

Effective Virtual Call Center with Free PBX Technology

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Received: 20 Nov 2023,

Receive in revised form: 19 Jan 2024,

Accepted: 25 Sep 2024,

Available online: 31 Oct 2024

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Keywords— evolution of call center, Linux
Virtual machine, PBX Simulation, VM
Simulation, and Web-based call center

Abstract— A call center manages new and existing client questions and issues with the help of skilled specialists. Existing customers answer new consumers' inquiries and concerns. These questions may come from new or existing clients. Call centers are important in Rwanda as they enable companies to monitor calls. Companies can also analyze their markets through data acquired through call centers. However, setting up a call center is expensive. The running costs of a call center are also large. Businesses that operate call centers spend a lot of money running them, consequently reducing their profits. Therefore, this study proposes a cheaper technique for handling call traffic implemented using free PBX, which is a Linux based web-application for monitoring call traffic. From the results of the simulations carried out, a fast connection between mobile phones was observed. Moreover, it was determined that the capacity of free PBX is unlimited, making it ideal for use in call centers. The analysis shows that this project can be implemented in different institutions on chipper prices. The existing cost of implementing a call center on 50 users using hardware PBX is 100.000 USD, whereas, with the proposed solution using FreePBX which is a Linux based web-application for monitoring call traffic, the implementation cost can be between 5000 USD and 10000 USD with the same range of users. The discounted price as compared to the existing system can be estimated to be around 90%, which is much cheaper.

I. INTRODUCTION

A call center is a department or office that manages all of the questions and concerns that are asked by new customers in addition to those that are addressed by existing customers with the assistance of a team of trained specialists. The questions and concerns that are asked by new customers include those that are addressed by existing customers. These inquiries and concerns may originate from either newly acquired or already established clients (Aksin, et al., 2020).

A call center is also referred to as a contact center on occasion. This may comprise inquiries and concerns raised

not only by new clients of the organization but also by those who have previously done business with the company. This category may include customers who are new to the establishment as well as those who have been coming to the place regularly for some time. These employees are able to respond to customers in real time and offer answers to any questions or concerns that customers may have regarding their purchases (Ang, 2019).

In the context of the highly competitive business environment of today, some companies view it as an unwelcome but unavoidable need, whereas other

organizations view it as an opportunity to earn a return on the investment they've made. This dichotomy can be attributed to the fact that some businesses view it as an unwelcome but unavoidable need, whereas other organizations view it as an opportunity. This seeming contradiction can be explained by the fact that certain companies and organizations view it as an undesirable but inevitable requirement, whereas other businesses and organizations view it as an opportunity. This seeming paradox can be resolved by noting that some businesses and organizations perceive it as an unwelcome but unavoidable requirement, whilst other companies and organizations see it as an opportunity. This seeming contradiction can be reconciled by recognizing that some firms and organizations view it as an unwanted but inescapable requirement, whilst other businesses and organizations view it as an opportunity (Bhatnagar, 2021).

In any case, however, the demand is unavoidable. This seeming paradox can be resolved by acknowledging the fact that some businesses and organizations perceive it as an unwelcome but unavoidable need, whereas other businesses and organizations see it as an opportunity for growth and advancement. In any event, meeting the demand is something that can't be avoided. It is possible to find a solution to this apparent contradiction by recognizing the reality that some companies and organizations view it as an undesirable but inevitable requirement, whereas other companies and organizations view it as an opportunity for expansion and improvement in their operations. In any case, satisfying the demand is an obligation that simply cannot be sidestepped. It is possible to find a solution to this apparent contradiction by recognizing the reality that some companies and organizations view it as an undesirable but inevitable requirement, while other companies and organizations view it as an opportunity for expansion and improvement in their operations (Bhatnagar, 2021).

By acknowledging this reality, it is possible to find a solution to this apparent contradiction. In any event, gratifying the demand is an obligation that just cannot be avoided under any circumstances. Both points of view are valid and deserve to be taken into consideration, especially when viewed in the context of the highly competitive corporate atmosphere that characterizes the world at the present moment. Both points of view are valid and deserve to be taken into consideration. Both points of view are valid and should be taken into consideration because they both deserve to be heard. It is possible that any one of these points of view is correct in light of the events that have taken place given the current state of affairs. In other words, it is possible that all of these points of view are

correct. It is not impossible that each and every one of these points of view is accurate (Charoensukmongkol, *et al.*, 2022).

To put it another way, there is a chance that each and every one of these points of view is correct. It is not at all implausible that this is the condition of circumstances at the moment. In addition to this, there is the possibility that each and every one of these points of view is correct. Someone who is in control of a call center or contact center is required to have a very high level of attention, in addition to being aware of what is going on within the center itself. This level of attention is paid not only to what is occurring outside of the center, but also to what is occurring within the center itself. It is essential to carry out these steps in order to guarantee that the customers will be provided with the highest possible standard of service that is available in the industry at the present time. This is a direct result of the fact that individuals in charge of such a center need to be aware of what is happening within the center itself in order to manage the center in an appropriate manner. In order to manage the center in an appropriate manner, these individuals need to be aware of what is happening within the center. These individuals have a responsibility to be informed of everything that is going on within the center so that they can effectively manage it in the appropriate manner (Cleveland, *et al.*, 2019).

Call centers are of great importance in Rwanda as they enable companies to monitor calls. Companies are also able to analyze their markets through data acquired through the call centers. However, setting up call center is expensive (Zhang, *et al.*, 2022). The running costs of a call center are also large. Businesses that operate on call centers end up spending a lot of money running them, consequently reducing their profits. A need, therefore, arises to devise a cheaper technique for handling call traffic. Management of existing call centers also requires a lot scripting commands that are not effective to all call center administrators.

In order to achieve the main objective, the following are the key objectives: the first key is to test the viability of the FreePBX web-based system as a call center. The second key is to determine the effectiveness of the web-based application in handling and analyzing calls. And the third is to modify the application so as to increase its efficiency and capacity.

II. RELATED WORK

The only kinds of services that can be obtained through a call center of any kind are the kinds of services that are connected to voice communication in some fashion or

another. The provision of any other kinds of services is not possible at this time. There is no other type of enterprise other than a contact center that is able to provide the services that it does; this makes it the only viable option. Because call centers are only able to provide the types of services that are listed above, they are unable to provide any other types of services to their customers besides those listed above (Deng, 2022).

This could encompass a wide range of activities, such as providing assistance to customers who have already made purchases from the company or taking incoming phone calls from customers who have questions regarding their orders. a. As a consequence of this reality, the primary responsibility of customer service representatives working in conventional contact centers is to make or receive phone calls from end users and to actively listen to the difficulties that are being experienced by those end users. After that, it is of the utmost necessity that you provide them with the appropriate solutions to the problems that they are now dealing with and that you do so as quickly as you possibly can (Gans, 2020).

In addition, it is of the utmost promising that you provide them with the appropriate solutions to the problems that they are now dealing with. After that, it is of the biggest significance that you present them with the suitable solutions to the problems that they are now struggling with. You must do this as soon as possible. After that, it is of the utmost importance that you give them with viable answers to the issues that they are currently having trouble coping with. You have an immediate obligation to carry out these steps. After that, it is of the utmost importance that you provide them with feasible answers to the challenges that they are now having trouble coping with (Golembiewski, 2018).

It is imperative that you carry out these procedures as soon as possible. Following that, it is of the utmost importance that you provide them with workable solutions to the challenges that they are currently having trouble coping with. You need to get started on this as soon as you can. It is of the utmost importance that you complete these steps as quickly as you possibly can. This is due to the fact that people look to you as a source of leadership and guidance, which is a direct result of the fact that they do so (Kumar, 2022).

Consequently, this is a result of the fact that they do so. People look to you as a source of leadership and direction, which is why this is the case. On the other hand, when it starts to provide additional services, eventually the call center will transition into a contact center. This will occur when it begins to provide those additional services. The

administration of live chats, the management of email correspondence, and the transmission of messages will all be included in these supplementary service offerings, among other things. All of these activities serve as illustrative examples of actions and duties that a contact center may be able to carry out, and they are listed below as a list of tasks that may be able to be carried out by a contact center for your convenience as a list of activities that may be able to be carried out by a contact center (Kumar, 2019).

On the other hand, in this day and age, the vast majority of companies are able to provide responses to the questions that are posed by customers through the utilization of live chats, emails, and telephone conversations with customers. The evolution of various methods and forms of communication technology is to blame for the current state of affairs. There have been significant developments made in the technology that is utilized for communication, and this is the reason why this is the case. The reason why this is the case is because of these technological advancements. This state of affairs has arisen as a direct result of the recent advances that have been made in the fields of information and communication technology over the course of the past few years (Kumwilaisak, *et al.*, 2022).

The significant developments that have been made in the technology that is used for the purpose of communication are the reason why this is the case. The fact that this is the case is due to the fact that this is the reason why this is the case. This phenomenon can be traced back to the creation of new technologies, which helps explain why it has come to pass in the first place. When compared to the generations that came before it, this represents a significant advancement in terms of the technological and scientific development that has been achieved. When it comes to the management of a company, the utilization of each of these numerous communication channels is widely acknowledged as a best practice across the entirety of the industry as a whole. When referring to businesses that provide assistance to customers while they are conducting business, the terms "call center" and "contact center" are frequently used interchangeably by a significant number of people. This is particularly prevalent in the United States (Butler, 2020).

During the course of doing business, these companies offer their customers various forms of assistance. This is the conclusion that one must reach in order to make sense of the information that was presented earlier in the conversation. As a result of the fact that call centers are currently an essential component of the day-to-day operations of a significant number of businesses, it is anticipated that the importance of call centers to the

overall economy will continue to grow in the years to come. This is one of the primary reasons why this trend is anticipated to occur. This is as a result of the fact that call centers are now an integral part of the day-to-day operations of a considerable number of different enterprises (Li, 2022).

It is anticipated that this pattern will persist for a variety of reasons, one of the most significant of which is the following: It is anticipated that this trend will continue for a variety of explanations, with the following constituting one of the most significant of those explanations: They are also fascinating instances of sociotechnical systems due to the fact that the actions of customers and employees are strongly entangled with indicators of both workers' and customers' physical performance. This makes them particularly interesting sociotechnical systems. Because of this, both of these systems are remarkable examples of their respective types. As a consequence of this, each of these systems are exceptional illustrations of the kinds to which they belong (Mehrotra, 2019).

As a result of this, having a discussion about them is one of the activities that is capable of producing the most interesting results. The study of sociotechnical systems is, in and of itself, one of the most fascinating elements of sociotechnical systems. To put it another way, the capability of standard operational models to characterize the performance of a system is, to put it in the most straightforward terms imaginable, inherently constrained. This is due to the limitations that were covered earlier in the discussion. This constraint is an unavoidable consequence that arises as a direct result of the restrictions that were discussed in the paragraph before this one. Even if these models are beneficial in a wide variety of ways, the current situation has not changed despite these models' existence (Murthy, 2019).

In spite of the fact that these models are helpful in a great many different ways, this is the case for some reason. Despite the fact that these models are highly significant, it is not possible to assess the efficiency of the system using them because of the limits that are built into these models. This is the case despite the fact that these models are very significant. Traditional models, despite the significance they bear, have a capacity that is fundamentally restricted in their ability to characterize the performance of a system. This is because traditional models were developed using methods that are no longer applicable. In these kinds of situations, classic operational models offer a wide range of important advantages; despite these advantages, however, traditional models still have some limitations (Nina-Mollinedo, 2022).

Call centers are utilized in virtually every industry and field of work imaginable in the modern world, and the practice of engaging the services of these facilities is becoming a trend that is becoming increasingly commonplace. In addition, call centers are utilized in virtually every country in the world. In addition, call centers are utilized in almost every nation on the face of the planet. Call centers are utilized in virtually every industry and field of work that can be imagined of in today's modern world. Call centers are particularly prevalent in the retail and telecommunications sectors (Rowe, 2019).

When a firm uses the services of an outsourced call center, it is able to have access to resources that it otherwise would not have. These resources could include personnel, technology, and more. These resources could consist of manpower, technological advancements, and much more. These resources may take the form of humans, technical developments, and a variety of other possibilities. This is due to the fact that call centers often staff their operations by employing a sizeable number of people. This is because call centers have access to a wide variety of both technological and human resources, which enables them to provide superior customer care and makes it possible for them to do so. Because of this, call centers are able to provide better support to their clients. This is because, rather than the company itself being in charge of the operations of the call center, a separate organization is in charge of such obligations (Sencer, 2019).

As a result, this situation has come about. This is because call centers have access to a wide array of resources, both technological and human. The reason for this is that call centers can better serve customers. This not only makes it possible for them to provide superior service to their customers but also provides them with the ability to do so. As a direct consequence of this element, call centers are in a position to provide their clients superior levels of customer support. This is due to the fact that the call center has engaged into a contract with a third-party vendor to handle specific areas of its business operations, which will ultimately result in the vendor handling those aspects of the company operations (BasarirOzel, 2021).

This is due to the fact that the call center has a contract in place with a third-party vendor to manage some areas of its company operations. The rationale for this can be seen in the previous sentence. This has resulted in the current predicament, which is a direct consequence of this. If this company did not make use of the services that are given by the call center, it would not be able to have access to the resources that are being discussed in this text. One example of how the term "outsourcing" can be used to

refer either to the process of outsourcing in and of itself or to the procedure that occurs when a company does so is the procedure that occurs when a company enters into a contract with a third-party call center to meet its customer service obligations (Sienes, 2022).

This is an example of how the term "outsourcing" can be used to refer either to the process of outsourcing in and of itself or to the procedure that occurs when a company does so. An illustration of how the term "outsourcing" can be used to refer either to the practice of outsourcing as it is in and of itself or to the procedure that takes place when a corporation does so is provided here. This serves as an example of how the term "outsourcing" may be used to refer either to the process of outsourcing as it is in and of itself or to the method that takes place when a firm does so. Both of these meanings can be attached to the phrase "outsourcing." An illustration of how the term "outsourcing" can be used to refer either to the practice of outsourcing as it is in and of itself or to the method that takes place when a company decides to outsource work is provided here (Singh, *et al.*, 2021).

One illustration of how the phrase may be used to refer either to the process of outsourcing as a practice in and of itself or to the procedure that takes place anytime a firm decides to engage in such a practice is presented here. This is just one example of how the term can be used. The following grammatical construction offers another illustration of the term's potential applications. Both the process that takes place when a company enters into a contract with a third-party call center to meet its customer service requirements and the activity that takes place when the company does so are referred to as "outsourcing." Outsourcing is a term that is used to describe both of these things. When a company engages in the process of outsourcing, the term "outsourcing" is used to refer to both the process that is followed and the activity that is carried out by the company (Smith, 2021).

There are two distinct actions that can be referred to by the term "outsourcing" when referring to a corporation that engages in this activity, and both of these activities are described here. The first activity is the procedure that is carried out, and the second activity is the operation that is carried out as a direct result of the first activity. The term "outsourcing" can refer to any of these two different types of activity. Call centers typically have the capabilities that are required to manage unusually high contact volumes for a wide variety of clientele and services. These characteristics may be found in call centers all over the world. Call centers typically have the capacity to do these functions. These contact volumes may have originated from any one of a number of different locations all across

the world. There are call centers established in every area of the world, and each one of them is geared up to offer these services to the clients of the respective organization. Call centers can be found in every region of the world, and each one of them is geared up to provide these services to the customers of the particular firm that it serves (Taylor, *et al.*, 2021).

These characteristics can be observed in a considerable number of distinct contact centers that are situated all around the United States. Each day, there are possibly several hundred to several thousand new connections created. This number can range anywhere from a few hundred to several thousand. This Fig1 is subject to significant variation. Depending on the circumstances, the value of this number could range anywhere from a few hundred to several thousand. When compared to the lowest possible score and the greatest possible score, they are most likely to fall somewhere in the middle of the spectrum. As a direct result of this component of their business strategy, which provides them with a competitive advantage, call centers have an advantage over other companies operating in their area that offers them a competitive advantage (Tsai, *et al.*, 2022).

The organizational structure of the vast majority of call centers located all over the world is built on the basis of this paradigm, which can be summed up as follows. This paradigm is utilized to design the organizational structure. These call centers are present in virtually every nation on the face of the world. When you outsource your job to a call center, you significantly enhance the likelihood that you will have access to the most cutting-edge and up-to-date pieces of technological equipment. This is due to the fact that call centers are constantly modernizing and upgrading various pieces of equipment. This is only one of the many benefits that will come as a direct result of making this decision, which is just one of the many advantages. As just one of the numerous benefits that will come your way as a direct result of making this choice, you will also enjoy this one (Zhang, *et al.*, 2022).

This is just one of the many advantages that will come your way. This is just one of the numerous advantages that can be acquired when a firm hires the services of other people to carry out labor-intensive tasks for the operations of the company. There are many more advantages. One of the many benefits that arises as a direct result of contracting work to be performed by a call center rather than performing the work oneself is access to a wider selection of benefits. This is just one of the many advantages that arises as a direct result of contracting work to be performed by a call center. This advantage is simply one of the numerous benefits that emerge as a result of the

many advantages that develop as a result of delegating work to a contact center, which in turn develop as a result of the many advantages that develop as a result of delegating work to a call center (Aksin, *et al.*, 2020).

This advantage is just one of the numerous that arise as a result of assigning work to a call center, which also has many other perks. However, this is only one of those perks; outsourcing your job gives you access to a wide range of additional benefits, some of which are detailed in this article. However, this is only one of those benefits. One more advantage of contracting your work to a third party is that it enables you to enjoy financial savings. You will enjoy a greater degree of personal freedom and flexibility in your day-to-day life as a direct result of outsourcing the work that you do. The supplemental benefits that have been made available to you for the purpose of making access to them more convenient are described in the list that follows, which includes the following items: Call centers are the organizations that, in the vast majority of instances, are given the responsibility of delivering these services and are entrusted with doing so in order to carry out their functions (Ang, 2019).

This responsibility and trust is given to call centers in order for them to carry out their functions. Call centers are entrusted with this duty in order to guarantee that they are capable of performing the functions that are expected of them. Call centers are entrusted with taking on this obligation in order to ensure that they are able to successfully carry out the activities that have been assigned to them. Call centers that provide customer service typically have access to the most recent and cutting-edge technology that is presently on the market. This is the case in the majority of circumstances. Working in a call center comes with a number of benefits, one of which is that you get compensated for breaks (Bhatnagar, 2021).

The utilization of the services that are provided by a call center is not devoid of any potential drawbacks or disadvantages; on the contrary, these are both inherent in the nature of the service. The utilization of the services that are offered by a call center is not devoid of any potential drawbacks or downsides; on the contrary, the utilization of these services could genuinely have both potential drawbacks and drawbacks. The utilization of the services that are provided by a call center is not devoid of any potential drawbacks or disadvantages; on the contrary, the consumption of these services could really have both potential drawbacks and disadvantages (Bhatnagar, 2021).

The consumption of the services that are offered by a call center is not without the possibility of having possible

drawbacks or disadvantages; on the contrary, the consumption of these services could truly have both potential drawbacks and disadvantages. In the vast majority of instances, the standard of service that is provided is not of the same high quality as it would be in the normal context of a commercial company. This is the case since commercial organizations strive to provide services of the highest possible standard. This is due to the fact that the majority of these locations are not owned by commercial businesses nor are they run by those establishments (Charoensukmongkol, *et al.*, 2022).

The reason for this is that most commercial companies adhere to a set of predetermined standards, which has led to the current predicament. This is the case due to the fact that, in general, settings that are more conventional have a tendency to be connected with greater levels of service quality. This is the case because, in the vast majority of instances, ensuring that the demands of the customer are met takes precedence over all other considerations and should be given the utmost priority. In point of fact, this is a completely spot-on appraisal of the situation in its current state as it stands right now in its current state as it stands right now. This holds true in the overwhelming majority of scenarios, and there are seldom any glaring exceptions to the rule that can be found (Cleveland, *et al.*, 2019).

This is correct in the overwhelming majority of circumstances. If you want to proceed in this manner, you need to be aware that it does not in any way, shape, or form provide any type of security, and you should keep this fact in mind at all times. If you want to proceed in this manner, you need to be aware that it does not provide any type of security in any way, shape, or form. If you want to proceed in this fashion, you need to be informed that it does not in any way, shape, or form provide any sort of security for you. This is just one of many reasons why you should steer clear of going down this route; there are many more reasons why you should avoid doing so. This is just one of the many reasons why you should steer clear of going down this path (Deng, 2022).

This is only one of the numerous reasons why you should avoid taking this route in your search for the best option. It is essential that you keep your distance from the object in question. Employees who work in call centers have the capacity to see personally identifiable information at any given time that belongs to thousands upon thousands of clients. This is made feasible by the nature of the work schedule in contact centers, which requires staff to work in shifts rather than in one continuous shift throughout the day. As a direct result of the fact that this is the case, there is a possibility that the capability of the system to supply

an adequate degree of security across the board may be compromised in some kind (Gans, 2020).

Contact centers, which are in charge of the management of the vast majority of call scenarios, frequently accept calls in a variety of formats and types and handle them in accordance with the format or type to which they belong. This is because contact centers are responsible for the management of the vast majority of call scenarios. Contact centers are responsible for managing the great majority of call scenarios, which is one reason why this is the case. This is because call centers are assigned with the responsibility of handling the management of the vast majority of call scenarios. This is due to the fact that contact centers have been tasked with the responsibility of managing the vast majority of possible call circumstances (Golembiewski, 2018).

This assumption is valid for each and every conceivable kind of call that can be made by making use of the system. Because it describes the calls that can be made through the system and because it explains the calls that can be made through the system, it is pertinent to the environment of the call center where it is utilized because it explains the calls that can be made through the system. It is related to the phone call that the system is currently processing at this precise time as a component of its investigation of the current scenario. These identifiers are unique to each and every one of the aforementioned sorts of phone conversations, and they in no way, shape, or form apply to any other type of calls whatsoever (Kumar, 2022).

In each queue, randomization is utilized to help create the order in which incoming calls are processed in each queue over the duration of time spans that can span several years. These time spans can range anywhere from a few months to several years. These periods of time could last anywhere from a few months to a few years or even longer. These stretches of time could extend anywhere from a couple of months to a couple of years or even longer in some cases. These intervals of time could last anywhere from a few weeks to a few years or even longer in some circumstances. In some instances, they could even go on for even longer. These stretches of time could run anywhere from a few weeks to a few years or even longer in certain situations. The exact length of these epochs was not always clear. In certain circumstances, they might possibly continue for an even greater length of time (Kumar, 2019).

Depending on the specifics of the situation, the time that has passed since this event could be as little as a few months or as much as several decades. It is challenging to hazard a guess in the absence of additional facts. These

periods of time could run anywhere from a few weeks to a few years or even longer in certain situations. In other cases, the length of this time could even be longer. In other circumstances, they might even continue for a longer period of time (Kumwilaisak, *et al.*, 2022).

There were times when it was unclear how long each of these epochs had actually been in existence. There are some circumstances in which there is a chance that they will continue for an even longer period of time than they have so far. This strategy ultimately results in the construction of this order within each queue as a direct consequence of the randomization that is used in the operation that is now being carried out in each queue. This order is constructed as a direct consequence of the randomization that is used in the operation that is now being carried out in each queue (Butler, 2020).

It is common procedure for contact centers that are tasked with the delivery of customer support to always have a significant crew present. This is done in order to ensure that customers receive adequate assistance. This is done in order to provide superior assistance to the company's clients. The vast majority of the time, it is the obligation of these workers to make phone calls to a wide variety of locations that are dispersed across the entire planet. These calls can be placed to anybody or anything, beginning with a single individual and progressing all the way up to a whole nation. As soon as a company takes a call, the call is referred to as a "inbound call," and the receptionist will file it away in the correct folder as soon as the company receives the call. It is common practice for businesses to engage in activities such as telemarketing or debt collection, and as part of those activities, it is also common practice for those businesses to make calls in a proactive manner (Li, 2022).

It's possible that this is the case with other kinds of commercial endeavors as well. The following are some further examples of activities that fall under this category: The use of automated calling systems and the practice of making cold calls are two examples of operations that are carried out more regularly and are classified as being under this category. The term "commercial activity" encompasses a broad range of endeavors, each of which can be thought of as a subset of the larger whole. Some examples of these subsets are telemarketing and debt collecting (Mehrotra, 2019).

Customers have the option of selecting any of these two communication channels with the company as their preferred manner of engaging with the company. Alternatively stated: Customers have the option of communicating with the firm through any of the two

channels of communication that are now available to them. This is done in an effort to make the customers' interactions with the company as uncomplicated and easy to understand as is humanly possible.

Each phone call, as well as the work (data entry, documentation, research, and so on) that agents are obliged to undertake after the call has completed, has a duration that is fully arbitrary. This applies to both the length of the call itself as well as the labor. This holds true not only for the activity, but also for the call itself. This refers to the total amount of time spent on the call itself as well as the amount of work that must be completed. This is true not only for the endeavor in and of itself but also for the call that was issued (Murthy, 2019).

In addition to the amount of work that needs to be completed, this is a reference to the total amount of time that was spent on the call itself. This holds true not only for the endeavor in and of itself but also for the call that was placed out there. Not only does this ring true for the undertaking, but it also holds true for the call. This is a reference to the total length of time that was spent on the call itself, in addition to the amount of work that has to be performed, which is what is being referred to here. This is a reference to the quantity of work that needs to be completed. This is not only true for the endeavour in and of itself, but also for the call that was put out there, thus it is important to keep this in mind. Not only does this ring true for the undertaking, but it also chimes in with the decision that was ultimately taken (Nina-Mollinedo, 2022).

What is being alluded to here is not only the amount of time that was spent on the call itself, but also the amount of work that still needs to be done. This is a reference to the total amount of time that was spent on the call itself, which can be found in the previous sentence. This makes a reference to the quantity of work that needs to be done at this particular point in time. It is necessary that this truth be kept in mind because it is applicable not only to the endeavor in and of itself but also to the call that was made public. It is important that this reality be kept in mind since it applies to the endeavor in and of itself. Not only does this ring true for the initiative, but it also chimes in with the decision that was finally taken. This is an excellent example of how the two are connected (Rowe, 2019).

This is a great illustration of how the two are connected to one another. In this particular instance, not only is the length of time that was spent on the call itself being alluded to, but also the amount of work that has not yet been completed is being referred to as well. The quantity of work that needs to be completed at this particular instant in time is discussed in the preceding sentence, and this is a

reference to that sentence. This makes a reference to the total length of time that was spent on the call itself, which was mentioned in the statement that came before this one. It is of the highest importance that this fact be kept in mind since it is relevant not only to the endeavor in and of itself but also to the appeal that was made out to the general public. Keeping this truth in mind is of the utmost importance (Sencer, 2019).

This fact should be kept in mind at all times because it is of the utmost significance. This holds true not only for the effort that is being made but also for the request that is being made right at this very minute. These two statements are consistent with one another. This makes a reference not only to the amount of time that will be used by the call itself, but it also makes a reference to the events that will occur inside the boundaries of that period of time. Specifically, this makes a reference to the amount of time that will be used by the call itself. In other words, we are dealing with a case of double reference here. Read it carefully and pay attention to what it has to say at the same time because it makes a reference to the total amount of time that the call itself will take up (BasarirOzel, 2021).

Therefore, pay special attention to what it has to say because it makes a reference to the overall length of time that the call itself will take up. The total amount of time that the call itself will consume in its entirety throughout the course of its duration has been broken down into its component components and is listed below in an effort to make everything more apparent. This was done in an effort to make everything clearer. As an additional point of clarification, the total amount of time that was spent on the call was given in the form of a number of minutes. This is something that is pertinent not only to the action that has to be carried out, but also to the telephone call that needs to be made. Both of these things are related in some way.

It is essential that this regulation be followed at all times and in each and every one of the situations described above (Siens, 2022).

There is absolutely no space for bargaining regarding this prerequisite. The applicability of this rule does not include any exemptions of any kind. This is a rule that must be followed at all times and in all circumstances. There are no exceptions. There are no exemptions to this rule. Regardless of the nature of the exceptions that are being sought, the rule's scope of application does not allow for any exclusions to be granted in any circumstance. Regardless of the nature of the exceptions that are being sought, the rule's scope of application does not allow for any exclusions to be granted in any circumstance. This is pertinent not only to the entire length of time that has been

spent on the call, but also to the activity that is being carried out specifically at this present instant in time and at no other time (Singh, *et al.*, 2021).

Incoming calls can be routed to agents, groups, and/or places by making use of technologies such as Computer Telephony Interaction, which is more commonly abbreviated as "CTI." This can be accomplished in a variety of various ways depending on the situation. Automatic Call Distribution is an extra option that can be taken into consideration. CTI stands for "Computer Telephony Interaction," but its full name is "Computer Telephony Interaction." CTI is an abbreviation for "Computer Telephony Interaction" (sometimes abbreviated as "ACD"). When taken together, these two abbreviations make reference to the same idea when considered in conjunction with one another (abbreviated as "ACD"). These technologies are always being improved, and at some **point**, in the **not-too-distant** future, they will be able to support a level of thinking that is significantly more advanced than it was previously capable of being supported by them. This will be a significant leap forward from where they were previously capable of supporting thinking (Smith, 2021).

When compared to what they were previously capable of supporting in terms of thinking, this will be a significant leap forward. Incoming phone calls that are received by one of these devices have the capacity of being routed to particular agents, groups, or locations based on the preferences of the person who is using the device. These preferences can be set by the person who is using the device (Mehrotra & Fama, 2003). It is possible to educate a number of agents to manage either a single form of call, a number of separate types of calls, or all types of calls by using a range of call handling strategies. This is possible since there are many different types of calls. This can be accomplished by applying a singular method to all different kinds of phone conversations (Taylor, *et al.*, 2021).

This instruction can be given to each of the agents one at a time, or it can be given to all of them at the same time. It is feasible for you to issue this command to a big number of agents all at once in a single, consolidated action if that is something you would like to do. Each agent has the capability to learn how to handle a certain type of call, and each agent has the potential to establish their own one-of-a-kind set of priorities and preferences surrounding the technique in which they handle calls (Tsai, *et al.*, 2022).

A. Evolution of call centers

According to the findings of the research that was carried out by Rowe, Marciniak, and Clergeau, call centers, or

CCs as they are more often known, "are typically believed to be a hotbed for testing new information technology" (2011). Not only do technologies of this kind play an important part in the delivery of exceptional customer service across all industries, but they also assist to alleviate tension within the framework of the CC environment. CC environments are notorious for their high levels of stress. The surroundings at CC are well-known for the high levels of stress they contain (Cleveland, *et al.*, 2019).

It is common knowledge that the business of providing customer service is one of the most cutthroat and competitive sectors in any region on the entire planet. This is true regardless of where you are located. It makes no difference where you reside; this is always the case. The most important factor in determining how much of an improvement can be made to an organization's overall customer experience is the effectiveness with which it recruits new customers, maintains relationships with existing ones, and satisfies existing clientele (Deng, 2022).

This can be accomplished by the organization's ability to satisfy existing clientele. This relates to the degree to which the business is able to satisfy the requirements of the customers it already has. If the company is effective in satisfying the requirements of its existing clientele, then it will be able to accomplish this goal. This pertains to the degree to which the organization is able to live up to the requirements set out by the customers that it already possesses. This target will be accomplished for the company if it is effective in satisfying the requirements of the customers it already has, which is a prerequisite for accomplishing the goal (Gans, 2020).

This is as a result of the fact that the level of efficiency with which existing communication channels are utilized is the single most essential element in determining the amount of room there is for future development.

Previous research has investigated both the part that technology played in the growth of CCs as well as the way in which technology enables new organizational forms. Specifically, the function that technology played in the growth of CCs was investigated. According to the findings of these investigations, technology played a big role in each of these areas (Golembiewski, 2018).

It has been determined through the course of these research that technology is involved in both of these facets. On the other hand, there is not a significant amount of research that is primarily focused on the advancement of technology in CCs. This is a limitation of the field. This is one of the constraints placed on the field. This creates a significant obstacle in the way of progress. It gave an insight of the past by studying and analyzing data, and it

generated predictions about the future on the rate at which new technologies evolved and ultimately impacted CC operations. This research made use of a process that is referred to as historical research. The method of looking into significant events that have place in the past is one of the options that is being considered here (Kumar, 2022).

In addition, call centers, which are an essential component of the entire experience a customer has with a company, use technology to standardize, streamline, and uniformly provide service across multiple contact channels (such as voice, fax, e-mail, and the Internet), regardless of whether they are operating in a single network call queue or multiple call queues. This is the case regardless of whether the call center is operating in a single network call queue or multiple call queues. This is the situation regardless of whether the call center is working in a single network call queue or many call queues at the same time (Kumar, 2019).

It makes no difference whether the call center is functioning in a single network call queue or several call queues at the same time; this is the situation regardless of which. This is the condition regardless of whether the call center is operating in a single network call queue or numerous call queues at the same time; it makes no difference either way. In this sense, it makes no difference whether the call center makes use of a single network call queue or a number of distinct call queues. In this regard, it is irrelevant whether the call center makes use of a single network call queue or a number of separate call queues. Either way, the call center must deal with incoming calls in some fashion (Kumwilaisak, *et al.*, 2022).

This phase is completed even if the call center is operating in a single network call queue or in a number of call queues at the same time. It makes no difference. It is carried out in a manner that is distinct from the method used in the other instances. It is unrelated to the topic that is being discussed at the present time for a number of reasons. In addition, the credit card industry is continuing its rapid expansion in an effort to maintain the availability of entry-level jobs, provide customer support that goes beyond the use of the telephone, influence businesses, and achieve economic benefits. All of these goals are being pursued with the intention of achieving economic benefits (Butler, 2020).

These goals are being pursued simultaneously one after the other in a sequential order. In the meantime, we are making every effort to achieve each and every one of these goals by using every resource at our disposal. The fundamental purpose of contact centers is to manage the processing of exceptionally high quantities of service

requests that are received by telephone. These requests can come from a variety of different customers. To be more explicit, the duty of responding to these enquiries belongs to call or customer service centers known as contact centers. In addition, call centers that provide customer service have broadened the range of activities that fall within their purview to include contact services in addition to the processing of phone calls. This is done in an effort to bring in a greater number of clients (Li, 2022).

In the past, their primary task was to answer any and all calls that were placed to the company. In addition to taking care of the customers' telephone calls, the customer contact services at issue are also tasked with managing the customers' written correspondence, including e-mail, faxes, and other forms of electronic mail. Synchronous online chats are an additional feature that certain contact centers offer to their clientele as a supplementary perk of their business (Mehrotra, 2019).

This is done since it makes it simpler for call centers to better satisfy the wants of their customers by utilizing the information gained from this practice. In addition, CCs provide additional services through a wide variety of alternate modes of service delivery, which may be accessible in a variety of different ways. These services can be utilized in a variety of settings. These services are adaptable, and can be used in a range of different environments. These services are sufficiently adaptable to be utilized in a broad variety of distinct contexts and environments. Because of the adaptability of these services, they can be employed in a wide number of settings, which contributes to the overall versatility of these services (Murthy, 2019).

B. Web-based call centers

Over the course of the past few years, there has been a discernible increase in the significance of contact centers that are run through the utilization of the internet. Over the course of the last few years, this trend has become much more obvious. Customers have the capacity to communicate with customer service representatives by using the internet, which provides them with access to contact centers that they may use to establish communication with the experts that provide customer service. These call centers are able to effectively manage communications with customers, which is a factor that plays an essential role in achieving customer satisfaction and loyalty (Nina-Mollinedo, 2022).

Both of these endeavors need effectively managing their communications with their respective customers. Many smaller businesses make the decision to outsource their customer care and support services to third-party contact

centers because they do not have the financial or labor resources necessary to construct and staff a fully owned and operated call center. These resources include both financial and labor resources. This is because they are unable to fulfill all of the requests that have been made for their services (Rowe, 2019).

This takes place rather regularly as a direct result of the fact that they do not have adequate people. This is because they are unable to successfully compete with businesses that are more well-established and larger in size. This is the primary reason behind this. When it comes to assisting customers in a digital environment, like the one we are currently examining, situations similar to the one we are currently examining occur rather frequently. This is due to the characteristics of the media itself. On the other hand, in the vast majority of cases, managers are reluctant to outsource the communication management responsibilities for which they are responsible to contact centers that also provide their services to the managers' competitors (Sencer, 2019).

This is due to the fact that contact centers provide their services to the managers' competitors. This is due to the fact that the contact centers are tasked with handling the communication of the competitors of the managers. This is due to the fact that there is a concern that confidential information may be disclosed to the general public if the responsibilities of management were delegated to independent call centers. The possibility that private information could be viewed by members of the wider public is the source of this worry (BasarirOzel, 2021).

By entering into exclusive contracts with retailers in each product category, call centers that are owned and run independently may be able to mitigate the negative effects of this risk. Because of this, independent call centers will need to have customers who use a variety of product categories, despite the fact that it is more efficient for them to select items that allow them to keep operational synergies. This is the case even though it is more efficient for them to select items that allow them to keep operational synergies. This is the case despite the fact that it would be more beneficial for them to choose things that would enable them to maintain operational synergies (Sienes, 2022).

This is the case in spite of the fact that it would be more advantageous for them to make decisions that would enable them to keep operational synergies, which they are unable to do. This is the situation despite the fact that it would be more beneficial for them to make decisions that would enable them to retain operational synergies, which they are unable to achieve. This is the case despite the fact

that they are unable to do so. Despite the fact that it would be more advantageous for them to make decisions that would enable them to retain operational synergies, which is something that they are unable to accomplish, this is the situation that has arisen (Singh, *et al.*, 2021).

Despite the fact that they are unable to carry out the action, this is nonetheless the situation. This circumstance has developed despite the fact that it would be more advantageous for them to make judgments that would enable them to retain operational synergies, which is something that they are unable to accomplish. Nevertheless, this is the situation that has come about. The circumstance remains the same, despite the fact that they are unable to carry out the action in question. Over the course of the past few years, there has been a discernible increase in the significance of contact centers that are run through the utilization of the internet. Over the course of the last few years, this trend has become much more obvious. Customers have the capacity to communicate with customer service representatives by using the internet, which provides them with access to contact centers that they may use to establish communication with the experts that provide customer service (Smith, 2021).

These call centers are able to effectively manage communications with customers, which is a factor that plays an essential role in achieving customer satisfaction and loyalty. Both of these endeavors need effectively managing their communications with their respective customers. Many smaller businesses make the decision to outsource their customer care and support services to third-party contact centers because they do not have the financial or labor resources necessary to construct and staff a fully owned and operated call center (Taylor, *et al.*, 2021).

These resources include both financial and labor resources. This is because they are unable to fulfill all of the requests that have been made for their services. This takes place rather regularly as a direct result of the fact that they do not have adequate people. This is because they are unable to successfully compete with businesses that are more well-established and larger in size. This is the primary reason behind this. When it comes to assisting customers in a digital environment, like the one we are currently examining, situations similar to the one we are currently examining occur rather frequently. This is due to the characteristics of the media itself. On the other hand, managers frequently display reluctance when it comes to outsourcing the communication management responsibilities for which they are responsible to contact centers that also provide their services to the managers' competitors. This is because the managers' competitors

could potentially benefit from the contact centers' services. This is due to the fact that the managers' rivals may be able to get an advantage from the services provided by the contact centers. This is due to the fact that there is a worry that the confidential information may be disclosed to unauthorized parties if these obligations are outsourced (Tsai, *et al.*, 2022).

This is the basis for our concerns in this regard. By entering into exclusive contracts with retailers in each product category, call centers that are owned and run independently may be able to mitigate the negative effects of this risk. Despite the fact that it is more efficient for them to select items that allow them to keep operational synergies, independent call centers will need to have customers who use a variety of product categories because of this. This is the case even though it is more efficient for them to select items that allow them to keep operational synergies. This is the case in spite of the fact that it would be more advantageous for them to make decisions that would enable them to keep operational synergies, which they are unable to do (Zhang, *et al.*, 2022).

This is the situation despite the fact that it would be more beneficial for them to make decisions that would enable them to retain operational synergies, which they are unable to achieve. This is the case despite the fact that they are unable to do so. Despite the fact that it would be more advantageous for them to make decisions that would enable them to retain operational synergies, which is something that they are unable to accomplish, this is the situation that has arisen. Despite the fact that they are unable to carry out the action, this is nonetheless the situation. Even if it were to be to their advantage to make decisions that would allow them to keep operational synergies even if they chose items that would inhibit those efforts, this is not the case (Aksin, *et al.*, 2020).

Even if it were to be to their advantage, it would not be to their advantage to make decisions that would enable them to keep operational synergies. It would be in their best advantage to make decisions that would allow them to maintain the synergies that result from their operations. This is not the case, despite the fact that it would be to their advantage to make decisions that would enable them to keep operational synergies, which they are currently unable to do (Bhatnagar, 2004). Access to the internet is currently the most important piece of technology for the delivery of electronic government services, and governments all over the world are making significant efforts to increase the number of people who are connected to the internet in their respective countries in order to meet the growing demand for these services (Ang, 2019).

In addition to offering a variety of monetary subsidies and incentives, they are achieving this objective by installing public Internet kiosks in a wide variety of public venues, such as libraries, shopping malls, and other areas that are comparable to these kinds of establishments. In addition to that, they are providing a wide range of additional monetary perks and incentives (Bhatnagar, 2021).

However, the number of people who have access to the internet is a significant issue that acts as a limitation not only on the popularity of the internet but also on the ways that it is utilized. This is a significant issue that acts as a limitation not only on the popularity of the internet but also on the ways that it is utilized. This is a significant problem that acts as a barrier not just to the widespread adoption of the internet but also to the various applications of it that are now in use. This presents a difficulty due to the fact that there is a certain number of people who can connect to the internet at any one moment, which acts as a limiting factor. There were only 863 million people all across the world who used the internet in the year 2004 (Bhatnagar, 2021).

Since then, those Fig.s have seen a dramatic increase. Since then, that Fig. has increased by a substantial amount since it was originally announced to the public. By a wide margin, the most typical approach to get access to information is through the utilization of a telephone. This is especially apparent when contrasted with the usage of the internet in this setting, where internet usage is quite infrequent. In 2004, it was predicted that there would be 1207 million users of fixed line services; nevertheless, there were 1758 million members of mobile service providers. This discrepancy was due to the fact that more people opted to utilize mobile services (Charoensukmongkol, *et al.*, 2022).

This disparity was caused by the fact that a greater number of people choose to make use of mobile services. When the data were gathered in the 1990s, mobile service providers had just begun to expand their network coverage, which is why there is such a gap between the two sets of results. In addition, the number of people who use the internet is not distributed evenly across the population in any way that can even be compared to a distribution that is even slightly similar to an even distribution (Cleveland, *et al.*, 2019).

This is the case in any way that can even be compared to a distribution that is even slightly similar to an even distribution. In 2004, just 7.23 percent of the population in China had access to the internet. In comparison, this ratio was at 63.3 percent in the United States and 65.28 percent in Australia. In this regard, China's performance lags well

below that of other countries that are considered prosperous. When the number of individuals who use mobile phones in developed countries and industrialized countries are compared, it becomes apparent that the gap between the two is not quite as big as it might at first appear to be. As a direct consequence of this, almost every single household in the modern world, and particularly those in emerging nations like China, now has access to a cell phone. One nation that exhibits this concept in a manner that is quite straightforward is China (Deng, 2022).

Despite this, governments in every region of the world are rapidly becoming significantly more dependent on the Internet as their principal platform for the provision of electronic government services to the people living in each of their distinct locations. It is not unreasonable to suppose that this trend will continue into the unknowably far future. It is imperative that governments take the necessary precautions to assure that the integrity of the public finance system will not be compromised by electronic government projects. It is also imperative that governments take the necessary precautions to ensure that the public finance system will not be compromised (Gans, 2020).

In addition, it is of the utmost importance that governments implement the appropriate safety measures to guarantee that the integrity of the public finance system will not be jeopardized. In addition, it is of the utmost importance that governments implement the required safety measures to guarantee that the integrity of the public finance system will not be threatened. This is because the integrity of the public finance system is vitally important (Golembiewski, 2018).

It is of the utmost importance that governments put into effect the required measures for the safety of the general population in their respective countries. The singular dependence on the Internet that is being utilized in the process of putting into practice e-governance is being done so with the intention of enticing the greatest possible number of people, which is the incentive behind the use of the Internet in this manner. This is being done so in order to put into practice e-governance. On the other hand, given that this cannot be guaranteed to lead to an improvement in the overall quality of the service, there is no certainty that this will lead to such an improvement (Kumar, 2022).

It is possible that efforts to improve the general quality of the service may be hampered as a result of this because it places a significant amount of responsibility on the shoulders of the typical citizen. This is because it places a significant amount of responsibility squarely on their shoulders, which is the only place it can be placed. This is

because the vast bulk of the duty is placed squarely on the shoulders of the average citizen. The reason for this is due to the fact that the vast majority of the responsibility is placed on them. As a consequence of the divide, individuals who are considered to be on the "have not" side of the digital divide will be unable to access the official websites of the various levels of government (Kumar, 2019).

This is because the websites are password protected. On these websites, the general public can always read over the most recent instructions, regulations, and guidelines that have been posted. Instead of communicating with citizens through traditional types of media like newspapers, televisions, and other comparable forms of media, this would be done instead (Kumwilaisak, *et al.*, 2022).

(Buffa et al., 1976) Developed an integrated work shift scheduling system, which was then employed by the General Telephone Company of California for the purpose of scheduling 2,600 telephone operators across 43 different sites. This system was integrated into the work shift scheduling process. The process of arranging work shifts was updated to include the addition of this technology. The system required that a prediction of incoming calls be created every half an hour, that call volume be turned into operator requirements, that tours be scheduled making use of a heuristic technique, that operators be assigned to tours, and that the system be executed (Butler, 2020).

III. METHODOLOGY

In this section, the methods that are used for the design and implementation of the project. The methodology is divided into sections.

A. Linux virtual machine

A virtual machine (VM) is a term that is used in the world of information technology to refer to the virtualization or emulation of a computer system. The capabilities of a real computer can be simulated on a computer network using "virtual machines," which are designed to look like actual computers (Aksin, *et al.*, 2020).

It is probable that their implementations will necessitate the use of specialized software, hardware, or possibly even a combination of the two. The computer used was running a windows operating system so a VM had to be used to emulate the LINUX operating system. This is because PBX works very well with Linux and not windows.

B. PBX simulation

The phrase "Private Branch Exchange" is sometimes shortened to "PBX," which is an acronym that stands for

the longer form of the phrase. This practice has become widespread. "PBX" is the abbreviation that's used while talking about "private branch exchange." In accordance with the standard operating procedure, the total amount of time will be decreased in half. Phone conversations between users of a PBX system can take place in both directions thanks to the system's internal lines, which enable users to connect with one another and support two-way discussions (Ang, 2019).

These lines also make it possible for users to have conversations with one another over the phone. Users are also able to have phone conversations with one another via these lines, which was not previously possible. Through these lines, users can now engage in phone conversations with one another, which was not previously feasible. Users are able to communicate verbally with one another and even carry on phone conversations with one another as a direct result of these lines. In addition to that, they could also phone one another.

Users of the PBX phone system are able to simultaneously make and receive calls from and to the outside world while also using the system. These calls can come in from any location in the world. These calls can be received from anywhere in the world, and they can also be directed to any destination on the planet. This is something that is feasible to do given that the system supports three-way calling. There is a good chance that these phone calls originated from any one of the countries that are physically located on this globe. It is not feasible to state with absolute certainty where they originated (Bhatnagar, 2021).

These phone calls may have come from any one of the countries that are physically located on this globe; there is a fair likelihood that they came from somewhere on this planet. There is no way to know with complete confidence where they came from because it is not possible. Call forwarding, call transfer, call queue, auto-attendant, and voicemail are only some of the business telephony services that may typically be provided by a PBX phone system. Other services that can be provided include voicemail and auto-attendant (Bhatnagar, 2021).

Customers of a company can receive these services if the company utilizes a PBX phone system in its operations. This is because PBX phone systems allow for a greater degree of flexibility and control over the manner in which calls are managed, which is the primary reason for this benefit. This is due to the fact that PBX phone systems were built to manage several calls at the same time, which is the reason why it is possible for them to handle so many calls at once. The supply of telecommunication services to

these customers is an expansion of the services that are already offered to those clients, which presents an opportunity for commercial organizations, as it would represent an increase in the number of customers served (Charoensukmongkol, *et al.*, 2022).

This is due to the fact that PBX phone systems are able to perform a huge number of tasks all at once, which is the reason why the situation is not impossible. In other words, the possibility of the event occurring is due to the ability that was mentioned earlier. The operation of PBX systems can be carried out by making use of a large number of various communication methods, such as conventional analog or digital telephone lines, in addition to Voice over Internet Protocol (VoIP), which is a relatively recent development (VoIP). The utilization of digital telephone lines is yet another method that is capable of being implemented. The use of digital telephone lines is yet another option that can be used, and this one can also be used. Additionally, this one is a possibility (Cleveland, *et al.*, 2019).

Voice over Internet Protocol, more commonly referred to more frequently as VoIP, is an additional choice that might possibly be employed in place of an alternative. VoIP is typically known more frequently as VoIP. If you did not have a PBX phone system, you would not be able to have as many telephones at your place of business as you would like to have there. This would prevent you from making as many calls as you would like. Because of this, you won't be able to utilize your room to its full potential. Because of this, you will not be able to accomplish as much as you are capable of in terms of productivity (Deng, 2022).

This restriction applies to both traditional landlines and mobile cellular phones in their mobile forms. Landlines are considered to be mobile phones. On the other side, you only need one of them in order to have as many of them as you require in order to meet your requirements, so there is no need to worry about running out. In order for you to be successful in achieving this objective, the one and only physical phone line that is now tied to the site where your firm is located will need to be severed. After the completion of this step, a sizeable number of lines will be able to be positioned in their appropriate locations. It is now feasible, as a result of this, to provide service to several customers at the same time, which is helpful not only for the business but also for the customers themselves (Gans, 2020).

After that, particular telephones can be connected to each of these lines by applying the right adapters that are necessary for the job. This can be accomplished by following the steps outlined above. A technician would be

able to carry this out successfully. To achieve this objective, all that is required is the application of the adapters that are designed specifically for the task at hand. In order to do this task, it is sufficient to check the instructions that were included with the adapters in the particular packaging that they came in. Because the service does not charge its customers for any of the calls that they make to one another while they are using it, the circumstances that are currently taking place are an even more desirable one to be in than they would otherwise be if the service did not provide this benefit. In other words, if the service did not offer this benefit, the circumstances would be less desirable (Golembiewski, 2018).

It was chosen to put into action the voice over IP PBX technology in order to boost the possibility of the application's being able to properly complete the requirements being asked of it. This is the most compelling illustration that could possibly be utilized. In recent years, the conventional private branch exchange, also known as a PBX, has been undergoing a process of modernization, which has resulted in the emergence of the more cutting-edge VoIP or IP PBX. This development came about as a result of the convergence of several technological advancements. The development of new technologies was directly responsible for the occurrence of this shift. This is because both "VoIP" and "IP PBX" are abbreviations that stand for "voice over Internet Protocol," which is the explanation for why this is the case (Kumar, 2022).

The increase in technological capability that has taken place over the course of the past few years is directly responsible for this shift in behavior. Even though it is capable of doing the same activities as a traditional PBX, it also offers a great degree of functionality that is not included in traditional PBXs. This is in addition to the fact that it is capable of doing the same activities as a regular PBX. This is in addition to the fact that it is able to do the same functions that a traditional PBX would. It is able to carry out a variety of tasks that are not possible with standard PBXs since it includes functionality that enables it to do so (Kumar, 2019).

These jobs include: In addition to this, it possesses the significant advantage of being able to carry out the same functions as a conventional PBX, which is a benefit that cannot be overlooked. Because of the capabilities that it provides, it is able to carry out a wide variety of operations that are not possible to carry out with regular PBXs. These operations include: Standard PBXs are insufficient for doing these tasks in their whole. These professions include the following: Because it possesses this quality, it is able to carry out the same acts as, which is a consequence of the fact that it possesses this quality. Because of its

enhanced capacity, which makes it possible for it to do so, it is able to carry out a far larger variety of tasks than traditional PBXs are able to carry out. This is because its capacity has been raised.

This is due to the fact that typical PBXs have restricted capabilities in this regard. In addition to this, there is a possibility that the costs involved with this alternative approach may turn out to be lower than what was initially anticipated in terms of the total amount of money that will be spent on it. This is because there is a possibility that the total amount of money that will be spent on it will be lower than what was initially anticipated. This is due to the fact that there is a chance that the overall sum of money that will be spent on it will be significantly less than what was first projected to be spent on it. This is because there is a possibility that the overall sum of money that will be spent on it will be a considerable amount less than what was initially predicted to be spent on it (Kumwilaisak, *et al.*, 2022).

IP PBX systems, as opposed to more conventional phone lines, make use of the Internet protocol in their communication processes. This is in contrast to traditional phone lines. In comparison to the conventional phone lines, this is an advantage. This is a benefit in compared to the traditional phone lines that are available. In comparison to the conventional phone lines that are offered, this is an advantage that may be taken advantage of. This is an advantage that can be used to one's advantage in comparison to the traditional phone lines that are currently being made available. In compared to the traditional phone lines that are currently being made available, this is an advantage that can work to an individual's benefit and can be exploited to one's advantage (Butler, 2020).

This is an advantage that can work to an individual's benefit and can be leveraged to one's advantage when contrasted to the traditional phone lines that are currently being made available. This is an advantage that can currently be exploited. Voice is originally transformed into data before being transmitted over the Internet; then, once it has arrived at its final location, the data is ultimately transformed back into voice (Li, 2022).

IV. RESULTS AND FINDS

a. VM installation

The oracle virtual box was used for installation of the virtual machine. The machine was named CALLCENTERBY PACIFIQUE and the server's name provided.

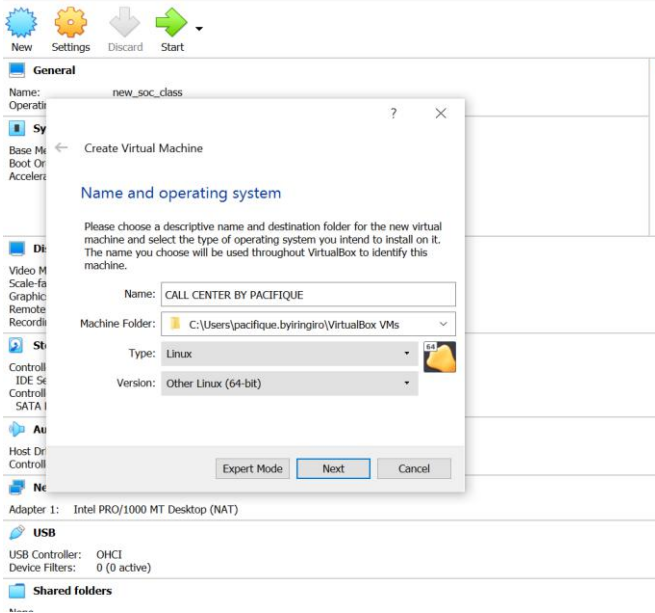


Fig. 1: Operating System Naming

As it can be seen from Fig. 1, the interface helps the user to choose the type of operating system and its version that the user will install. It also helps the user to rename the version machine that is going to be installed. A memory size (RAM) of 1 GB was chosen.

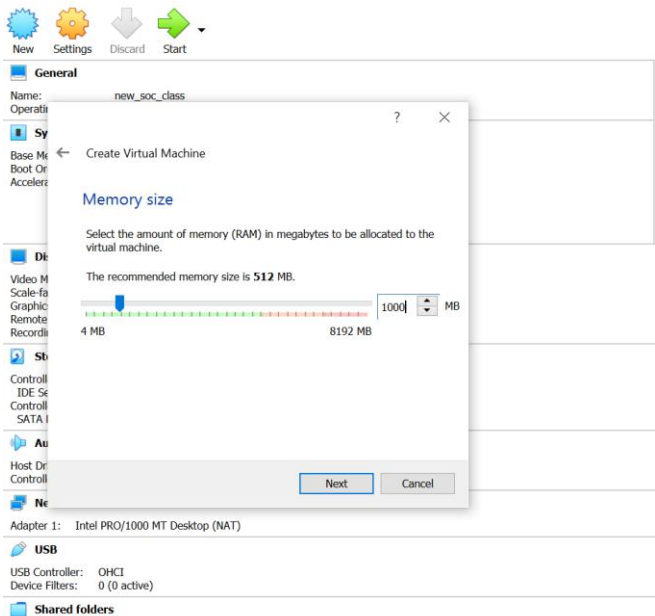


Fig. 2: Memory size allocation

As it can be seen from Fig. two, normally for a computer to have a speed, it needs some resources such as Random Access Memory (RAM). This interface helps to specify

the amount of the RAM that a new version machine will use.

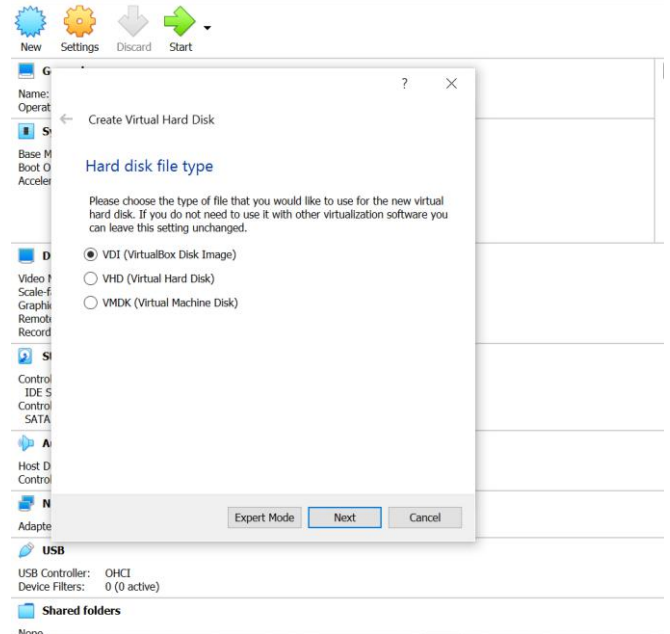


Fig. 3: Hard disk selection

As it can be seen from Fig. three, the virtual box disk image type of hard drive for the VM was chosen. This interface helps to provide different hard disc types that a user will use.

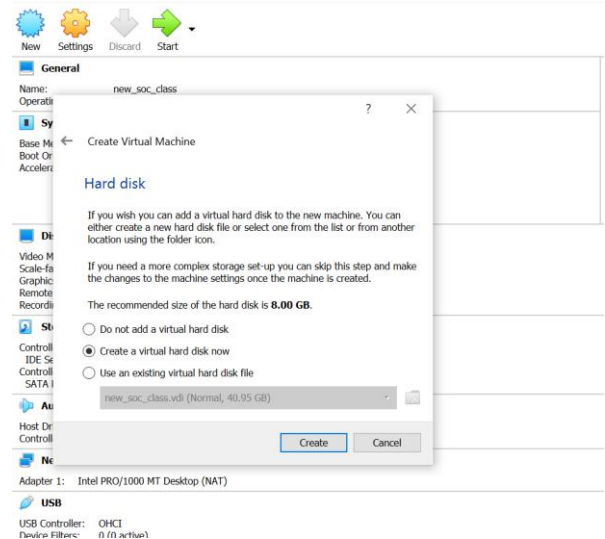


Fig. 4: Hard disk creation

A hard disk size of 20 GB was chosen for storing the data handled by virtual machine. As it can be seen from Fig. four, after deciding hard disc type, now it needed to create it with the help of this interface.

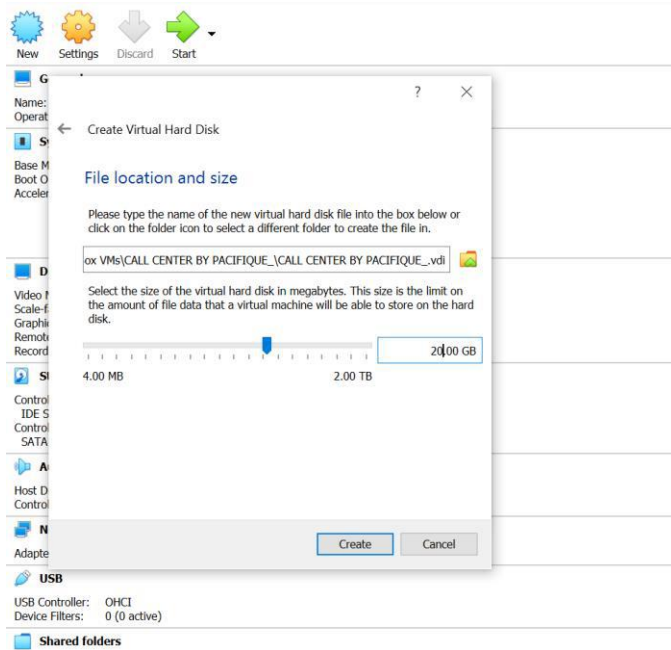


Fig. 5: Hard disk size selection

As it can be seen from Fig. five, the user can adjust the size of the disc, of which the interface shown represents.

The iso file for PBX was then selected for installation.

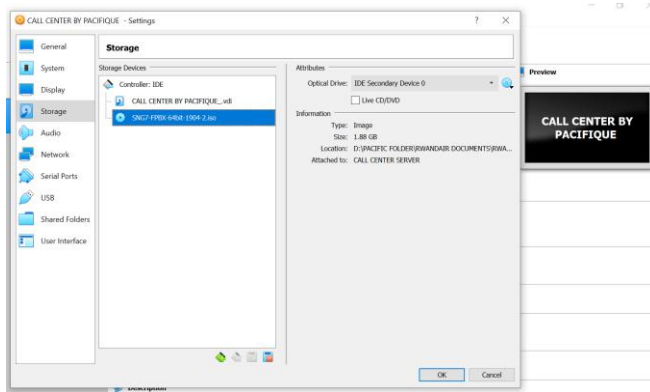


Fig. 6: ISO file selection

Fig. six shows how, once a virtual machine is created, the user can choose the ISO image that contains operating system set-

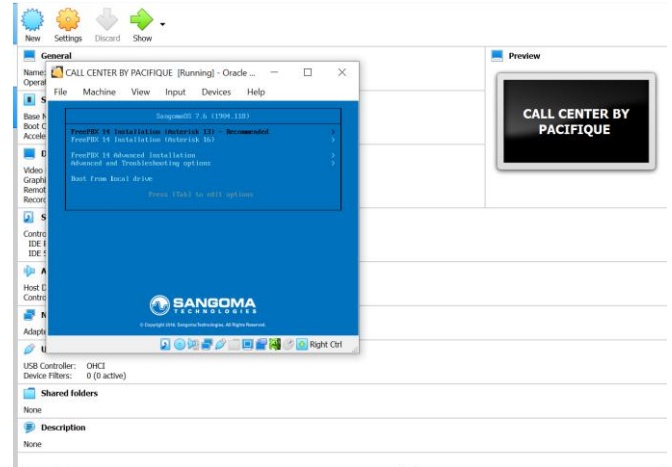


Fig.7: PBX Installation

There are different types of Free PBX set ups. The recommended one is the version Free PBX 14 and Asterisk 14 as shown in Fig. 7.

INSTALLATION IN PROCESS

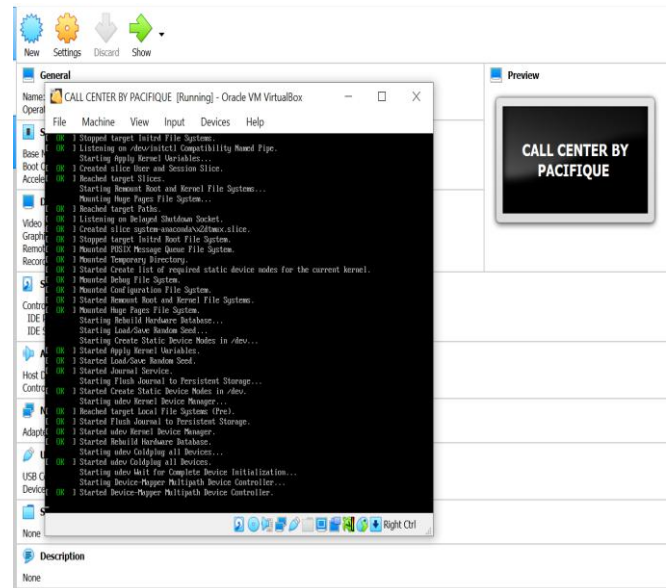


Fig.8: PBX installation process

As it can be seen from Fig. 8, the root password was set. At this phase, the operating system starts installing installation packages as it can be seen from the Fig. by "ok", the installation was successful.

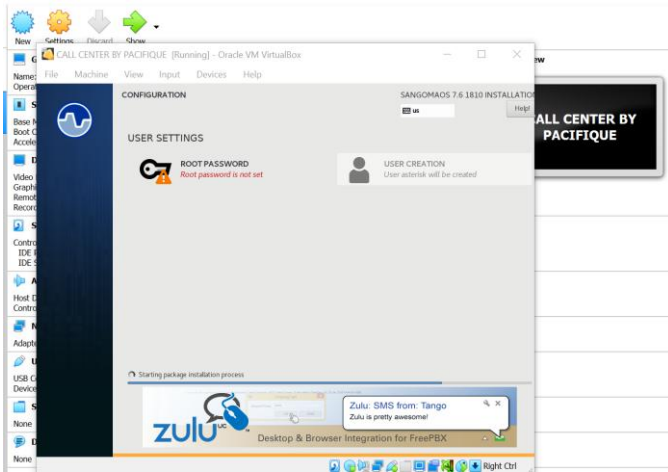


Fig.9: Root password

The system was then restarted for the installation to take effect. For security reasons, it is recommended to set up root password. This means that for any change that requires administrator password, root password will be used.

b. Free PBX activation

In order to use the commercial modules of free PBX, activation and account creation was required. This is illustrated in the steps that follow.

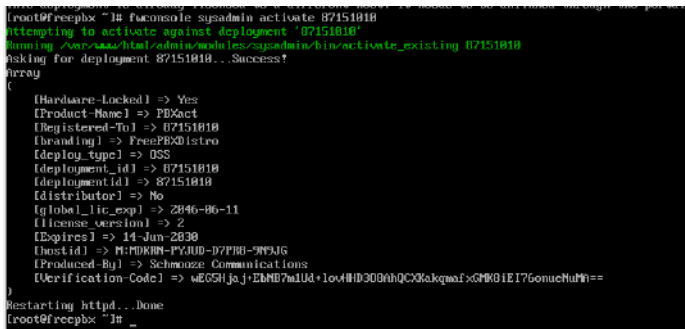


Fig.10: Free PBX activation

The system modules were then updated. Once a free PBX installed, it is needed to activate it to use commercial modules. Some free modules also require free BPX installation such as system admin and others.

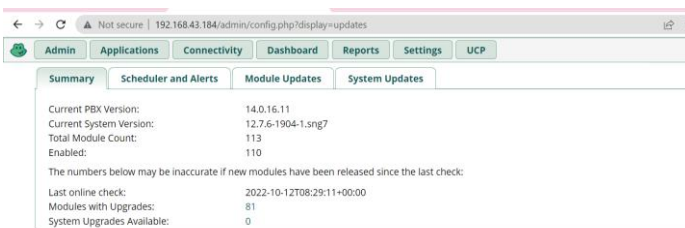


Fig.11: Module updates

As it can be seen from Fig. 11, once free PBX is installed, for it to work properly, updates are required to get the deployment ID from which the modules updates are done.

The updates were then run:

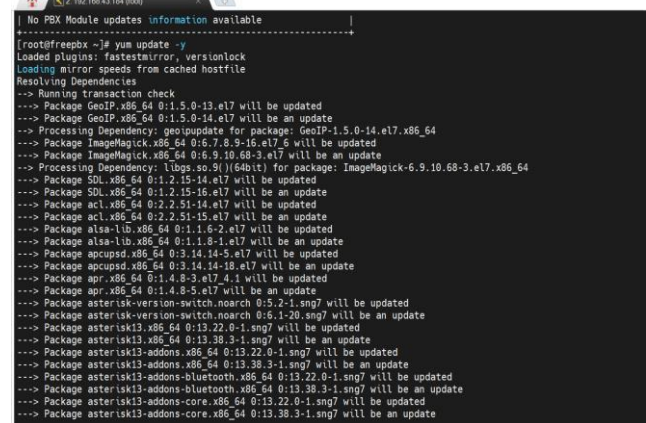


Fig.12: Running updates (first step)

Running updates take some time between thirty minutes to one hour depending on internet speed you are using. Updates are important of any operating system to be able to use latest features. However, it is not recommended to setup automatic updates on PBX server as it may disconnect sometimes the system services without acknowledgement of system administrator. Updating system manually is advisable to track which updates has been installed and plan for system maintenance depending working schedule.

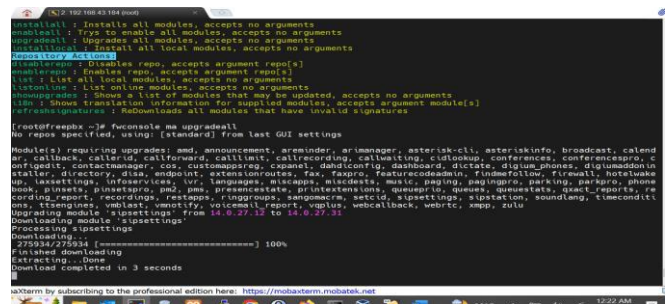


Fig.13: Running updates (second step)

As it can be seen from Fig. 12 and Fig. 13, for the updates to be running, requires to be connected on internet. It downloads every update package and displays the packages in percentages. Once 100% downloading is achieved. The system extracts the packages for installation.



Fig.14: Restarting services

Once updates are done, the system requires to restart all the services in order to access it again as it can be seen from Fig. 14.



Fig.15: Extension addition

As it can be seen from the Fig. 15, extension needs to be added because it's only the way to identify the person.



Fig.16: Adding a phone

As it can be seen from the Fig. 15, phone number needs to be added because its only the way to identify the person.

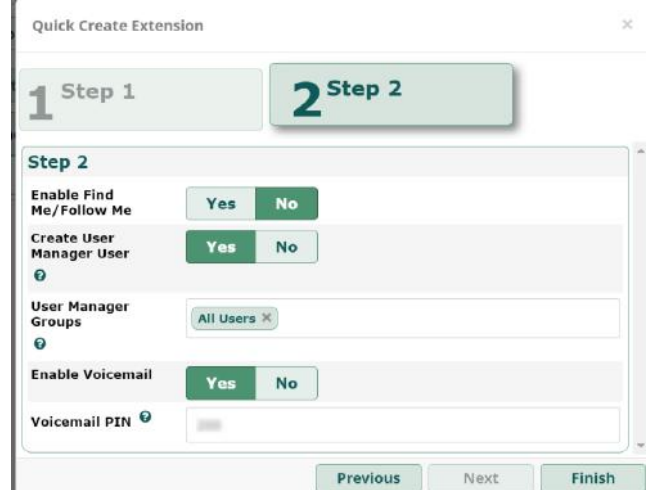


Fig.17: Extension creation

The microSIP virtual extension was added upon the creation of the extension account. As it can be seen from the Fig., a new phone number can be added immediately.

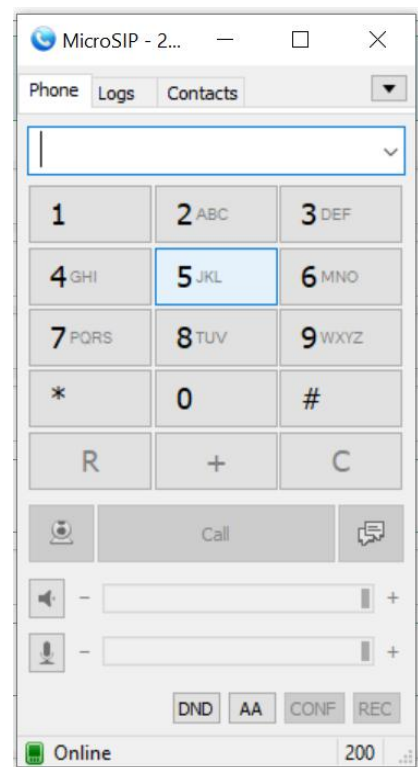


Fig.18: Microsip addition

A virtual desktop extension was made to assign a created extension details in order to communicate with other extensions connected on the same Free PBX sever.

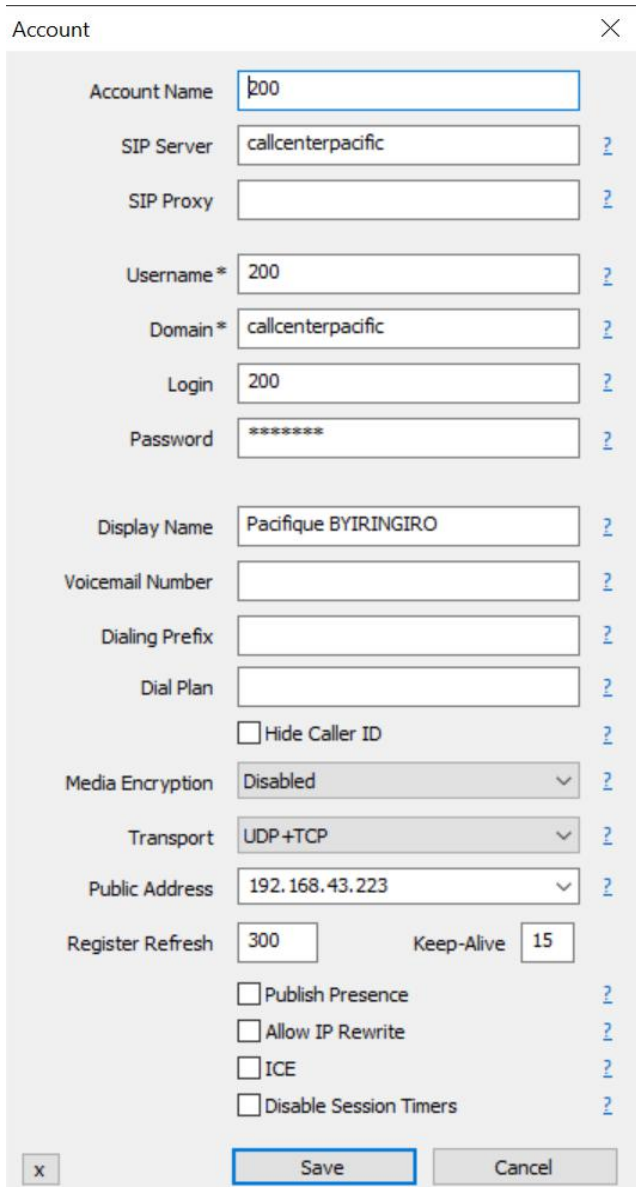


Fig.19: ConFig.d account

As it can be seen from the Fig., the online means that an extension is reaching the free PBX server successfully.

c. Free PBX connection

The Fig. below illustrates how mobile phones connect to the internet via free PBX:



Fig.20: Phone and PBX connection

As it can be seen from the Fig., extension connects to the free PBX server in local area network. If the user plans to use normal phones like MTN, the free PBX server, it is needed to be linked with the VPN server. The phones are linked through a server to a web. When one user makes a call from a phone, the signal is transmitted to the PBX system on the computer. The signal is then relayed to the cloud via the internet. The receiver then sends a response through the same path. Many phones can be connected together through the network to make a call center.

V. CONCLUSION

One of the most significant benefits of hosted PBX is that it enables businesses to save a sizeable portion of the money that would have been spent on the acquisition and upkeep of an on-premises system. This is one of the most significant financial advantages of hosted PBX. Because it is housed in the cloud, the PBX falls under the purview of the customer's service provider when it comes to matters of maintenance and setup. As a direct consequence of this, you won't have to spend any additional money on hardware or maintenance in the near future. This is because this situation has been resolved. The entire cost of the system does, in fact, include enough money to pay for the purchase of each and every one of those separate components. This not only results in cost savings, but it also eliminates the demand for additional IT personnel whose primary task it would be to solve issues of this kind. Because the provider is responsible for handling any issues that may arise with the PBX, this not only results in cost savings, but it also results in cost savings. Since the company does not have to worry about the burden of conducting maintenance or keeping software up to date, they are free to concentrate on the things that are most important to their business without any interruptions. This is a wonderful alternative for start-up businesses as well as enterprises that operate on a scale that is more modest.

A hosted PBX system will often offer a wide variety of services that are helpful to a company in its attempts to improve the quality of its internal communications. These services can be advantageous to an organization in the following ways: A company that uses a system that is hosted in the cloud is able to gain access to a wide variety of helpful services, such as call queuing and recording, call routing and switching, auto attendants, phone menus, conference calls, voicemails, greetings, and conference calls. These services are available to the company because the company is able to gain access to a system that is hosted in the cloud. In addition to that, the company is able

to keep a record of any calls that are placed to the establishment.

The audio quality of a PBX system is ideal for clearer communication, and the capability to record calls, maintain client information, and provide a better communication experience for the customer from the very beginning to the very end is essential for preserving the best practices for successfully conducting business in today's environment. Because of the capabilities provided by PBX phone systems, calls may be directed to anybody, at any time, and via any mobile device. This is true regardless of location (assuming that certain features are applicable). Because of this, critical customers' phone calls will never go unanswered, and staff will be able to connect with one another in a way that is both productive and uninterrupted.

To summarize, a private branch exchange (PBX) phone system is beneficial not just for a company or a call center, but also for the end user of the service. This is because PBX systems allow users to make and receive calls over a private network. PBX systems make it possible for several users to share a single phone line, which is why they are so popular. In this day and age, when consumers expect things to be reasonably quick while also desiring a satisfying experience with the firms, they choose to do business with, providing outstanding communication and customer service is a critical aspect in a company's ability to be successful.

In this day and age, consumers expect things to be reasonably quick while also desiring a satisfying experience with the firms, they choose to do business with. Consumers in this day and age have come to anticipate that things will be completed within a reasonable amount of time and also want to have a positive experience with the companies they choose to do business with.

As illustrated on chapter four, we were able to clarify solution in terms of cost saving and effectiveness by implementing freePBX which is a Linux based web-application for monitoring call traffic. The existing implementation price is around 100.000 USD for 50 users. And solution cost 5000 USD between 50 and 100 users which saves 90% as discount. In terms of effectiveness, the system has web based interface that helps call center admin to perform their operations without using scripting commands.

It is recommended that future researchers could integrate the implemented call center with other Web Apps.

ACKNOWLEDGEMENTS

An acknowledgement Kigali Independent University ULK, School of Science and Technology.

REFERENCES

- [1] Aksin, Z., Armony, M., & Mehrotra, V. (2020). The modern call center: A multi-disciplinary perspective on operations management research. *Production and operations management*, 16(6), 665-688.
- [2] Ang, L. (2019). Community relationship management and social media. *Journal of Database Marketing & Customer Strategy Management*, 18(1), 31-38.
- [3] Bhatnagar, A. (2021). Product assortment choice for independent Web-based call service centers. *Journal of Services Marketing*.
- [4] Bhatnagar, A. (2021). Product assortment choice for independent Web-based call service centers. *Journal of Services Marketing*.
- [5] Charoensukmongkol, P., & Puyod, J. V. (2022). Mindfulness and emotional exhaustion in call center agents in the Philippines: moderating roles of work and personal characteristics. *The Journal of General Psychology*, 149(1), 72-96.
- [6] Cleveland, B., & Mayben, J. (2019). Call center management on fast forward: succeeding in today's dynamic inbound environment. ICMI Inc.
- [7] Deng, Y. (2022, March). Architecture Design of Rental Call-Center Platform Based on Cloud. In *CIBDA 2022; 3rd International Conference on Computer Information and Big Data Applications* (pp. 1-4). VDE.
- [8] Gans, N., Koole, G., & Mandelbaum, A. (2020). Telephone call centers: Tutorial, review, and research prospects. *Manufacturing & Service Operations Management*, 5(2), 79-141.
- [9] Golembiewski, R. T. (2018). Wake-Up Call For All Change Agents: I Hear The Train A'Comin', Again. In *Current topics in management* (pp. 95-121). Routledge.
- [10] Kumar, B. K., Sankar, R., Krishnan, R. N., & Rukmani, R. (2022). Performance analysis of multi-processor two-stage tandem call center retrieval queues with non-reliable processors. *Methodology and Computing in Applied Probability*, 24(1), 95-142.
- [11] Kumar, P., & Schenk, C. R. (Eds.). (2019). *Paths to union renewal: Canadian experiences*. Broadview Press.
- [12] Kumwilaisak, W., Phikulngoen, S., Piriyyaravet, J., Thatphithakkul, N., & Hansakunbuntheung, C. (2022). Adaptive Call Center Workforce Management With Deep Neural Network and Reinforcement Learning. *IEEE Access*, 10, 35712-35724.
- [13] L Butler, D. (2020). *Bottom-Line Call Center Management*.
- [14] Li, B., Liu, L., Mao, W., & Qu, Y. (2022, January). Does Customers' Emotion toward Voice-based Service AI Cause Negative Reactions? Empirical Evidence from a Call Center. In *Proceedings of the 55th Hawaii International Conference on System Sciences*.

- [15] Mehrotra, V., &Fama, J. (2019, December). Call center simulation modeling: methods, challenges, and opportunities. In *Proceedings of the 35th conference on Winter simulation: driving innovation* (pp. 135-143).
- [16] Murthy, N. N., Challagalla, G. N., Vincent, L. H., &Shervani, T. A. (2019). The impact of simulation training on call center agent performance: A field-based investigation. *Management Science*, 54(2), 384-399.
- [17] Nina-Mollinedo, J. M., Quesada-Cubo, V., Rivera-Zabala, L., Miranda-Rojas, S. H., Olmos-Machicado, J. R., Arce-Alarcon, N., ... &Escalera-Antezana, J. P. (2022). Hundred days of teleconsultations and their usefulness in the management of Covid-19: Experience of the Covid-19 national call center in Bolivia. *Telemedicine and e-Health*, 28(5), 654-665.
- [18] Rowe, F., Marciniak, R., &Clergeau, C. (2019). The contribution of information technology to call center productivity: An organizational design analysis. *Information Technology & People. Sciences*, 7, 1976, 620–630.
- [19] Sencer, A., &BasarirOzel, B. (2019). A simulation-based decision support system for workforce management in call centers. *Simulation*, 89(4), 481-497.
- [20] Sencer, A., &BasarirOzel, B. (2021). A simulation-based decision support system for workforce management in call centers. *Simulation*, 89(4), 481-497.
- [21] Sienes, M. J. V., & Catan, J. E. C. (2022). The Speech Act of Apology by Filipino Call Center Agents. *International Journal of TESOL & Education*, 2(1), 117-128.
- [22] Singh, A. K., &Sahu, R. (2021). Integrating Internet, telephones, and call centers for delivering better quality e-governance to all citizens. *Government Information Quarterly*, 25(3), 477-490.
- [23] Smith, E. (2021). The History of the Call Center Explains How Customer Service Got So Annoying. *Vice*. https://www.vice.com/en_us/article/xyg4mn/the-history-of-the-call-center-explains-how-customer-service-got-so-annoying.
- [24] Taylor, P., & Bain, P. (2021). United by a common language? Trade union responses in the UK and India to call centre offshoring. *Antipode*, 40(1), 131-154.
- [25] Tsai, J., Montgomery, A. E., &Szymkowiak, D. (2022). Preventing Homelessness Through the National Call Center for Homeless Veterans: Analysis of Calls and Service Referrals. *Psychiatric Services*, appi-ps.
- [26] Zhang, Q., &Lockee, B. B. (2022). Building a Community of Practice in the Workplace: A Case Study at a University Information Technology Call Center. *International Journal of Smart Education and Urban Society (IJSEUS)*, 13(1), 1-11.