THE IMPLEMENTATION OF CLOUD PHONE TELEPHONE SYSTEMS,
MPLS INTERNET AND SERVER VIRTUALIZATION IN THE GOVERNMENT
SECTOR OF IBIÁ: A SUCCESSFUL EXPERIENCE

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A IMPLEMENTAÇÃO DE SISTEMAS DE TELEFONIA CLOUD PHONE, INTERNET MPLS E VIRTUALIZAÇÃO DE SERVIDORES NO SETOR GOVERNAMENTAL DE IBIÁ: UMA EXPERIÊNCIA DE SUCESSO

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RESUMO

Devido a problemas como, ausência de interconectividade entre todos os 33 locais, entre secretarias e diversos outros pontos da municipalidade, bem como dificuldades de contratação, suporte e velocidade de serviços prestados pelo empresa de telecomunicações, bem como riscos de segurança e adequações a LGPD 13.709/2018 e por fim melhor gestão de recursos de informática, uma delas a virtualização de servidores, se fez necessária a implementação de sistemas de telefonia Cloud Phone, Internet Mpls com

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Rede Virtual Privada em todos os pontos e virtualização de servidores no âmbito da Prefeitura Municipal de Ibiá, Minas Gerais, representou uma grande transformação da infraestrutura de TI municipal. A mudança de um ambiente descentralizado para uma estrutura integrada revolucionou a eficiência operacional, otimizando recursos e aumentando a segurança cibernética, bem como uso de plataforma como serviço. A interconectividade entre todas as localidades da gestão pública municipal facilitou a comunicação e a colaboração entre os diferentes setores e departamentos, possibilitando o trabalho remoto e a adaptação a novas necessidades à medida que surjam.

Palavras-chave: Tecnologia da Informação Rede Virtual Privada, Plataforma como Serviço, Governo, Telecomunicações

ABSTRACT

Due to problems such as lack of interconnectivity between all 33 locations, between secretariats and several other points in the municipality, as well as difficulties in hiring, support, and speed of services provided by the telecommunications company, as well as security risks and adjustments to LGPD 13.709 /2018 and finally better management of IT resources, one of which was server virtualization, it was necessary to implement Cloud Phone telephony systems, Internet Mpls with Virtual Private Network at all points and server virtualization within the scope of the City Hall of Ibiá, Minas Gerais, represented a major transformation of the municipal IT infrastructure. The shift from a decentralized environment to an integrated structure has revolutionized operational efficiency, optimizing resources and increasing cybersecurity, as well as platform-as-a-service usage. The interconnectivity between all municipal public management locations facilitated communication and collaboration between different sectors and departments, enabling remote work and adaptation to new needs as they arise.

Keywords: Information Technology Virtual Private Network, Platform as a Service, Government, Telecommunications

1 INTRODUCTION

The absence of a firewall in all 33 municipal public management locations, which include schools, health centers, the administration headquarters building, all secretaries, and social assistance secretaries, among other points, represented a major challenge, exposing the infrastructure to potential vulnerabilities and cybersecurity risks, and still not adapting services to LGPD 13,709/2018 (General Data Protection Law). Furthermore, the need for interconnectivity between these locations severely limits the efficiency in the remote management of telecommunications equipment and IT assets, such as printers, computers, and even access to security cameras at various points of municipal management. The situation is even more complicated due to the operator OI S.A. being in judicial recovery and unable to offer new telephone lines and internet services, resulting in enormous inconvenience for the municipality. Additionally, the company's limitation in providing connections only via metallic cabling in Ibiá (MG), with a maximum internet speed of just 5 Mbps, according to information obtained directly from consultants

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from the government follow-up of the company OI S.A., imposes an additional obstacle in the search for high-performance and reliable technological solutions for the city, as there is no technical feasibility for higher speeds in this region.

Although there are many small operators, in the fixed telephony sector in the municipality of Ibiá, as well as in the fixed broadband sector, it is still possible to identify a gap in Telecom services. The current concession model for fixed telephony through metallic cables has been discontinued, along with this model, and access via the internet through metallic pair, especially through ADSL (Asymmetric Digital Subscriber Line), which the company OI S.A., provides. who owns the concession in the municipality holds the license to operate these services. As widely reported, the company is in judicial recovery, according to (Timi, 2022), on June 20, 2016, the company filed for judicial recovery for negotiation and financial restructuring of its activities. Figure 1 shows the evolution of the company's debt, which resulted in the need to use legislative tools to help overcome the crisis.

Figure 1 Evolution of Oi's Gross Debt
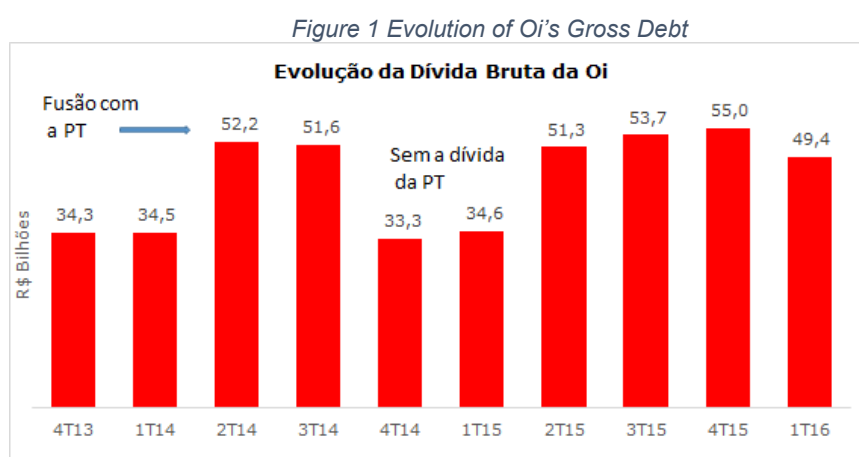
Source: https://www.teleco.com.br/comentario/com686.asp (PEREIRA, 2022)

Ibiá, Minas Gerais, is home to approximately 25,511 inhabitants, according to (IBGE 2023), and is approximately 340 kilometers from the capital of Minas Gerais. It is one of the municipalities with the largest territorial extension in Minas Gerais.

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At the municipal public level, there are several sectors and departments, both inside and outside the urban area, that require telecommunications, internet, and IT services. This dispersion makes decentralized and non-integrated management difficult, which implies frequent trips for interventions, even for simpler care in these services. The municipality's IT (Information Technology) team is limited in the face of high demand, requiring ways to mitigate problems and improve service in different locations. Furthermore, it is necessary to modernize the ICT (Information and Communication Technology) structure of the public body, bringing greater efficiency to users and the population.

Since 2021, I have been working on developing projects and mechanisms to solve these problems, such as contracting Telecom and internet services and implementing computing services, such as virtualizing local servers to better use existing hardware resources.

According to the overview (Anatel, 2023), illustrated in Figure 2, it is possible to view the services offered by various operators within the municipality. Specifically, the concession operator OI S.A. stands out, responsible for serving the public sector as indicated.

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Figure 2 Overview of services in Ibiá - MG

Source: https://informacoes.anatel.gov.br/paineis/acessos/panorama (Anatel, 2023)

2 GOAL

The purpose of this work is to evaluate and describe the experience of implementing Cloud Phones, Internet Mpls, and server virtualization telephony systems in the government sector of Ibiá.

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It is intended to highlight his contributions to public management, especially to the IT department of this body.

3 THEORETICAL FOUNDATION

Fixed Telephony via Metallic Cables:

The fixed telephone model using metallic cables was for a long time the main form of voice communication. Using copper wire infrastructure, this system allowed voice transmission over long distances. Three types of cable are generally used, the FI cable, the FE cable, and the multi-pair cables, specifically for external networks the cable used as a rule is the FE – or external wire (Neto, 2018). Metallic cables are used to form external or internal networks in buildings, enabling various types of configurations. However, over the years this method has faced discontinuity due to some main reasons:

- The emergence and advancement of alternative technologies, such as cellular mobile telephony and internet communication, thus the demand for traditional fixed telephony using metal cables has decreased considerably.
- This type of transmission medium using metallic cables has significant limitations in terms of bandwidth and data transmission capacity compared to more recent technologies, such as optical fiber, which have advantages, large bandwidth, low signal attenuation, and not affected by radiation, among others. According to (Neto, 2018) optical fiber has a central core made of plastic or crystal with a high refractive index, surrounded by a layer of similar material with a slightly lower refractive index.

Assymetrical Digital Subscriber Line (ADSL):

ADSL is an internet access method that uses the metal (copper) FE pair – or external wire, of traditional telephone cables to provide a high-speed internet connection. However, ADSL also presents discontinuity due to speed limitations. Although it was an innovative solution at one time, ADSL has limitations in relation to speed, including distance from the customer and telephone

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exchange, (Rego, 2007). ADSL is generally offered to users within a maximum radius of 4 km from the telephone exchange. The further away it is, the slower the user's speed may be and the connection may occasionally become unstable.

Another factor that contributes to discontinuity is constantly developing technological advances. Internet service providers are moving to faster, more efficient broadband solutions. Among these advances is the VOIP (Voice over Internet Protocol) model. According to (Alencar, 2011), voice transmission in networks that use the Internet Protocol (IP), known as voice over IP (VoIP), uses data transmission networks to convey voice signals in packet format. IP telephony consists of the provision of telephone services, using the data network, to establish calls.

VOIP revolutionized voice communication by allowing voice transmission over the internet, using IP communication protocols. This method is widely adopted due to several reasons:

- VOIP is economically viable for voice communications, eliminating dedicated infrastructure for conventional telephony.
- Offers greater flexibility, allowing the integration of different types of communication, such as voice, video and messaging, TV, on a single platform.

The transition from the conventional model of fixed telephony and internet access through metallic cables to more advanced technologies, such as fiber optics, is gradually replacing traditional methods, such as metallic pair (ADSL) and telephony based on metallic circuits. This opens up space for new technologies such as the VOIP model and fiber optic connections, bringing technological advances and changes in needs, habits, and demands for communication.

4 ACTIVITIES

In 2021, the process of designing telephony, internet, and system virtualization solutions began, starting with telecommunications solutions. Surveys of local needs, lines to be ported from the operator OI S.A., numbers of telephone devices, and addresses were carried out. All of this was brought together to later also be used for an internet project. After this phase, operators with concessions in the city were contacted: OI S.A., VIVO, MÉTODO TELECOM, and ALGAR

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TELECOM, requesting technical feasibility to begin the service specification phase. After approval from the operators, they informed that the traditional model via metallic pair was no longer used, but rather the model via VOIP telephony (voice over IP).
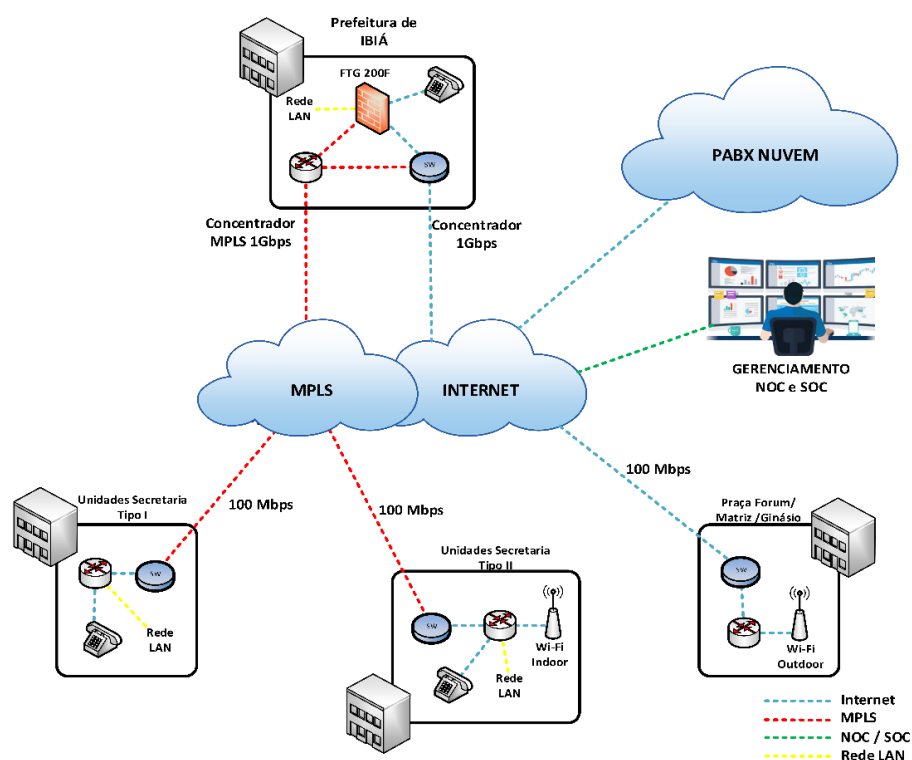
In this way, the need for a PABX (Automatic Exchange of Private Extensions) was raised, in the cloud to integrate all services into a single URA (Audible Response Unit), thus accessing secretariats through numerical options on the telephone, the possibility of internal communication between various sectors, as well as sectors in other locations inside and outside the municipality, reducing call costs and improving all internal and external communication, thus making municipal public service better.

After the survey phase, the bidding process was carried out under electronic auction number 015-22 available at (Ibiá, 2023), resulting in the victory of the company ALGAR TELECOM, making possible the portability of the entire existing numerical range, as well as contracting new lines, technical support, cancellations and other services, which until then was not possible with the active concession operator OI S.A. Thus, from this moment on, it was possible to control the entire range of telephony, in a centralized way with a single contract and have greater savings, as unlimited calls are now possible at no additional cost, both for landlines – landlines and for landlines – mobiles. As can be seen from the topology of the Cloud Telephony and MPLS Internet network in Figure 3.

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Figure 3 - Cloud Telephony and MPLS Internet Topology

Source: Author himself

After resolving the telephony problems, we still face challenges in managing the various devices installed locally and in different areas, inside and outside the urban area. Although OI S.A. is the main internet and telephone provider, a small local company, CLICK TELECOM, won bids in 2022, serving urban areas with GPON fiber optics (Passive Optical Network with Gigabit Connection Capacity). Areas outside the urban zone are served by several companies, some using GPON, others via VSAT (Very Small Aperture Terminal) satellite, and others using 4G mobile technology. This makes communication between these locations difficult, requiring significant investments in equipment to establish VPN (Virtual Private Network) connections and enable this communication.

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Franciely Pereira Moreira

In 2022, I started another project aimed at communication via MPLS (Multiprotocol Label Switching) internet connection, to solve problems not only in the management of IT assets but also in telecom assets.

I contacted the managers of Telecom companies to check technical feasibility. After confirming feasibility, I began the technical process of the terms of reference. In 2023, bid 016-2023 was held available in (Ibiá, 2023), where ALGAR TELECOM was the winner. We began implementation services, launching an exclusive 15 km fiber optic network in rings, with optical switching in all locations, as shown in Figure 4.

Figure 4 - MPLS implementation in Ibiá MG

Source: Author himself

After the implementation, configuration, and active service phase, it was possible, through a centralized point, to change asset configurations of all urban points, from telephone equipment, computers, WI-FI wireless routers, printers, and other devices on the network, to resolve configuration problems and several others, making centralized service possible with greater speed and efficiency, leaving the need for travel only in extreme cases, such as burning equipment or removals, among other similar cases. After this interconnection of several points within the urban area, it was possible to join all computers via Active Directory to the concentrator server, making use of shared resources such as printers, plotters, and shared folders, reducing costs with decentralized acquisitions. As you can see in Figure 3 the aforementioned scope of the MPLS network.

THE IMPLEMENTATION OF CLOUD PHONE TELEPHONE SYSTEMS, MPLS INTERNET AND SERVER VIRTUALIZATION IN THE GOVERNMENT SECTOR OF IBIÁ: A SUCCESSFUL EXPERIENCE
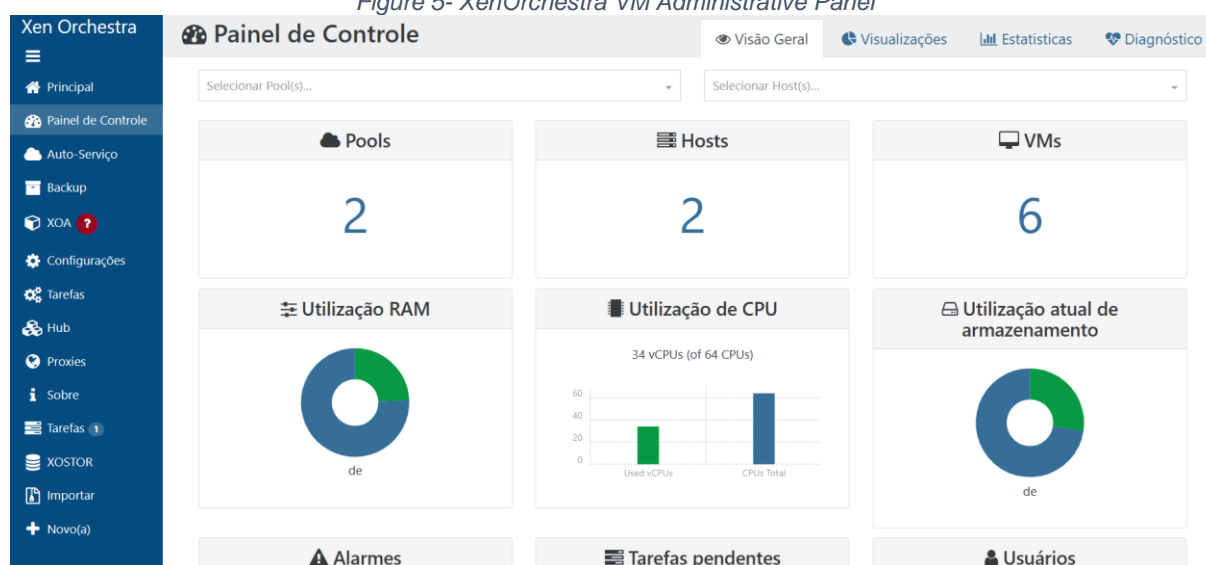
CRISTIANO SILVEIRA SILVA
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After the implementation of these Telecom and MPLS internet services, new possibilities were seen. One of them is the virtualization of current servers, which total two physical servers with a total of 4 Intel Xeon Silver processors above 3 Ghz each, around 320Gb of RAM, and a total of 16 Tb of storage, underutilized in just two servers with services aggregated, and without backup, with one server aggregating file services, DNS, DHCP, Active Directory and the other Web server. This way the virtualization process began, the software used was via XCP-NG, this system is installed on the server with the bare-metal interface, and its administration is carried out via web interface, the web administration panel was implemented via Xen Orchestra open-source community version, the system was installed on both devices as clusters, making the hardware of both available for conversion of current servers into virtual machines, and creating several virtual servers for these services. This made it possible to convert not only the current servers but also well as the creation of the virtual server for the municipality's Georeferencing system, accessed daily by the municipal tax department.

It was also possible to virtualize legacy health systems from sectors in different locations within the urban area, such as the health department and health surveillance, making it possible to backup all virtual machines, as well as access these machines remotely by departments, and access to departmental shared folders by several remote sectors. You can check the Virtual Machines administration interface in Figure 5 below:

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Figure 5- XenOrchestra VM Administrative Panel

Source: Author himself

5 RESULTS OBTAINED

During the period analyzed from mid-January 2021 to November 2023, a significant improvement can be seen in sector communication, account management, as well as the management of IT services and other IT assets in the municipality. The previous costly, decentralized way made it difficult for better interaction between sectors, better service from the IT department, and higher costs.

After the modernization of telephony, internet services, and the insertion of virtualization services, it even made remote work possible (since the necessary structure is fully implemented and integrated) or the inclusion of mobile extensions for any public server when necessary.

6 FINAL CONSIDERATIONS

Ibiá's Comprehensive Public Sector Transformation Looking back at Ibiá's public sector transformation journey, there is no denying the comprehensive impact that the introduction of the Cloud Phone telephone system, MPLS Internet, and server virtualization has had on governance from the city.

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Transformation and efficient communication:

The shift from a decentralized environment to an integrated structure has revolutionized operational efficiency. Communication between municipal departments has reached a new level, facilitating public services and significantly accelerating daily operations.

Financial impact and resource optimization:

In addition to improved communication, the economic benefits were also significant. The centralization of telecommunications and IT services has led to more efficient management of accounts and IT assets, resulting in significant savings and greater financial control for the municipality.

Adaptation and future perspectives:

Our ability to adapt to unexpected challenges has been demonstrated during the COVID-19 pandemic, as our existing infrastructure can enable a smooth transition to remote working if necessary. This flexibility will not only meet immediate needs but will also pave the way for future innovations and lay a solid foundation for the future of Ibiá's public sector.

This change was not just modernization. It was a revolution in the way the public sector in Ibiá operates and interacts with the community. The optimization of resources, operational efficiency, and adaptability to new challenges constitute a solid basis for the future development of the municipality, promoting continuous improvement and providing citizens with the highest level of public services.

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