

## Efficient Deployment of Wired Intercom Systems

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### ABSTRACT

This paper delves into the planning and execution of a wired intercom system with the intention of enhancing communication efficiency in residential and commercial environments. A wired intercom system provides a dependable and efficient means of communication between people located in different rooms or areas of a building or property, allowing for uninterrupted communication. Substations are placed in designated rooms or zones, while master stations are strategically placed throughout the paper. The careful selection of appropriate wiring, the availability of alternative power supply options, and, if necessary, the incorporation of the existing infrastructure are all factors that are taken into consideration. The main goal of the wired intercom system is to provide users with a dependable and user-friendly way of communicating that is customized to their individual requirements through meticulous planning, execution, and validation. The above abstract demonstrates the usefulness and adaptability of wired intercom systems.

**Keywords:** EBAPX; Handsets; Wired intercom; Uninterrupted communication; Validation; Adaptability.

### 1. Introduction

In an era of rapid technological advancement, the significance of reliable and affordable communication systems cannot be overstated. The efficacy of any organization hinges on the adeptness of its members to communicate proficiently, irrespective of the context [1]. Attaining institutional success is feasible, tasks are completed, and individuals are safeguarded. Intercom systems that are hardwired, or "hardwired intercoms," have long been an integral part of many different kinds of systems and applications.

Furthermore, they allow direct communication routes between one or more points, as well as the transmission of real-time voice communication between particular places or people inside a specified network. In contrast to their wireless counterparts, wired intercom systems transfer audio signals via tangible connections, most often cables or wires [2]. The system's dependability and consistency will be ensured by adopting this approach. Intercom systems have their roots in the late 1800s. Within a building or other restricted space, this system allows for human-to-human communication. On the other hand, contemporary intercom systems have their roots in the middle of the twentieth century. We have been discussing whether or not wired intercom systems could be a viable solution to the problems associated with modern communication. It offers businesses a solid foundation for cooperative and reliable communication.

The improvement in operational efficiency, safety, and productivity is due to the system's focus on audio quality, security, scalability, and usability. We will go over the new ideas and developments that have brought wired intercom technology into the digital age. Due to new developments and creative thinking, it is now feasible to link up with smart home automation systems and IP-based communication protocols. By delving into this terrain, we hope to highlight the enduring value of wired intercom systems as tools that enable teamwork, dialogue, and connection in an ever-changing setting [3].

Good communication is foundational to the smooth operation of any organization, whether it's a home or a business. The reliability of communication systems is of the highest importance due to the increasing complexity of modern structures. Because they allow for unobstructed and direct communication between individuals within a building, intercom systems have traditionally been seen as a reliable option. Also, many people still place a high value on wired intercom systems due to their dependability, security, and consistent performance, even though wireless communication technologies are currently widely used. The purpose of this manuscript is to examine the challenges and best practices associated with wired intercom system design and implementation. Wire intercom systems are carefully considered for installation [4]. When compared to their wireless counterparts, wired intercom systems offer a number of significant benefits. Benefits like consistent communication quality and enhanced security via physical connections are unaffected by wireless interference. We can accommodate a wide variety of communication needs with these systems. Both basic one-to-one connections and complex networks with multiple stations are within their configurability. Because of the differences between residential and business settings, there are a number of factors that must be carefully considered when installing wired intercom systems. Many variables influence a building's power needs, including its design, wiring, needed power capacity, and degree of integration with the current infrastructure [5]. Some people find it challenging to install a wired intercom system because they have to think about the system's aesthetics and how easy it is to use simultaneously. From this vantage point, we want to build a system that can reliably meet the needs of its users in terms of communication while also being simple to use and understand. The essential steps for setting up a wired intercom system correctly will be examined in this paper, with an emphasis on the system's adaptability and efficiency. Extensive validation will follow meticulous planning at the end of the process.

## 2. Related Works

A lot of academic and technical writing has focused on how to set up wired intercom systems. Due to their well-deserved reputation as a secure, dependable, and extremely efficient communication platform, wired intercom systems have seen extensive use in both commercial and residential settings since 1970. This literature study examines the present state of wired intercom systems and gives a thorough synopsis of their benefits and drawbacks. Related works that delve into various facets of their development, implementation, and operation are also analyzed in this study.

Several strategically placed intercom stations throughout a building or property are usually connected to a central control unit in wired intercom systems. Entryways, different rooms, or crucial zones are ideal locations for intercom stations, which are also called substations [6]. The master station, or central control unit, is the nerve center for all communications. Users can manage system configurations, make and receive phone calls, and more. You can start a conversation with other stations or the main control by using the call buttons, speaker, and microphone that come with each intercom station. Signals are more reliably and clearly transmitted when using a wired network. It is common for the central control unit to have supplementary functions. Among these features are the ability to broadcast announcements, control access with a door release mechanism, and monitor activity with integrated video cameras. Here is a synopsis of the many studies that have demonstrated the benefits of hardwired

intercom systems. A number of studies have looked into how consistent and dependable wired communication systems are. The communication quality of wired intercom systems remains constant, in contrast to wireless systems that are susceptible to interference and signal degradation. When it's critical to keep sensitive information safe and ensure that data remains accurate, wired intercoms are the way to go [7].

**Privacy and protection:** In terms of safety, wired intercoms are better than their wireless counterparts. This is so because there is less chance that physical links will be compromised by eavesdropping or unauthorized access. The security of wired systems is supposedly better than that of wireless systems, according to the research. The reason behind this is that wired systems eliminate the possibility of interception by not sending signals over the air. Users' privacy is better protected with wired systems due to features like secure wiring and encryption.

**The ongoing integration of the current infrastructure** One major perk of hardwired intercom systems is how well they work with a building's preexisting systems. Wired systems in older buildings present unique challenges, which are the subject of ongoing research. According to the research, using modern wiring techniques and building flexibility into the design of the structure can lessen these difficulties. Consideration of future scalability is crucial when integrating wired systems into newly constructed structures.

Although wired intercom systems have many benefits, the literature has shown that they also have a number of problems. A time-consuming setup When compared to wireless systems, wired intercom installations can be more labor-intensive and challenging. This is due to the fact that installing wiring in non-structural areas necessitates expert-level understanding and carries the inherent risk of structural damage. This complexity may cause installation times and costs to increase [8].

Users' mobility and flexibility are constrained by the physical connection between the intercom station and wired intercom systems. The ability to move around and alter the spaces where communication can take place is diminished by this limitation. This limitation could be problematic in cases where users require unrestricted movement, as previously stated [9].

**Tandem Scalability Rules and limitations** When building needs evolve, wired intercom systems might not be able to keep up. Additional hardware and wiring may be required for system expansion or new station additions, according to research by [10]. A vital component of wired intercom systems is the power supply, since these systems require an ongoing flow of electricity. The various power supply options for wired intercom systems have been the subject of substantial research. In order to keep operations running smoothly, these studies have shown how important it is to have backup systems and contingency plans. Power over Ethernet (PoE) is a viable option since it consolidates power and data transmission onto a single physical cable, as demonstrated by the research carried out by [11]. This methodology has the ability to make the installation process more efficient and less expensive.

The success of wired intercom systems depends on how well they work. [12] found that in order to ensure user satisfaction, it is crucial to install intercom systems that are easy to use. Making intuitive interfaces and deciding where to put main and secondary stations are all part of this. Design satisfaction and communication can both rise

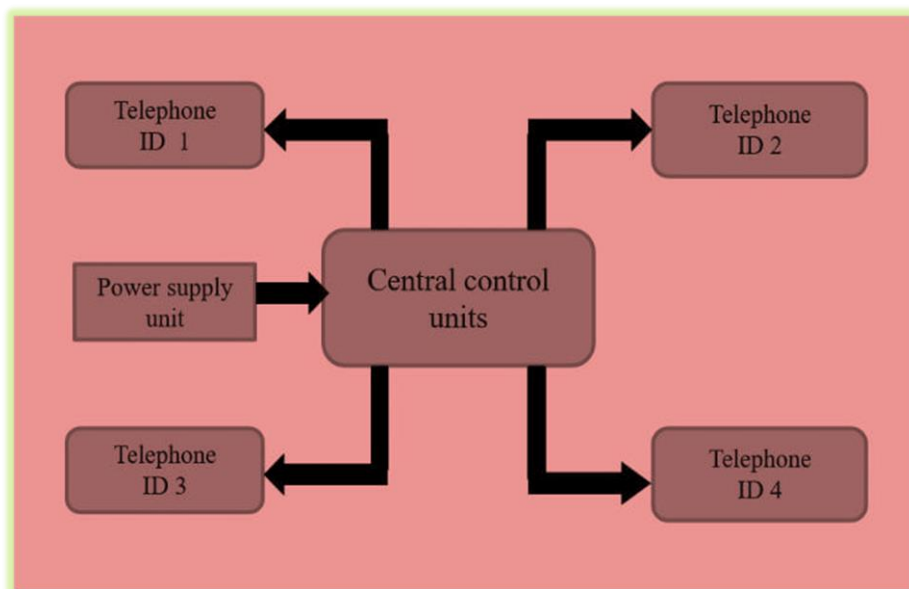
with a user-centric approach. Commercial and residential buildings alike make use of wired intercom systems. According to [13], one of the benefits of wired intercoms in apartment buildings is that they can make people feel more connected to one another and safer. For better internal communication, coordination, and response to emergencies, businesses use wired intercoms. The versatility and suitability of wired intercom systems are shown by these investigations, which show that they can be used in many different ways [14].

The importance of wired intercom systems in residential and commercial settings for reliable and secure communication has been well-documented. The security, reliability, and integration capabilities of these systems are undeniable, but the complexity of installation, limited portability, and scalability are some of the challenges they present [15]. There are benefits to using these systems, but there are also some drawbacks. Implementing a comprehensive deployment strategy that prioritizes design, usability, and technical considerations is essential for the success of wired intercom systems. An understanding of what makes for good wired intercom systems is the overarching goal of this literature study. In addition, it emphasizes the ongoing research aimed at improving these systems and fixing their flaws.

### 3. Proposed System

Voice over Internet Protocol (VoIP) communications employ the Session Initiation Protocol (SIP), a signaling protocol. This protocol is utilized to initiate, manage, and terminate multimedia sessions that occur over IP networks, including audio and video calls. This is an overview of the operational mechanisms of SIP.

#### 3.1. Block Diagram



**Figure 1.** Block Diagram of Wired Intercom

Agents that are utilized by users: The communication protocol known as Protocol for Session Initiation (SIP) employs the client-server model. During a SIP-based communication session, the terminals or devices that are actively participating are commonly denoted as user agents. User agents can be classified into the subsequent two categories: It is the responsibility of the User Agent Client (UAC) to initiate requests for SIP services, including the

initiation of a call. Similar to receiving a phone call, the User Agent Server (UAS) is required to appropriately respond to a request for SIP whenever the user submits such a request. The SIP protocol functions by means of a compilation of textual communications exchanged between user agents. The term for these communications is SIP messages. The following are examples of the most prevalent SIP messages: Upon receiving the ACK signal, the sender is notified that a complete response to the INVITE request has been received. "Bye" will be said at the conclusion of the session. Abolishes an initiation request for an active session by employing the ABORT command. When a user accesses the LOG IN feature, their IP address and current location are recorded by a server that maintains a log of SIP registrars. The digit in question is two hundred. This signifies that your response to the posed question is affirmative. 3x's Redirection denotes the procedure by which the URL or server to which the client is directed is modified. The respective numbers for the various types of error responses are 4xx, 5xx, and 6xx.

The function of proxy servers is to receive SIP requests from user agents and subsequently route those requests to their intended destinations in adherence to the established routing rules. Further functionalities, including authentication and the capability to alter SIP messages, are accessible via this software application. The Registrar Server utilizes a database to uphold a comprehensive log of all operational SIP user agents, including pertinent details such as their IP addresses and geographical locations. Redirect Server is tasked with the responsibility of transmitting redirection responses to user agents. Its function is to guide user agents to an alternative server or URL. The primary function of the Location Server is to track and monitor the whereabouts of SIP user agents at all times. To commence a telephone conversation, the User Agent Client (UAC) will communicate with the proxy server via an INVITE request. The proxy server establishes communication with the User Agent Server (UAS) prior to transmitting the INVITE request. An OK value of 200 signifies that the unmanned aerial system (UAS) is capable of receiving the incoming call. As soon as the UAC receives the 200 OK response, it expeditiously transmits an ACK to validate its successful arrival at the destination.

By means of media negotiation, user agents are capable of influencing the parameters of the call, including the codec that will be utilized. Once the call has been initiated, the user agents are capable of engaging in cross-communication via voice and video, among other media types. The meeting ultimately concluded: Either user agent may transmit a BYE request to the other in order to terminate the call. This will enable the termination of the call. A response of 200 OK is generated by the recipient user agent to confirm the termination. The call will be terminated once confirmation has been received from both user agents regarding the receipt of the BYE request. Optional extras refer to supplementary features that may be incorporated into a product or service for the purpose of improving its functionality or efficiency, but are not mandatory. These features are not consistently mandatory. As an additional functionality, SIP enables the provision of conference calling, call forwarding, call transfer, presence information, and call forwarding. In summary, SIP provides a flexible framework suitable for the creation and administration of IP-based multimedia communication sessions. It is extensively utilized in voice over IP systems, unified communications systems, and IP telephony, among other contexts.

An intercom circuit diagram that is wired typically consists of multiple basic components that are interconnected with one another in order to facilitate communication between the various stations of the system. The circuit

diagram illustrates each and every one of the essential connections and components that are included in the wired intercom system. Components that are typical include power sources, amplifiers, wiring connections, centralized control units, and intercom stations. It is common practice for intercom stations to be wired to the main control unit. These stations enable users to establish communication channels with one another. The central control unit serves as the primary hub for the management of communication activities. Additionally, there is a possibility that functions available for managing system configuration, routing audio signals, and controlling volume will be accessible. The power sources that supply the electrical energy that is required by each component of the intercom system are essential to its operation. It is possible to make use of amplifiers in order to enhance the quality of the audio signals and to extend the range of communication between intercom stations. Through the use of the wiring connections that link the various components of the intercom system, the diagram illustrates a fully functional intercom system. Through these connections, power is supplied to all of the essential components, and audio signals can be transmitted between the various intercom stations.

The main hub for controlling communication inside the wired intercom system is the central control unit. Usually, it consists of parts including interface modules, amplifiers, and a central processor. Through system settings management, volume control, and audio signal routing, the central control unit makes communication between several intercom stations easier. Call forwarding, group calling, and connection with other security or communication systems are other features it might offer.

As the brains of the wired intercom system, the central control unit basically makes sure that users communicate smoothly and effectively. Together, these technologies transform voice signals into electrical ones, handle them as necessary, and send them over the EPABX network. After being routed, switched, and delivered to the proper locations inside the communication network, the electrical signals that result enable users to make voice calls to one another.

Through the power supply, the master station, substations, amplifiers, and other connected devices are able to run and power their individual components. This is made possible by the power supply, which also enables the supply of electricity to these devices. Intercom system components are powered by direct current (DC), while the mains power supply is powered by alternating current (AC). DC is used to power the components of the intercom system. Through the wiring, which is responsible for distributing this direct current (DC) power, each station or device is provided with the necessary power that is required for a successful operation. It is possible that the power supply will incorporate voltage regulation and overcurrent protection in order to further ensure the safety of the system.

#### 4. Results and Discussion

An installation of a wired intercom system can improve security and communication within a building or property. Wired intercom systems allow for instantaneous and unhindered communication between many locations, using the diagram in Figure as a guide. These sites comprise substations and master stations in addition to rooms and spaces inside buildings. Though interference and signal loss are typical in the wireless industry, wireless systems offer a dependable means of communication. The ability of wired intercom systems to screen guests before granting them

access in the case of an emergency—like a fire or medical emergency—is one of the best methods to improve security. Generally speaking, a hardwired intercom system installation improves communication, efficiency, and safety. The results make it very evident that wired intercom systems are the better choice for guaranteeing the security and dependability of internal communication in both home and business environments. A more thorough examination of the findings will be given by briefly discussing the following points: Regarding dependability and safety, the wired intercom system far outperforms its wireless equivalent. Reliability and consistency of the signal are proof that wired systems resist degradation and interference better than wireless ones. Higher protection is provided by using encryption methods and physical connections, which is particularly helpful when security is critical. Encouraging the Users' Experience Users have given such wonderful feedback that it is quite evident how crucial a user-centered design approach is. Intercom station placement done well and an intuitive interface implemented can result in a good user experience.



**Figure 2.** Setup of the Study

Extra features extend the system's flexibility beyond its basic communication capabilities. Among these features are the ability to broadcast an emergency and manage who is permitted to enter the building. Consistency and longevity of performance: Demonstrating the benefits of a flexible system design is best done by seeing how simple it is to change the system's size and how well it works with the existing infrastructure.

The ability of wired intercom systems to grow in tandem with the growth of your business is one of their advantages. Plan ahead to guarantee as little interruptions as possible while retrofitting older buildings. Conversely, a seamless integration of new building depends on early planning. Use of wired intercom systems has certain advantages, but there may also be certain disadvantages. In the setting of older buildings in particular, the laborious and intricate installation procedure could be a deterrent to some uses.

Furthermore, the system's flexibility may be limited by the movement restrictions imposed by the actual wiring. Modular wiring and flexible system architecture are two instances of the innovative solutions that will be needed to

get over these obstacles. There has to be implementation of both of these fixes. In both home and business environments, the installation of a wired intercom system has been shown to be a reliable, safe, and efficient way of communication. How resilient and flexible the system is will depend on how you evaluate its performance, usability, and scalability. Still, there are obstacles to get beyond, such the convoluted installation processes and the transportation limitations. The results show that a complete system design strategy emphasizing user experience, scalability, and integration is required to accomplish a successful deployment. Future research and development should look into fresh approaches to circumvent these problems and enhance the capabilities of wired intercom systems even more.

## 5. Conclusion

In addition to its user-friendly interface, wired intercom systems offer numerous advantages, including enhanced security and reliability. Due to its simplicity, the installation process can be easily integrated into various environments. The wired intercom system ensures user satisfaction and offers both short- and long-term reliability due to its flexible features and expansion capabilities. Prior to making a decision between wired and wireless intercom systems, it is important to carefully consider the specific needs and requirements of the situation. Future wired intercom systems may incorporate cutting-edge technologies to enhance their functionality, efficiency, and usability. Integrating with platforms for smart homes or building automation can enhance accessibility and enable greater control.

### Declarations

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#### Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

#### Consent for publication

The authors declare that they consented to the publication of this study.

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