery capacity will naturally decrease with shelf life, time, usage, environment, temperature, system configuration, loaded apps, features, power management settings and other factors.
[35] HP Sure Admin requires Windows 10, HP BIOS, HP Manageability Integration Kit from http://www.hp.com/go/clientmanagement and HP Sure Admin Local Access Authenticator smartphone app from the Android or Apple store.
[36] Simply sign up and start using Xerox® DocuShare® Go. No credit card. No obligation. Data will become unavailable unless a subscription is entered before the end of the 30 day free trial period. See visit www.xerox.com/docusharego for details.
[37] Availability may vary by country.
[38] HP Care Packs are sold separately. Service levels and response times for HP Care Packs may vary depending on your geographic location. Service starts on date of hardware purchase. Restrictions and limitations apply. For details, visit http://www.hp.com/go/cpc. HP services are governed by the applicable HP terms and conditions of service provided or indicated to Customer at the time of purchase. Customer may have additional statutory rights according to applicable local laws, and such rights are not in any way affected by the HP terms and conditions of service or the HP Limited Warranty provided with your HP Product.
[39] Based on US EPEAT® registration according to IEEE 1680.1-2018 EPEAT®. Status varies by country. Visit www.epeat.net for more information.
[40] External power supplies, power cords, cables and peripherals are not Low Halogen. Service parts obtained after purchase may not be Low Halogen.
[41] Integrated graphics depends on processor. NVIDIA® Optimus™ technology requires an Intel processor, plus an NVIDIA® GeForce® discrete graphics configuration and is available on Windows 10 Pro OS. With NVIDIA® Optimus™ technology, full enablement of all discrete graphics video and display features may not be supported on all systems (e.g. OpenGL applications will run on the integrated GPU or the APU as the case may be).
[42] WWAN module is optional, must be configured at the factory and requires separately purchased service contract. Check with service provider for coverage and availability in your area. Connection speeds will vary due to location, environment, network conditions, and other factors. 4G LTE not available on all products, in all regions.
[43] The term "10/100/1000" or "Gigabit" Ethernet indicates compatibility with IEEE standard 802.3ab for Gigabit Ethernet, and does not connote actual operating speed of 1 Gb/s. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.
[44] Intel® Iris® Xᵉ Graphics capabilities require system to be configured with Intel® Core™ i5 or i7 processors and dual channel memory. Intel® Iris® Xᵉ Graphics with Intel® Core™ i5 or 7 processors and single channel memory will only function as UHD graphics.
[45] Windows 10 MM14 battery life will vary depending on various factors including product model, configuration, loaded applications, features, use, wireless functionality, and power management settings. The maximum capacity of the battery will naturally decrease with time and usage. See www.bapco.com for additional details.
[56] HP Wolf Pro Security Edition (including HP Sure Click Pro and HP Sure Sense Pro) is available preloaded on select SKUs and, depending on the HP product purchased, includes a paid 1-year or 3-year license. The HP Wolf Pro Security Edition software is licensed under the license terms of the HP Wolf Security Software - End-User license Agreement (EULA) that can be found at: https://support.hp.com/us-en/document/ish_3875769-3873014-16 as that EULA is modified by the following: "7. Term. Unless otherwise terminated earlier pursuant to the terms contained in this EULA, the license for the HP Wolf Pro Security Edition (HP Sure Sense Pro and HP Sure Click Pro) is effective upon activation and will continue for either a twelve (12) month or thirty-six (36) month license term ("Initial Term"). At the end of the Initial Term you may either (a) purchase a renewal license for the HP Wolf Pro Security Edition from HP.com, HP Sales or an HP Channel Partner, or (b) continue using the standard versions of HP Sure Click and HP Sure Sense at no additional cost with no future software updates or HP Support.
[57] HP Smart Support automatically collects the telemetry necessary upon initial boot of the product to deliver device-level configuration data and health insights and is available preinstalled on select products, thru HP Factory Configuration Services; or it can be downloaded. For more information about how to enable HP Smart Support or for download, please visit http://www.hp.com/smart-support.

Sign up for updates hp.com/go/getupdated

© Copyright 2023 HP Development Company, L.P. The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

Intel, Core and Intel vPro are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries. Bluetooth is a trademark owned by its proprietor and used by HP Inc. under license. DisplayPort™ and the DisplayPort™ logo are trademarks owned by the Video Electronics Standards Association (VESA®) in the United States and other countries. USB Type-C® and USB-C® are registered trademarks of USB Implementers Forum. ENERGY STAR is a registered trademark of the U.S. Environmental Protection Agency. All other trademarks are the property of their respective owners.

January 2023