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GobLin: El Sistema Operativo GNU/Linux para Gobiernos

GobLin: The GNU/Linux Operating System for Governments

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Resumen: La administración pública debe estar a la vanguardia de la innovación y los paradigmas tecnológicos. La Dirección de Modernización de la Gestión y Gobierno Electrónico de la provincia de Misiones, creó una distribución del sistema operativo GNU/Linux, especialmente diseñada para la administración pública. El objetivo de este sistema operativo es brindar un paquete "todo en uno", que contenga todas las aplicaciones que una oficina de gobierno pueda necesitar, sin aplicaciones innecesarias. Esto facilita a los administradores y usuarios de TI la instalación y el mantenimiento de la infraestructura de TI. Esta distribución se construyó rediseñando la integración de los componentes de un sistema operativo robusto y maduro, resistente a fallas y ampliamente utilizado en los servicios de Internet, que garantiza la estabilidad de ejecución de los sistemas. También es un sistema seguro que no incluye la compilación de telemetría que vende la información del usuario a los servidores de la empresa, lo que garantiza la seguridad, la privacidad de los datos y las actividades del usuario. Está construido con programas de software gratuitos, incluidas las últimas versiones de aplicaciones de productividad de oficina. El resultado es una distribución especializada del sistema operativo GNU/Linux que es estable, donde los programas incluidos no quedarán obsoletos porque se actualizarán continuamente con las últimas versiones disponibles. Todos pueden copiarlo, distribuirlo y adaptarlo a sus propias necesidades. No es necesario pagar ningún coste por el software instalado ni por sus futuras actualizaciones.

Palabras clave: *Transformación Digital, Gobierno Electrónico, Software Libre, GNU/Linux, Sistema Operativo, Soberanía Tecnológica.*

Abstract: Public administration must be at the forefront of innovation and technological paradigms. The Directorate of Management Modernization and Electronic Government of the province of Misiones, created a GNU/Linux operating system distribution, specially designed for public administration. The objective of this operating system is to provide an "all-in-one" package, containing all the applications that a government office may need, without unnecessary applications. This makes it easier for IT administrators and users to install and maintain the IT infrastructure. This distribution was built by redesigning the integration of the components of a

robust and mature operating system, resistant to failures and widely used in Internet services, which guarantees the stability of execution of the systems. It is also a secure system that does not include telemetry compilation which sells user information to enterprise servers, ensuring security, data privacy and user activities. It is built with free software programs, including the latest versions of office productivity applications. The result is a specialized distribution of the GNU/Linux operating system that is stable, where the included programs will not become obsolete because they will be continuously updated with the latest available versions. Everyone can copy it, distribute it and adapt it to their own needs. It is not necessary to pay any cost for the installed software nor for its future updates.

Keywords: *Digital Transformation, Electronic Government, Free Software, GNU/Linux, Operating System, Technological Sovereignty.*

1. Introduction

“GobLin [1] is The Linux for Governments”. A customized distribution of the GNU/Linux operating system, adapted to the requirements of public administration. It is designed under the Free Software Philosophy, and open to be adapted to cover every level of public administration. A Linux distribution, commonly abbreviated as a “distro”, is built from a kernel, which is complemented with libraries, utility software, and application software, through a package management system. In general, the distro is created by combining the kernel with compiled binaries, but it is usual to add the source code with a free license, to facilitate the modification of the original software. To address the problem of maintaining the government’s IT infrastructure with a stable version of the operating system and productivity applications, and to avoid compromising the State coffers with the constant repaying of private software licenses, we developed a solution for government offices, that respects open standards, without installation costs and constant updating to the latest versions of the software contained within it.

1.1. Free Software

“Free Software” is defined as any computer program whose source code can be studied, modified, used freely for any purpose and redistributed with or without changes. Its definition is associated with the birth of the Free Software Movement, spearheaded by the activist and computer expert Richard Stallman, and the creation of the Free Software Foundation in 1985, a non-profit organization which places the liberty of the user as an fundamental ethical purpose. Its basis is the philosophic and ethic universalization of knowledge, in theory and in practice, because the software created under this paradigm are at the disposal of all society, without licensing costs due to the encouragement of its continued updating and redistribution. It utilizes free formats and open standards to save the data that it produces and manages. It is based on the following fundamental premises, proposed by the Free Software Foundation:

1. Freedom to execute any program for any purpose.
2. Freedom to modify the program to adapt it to the user’s needs.
3. Freedom to redistribute copies, either freely or with the payment of a canon.
4. Freedom to distribute modified versions of the program, in a way that the community can benefit from its updates. It’s an intangible good whose universalization allows sustainable development and the advancement of society in all of its levels.

1.2. The Free Software on the State

This technological paradigm attracts the attention of governments, because they have seen the benefits from its use. On an international level, many countries have advanced their initiatives to create operating systems for their own management, based on sovereignty, freedom, security and costs allowed by the use of Free Software. There is a list on Wikipedia which shows countries currently pursuing their own initiatives. The Iberoamerican Charter of Electronic Government [2], approved by the IX Iberoamerican Conference of Ministers of Public Administration and State Reforms, that took place on Pucón, Chile, on May 31 and June 1st of 2007, establishes on Subsection “g” of the 6 Epigraph, the Principles of Electronic Government, recommending “the use of Open

Standards and Free Software on the matters of security, long-term sustainability, and the prevention of privatisation of public knowledge”.

1.3. GNU/Linux in the real world

According to Niel Harper [3], the GNU/Linux operating system is widely used in numerous technology solutions. Today GNU/Linux is present almost everywhere on the Internet. The Internet of Things (IoT) is one of the technologies that benefited the most, it has also driven innovation in various industry verticals such as embedded systems and robotics. The increasing adoption of GNU/Linux in government, academic and enterprise data centers will have a huge impact on market growth in the near future.

We can show a non-exhaustive list of places where GNU/Linux is in use:

- Countries such as the USA, Germany, India, Brazil, China, North Korea, Estonia, Iceland, Spain, etc. use GNU/Linux in the public sector, especially in education, law enforcement, military and e-government [4].
- The top 500 supercomputers use GNU/Linux as their operating system [5].
- The GNU/Linux kernel is the basis for Android [6]. There are currently more than 2.5 billion Android devices, representing 85% of the mobile market and 40% of all Internet-connected devices. Even the Ingenuity drone flying on Mars uses Android.
- Science-based organizations, particularly those running supercomputers, rely on GNU/Linux (e.g., NASA, CERN, NOAA).
- The International Space Station (ISS) uses GNU/Linux.
- Cloud services such as AWS, Azure, Google, Rackspace and others support servers using GNU/Linux [7].
- National e-voting systems around the world mostly use GNU/Linux [8].

2. Related work

During the IT ministers' conference held in South Korea, in 2003, the trio of Asian countries made up of China, Japan and South Korea (CJK) announced an initiative to promote free software and open source platforms based on products such as Linux [9]. The more governments adopt the Linux operating system, the companies that can benefit from systems integration and empower companies that sell Linux-based products and services. This explains why leading IT services and systems integration companies such as Microsoft, Red Hat, IBM and Oracle are increasing investment in developing open source related products.

The adoption of Linux by the Asian economic trio will have direct and indirect impacts on future technological development, the global economy, international politics, and software design culture and practices. Thorbergsson [10] examines the differences of using proprietary software and free software in electronic governance from an economic point of view. They conclude that there are more than economic benefits of using free and open source software. One of the most important arguments for governments to use free and open source software is how it reduces costs to update IT. If free software is used instead of proprietary software, there are key areas in network infrastructure, where the government can drastically cut costs of IT both short-term and long-term. So governments should be careful about which software products are chosen. Free and open source software is a step in the right direction as it lowers future switching costs.

Lunduke [11] asserts that “open source and government are a perfect couple” considering that an organization where there are people, for the purpose of representing the people, must use software over which the people have control. This control translates into cost savings, access to data thanks to open formats and the availability of source code. In addition, governments have more specific requirements and regulations than private companies. The conceptual and philosophical roots of this project have their basis in three previous projects: The first one is Huayra GNU/Linux [12], the first free operating system developed by the government of Argentina for education created in 2013 for the “Conectar Igualdad” program, and was the system that came installed on netbooks distributed during its course. The second was the EterTICS GNU/Linux [13] distribution, a custom made distro of GNU/Linux oriented to radio broadcasting, which included various tools and configurations for common use in popular communication and media. And the third project is GobMis GNU/Linux [14]. A distribution of the GNU/Linux operating system made with free software tools by the Directorate for the Modernization of

Management and Electronic Government of the Province of Misiones, Argentina, adapted to the requirements of the government administration offices.

3. About the software used by governments

The public administration uses software that requires large sums of money to pay for its user licenses. Most of this software relies on a private software business model, which only allows executing the program, denying the user the knowledge of the internal processes that it executes or the ability to introduce modifications, which are protected by commercial policies of the owning company. Also, copyright terms explicitly prohibit copying the software and executing it simultaneously on multiple computers. This situation creates a dilemma which governments must face, and gives a reason for the use of Free Software on the Government.

The Sovereign Reason: If the governments that use computer software don't have the contractual liberty on the matters of amplification and modifications of the system, a technological dependency is formed, in which the software provider is the sole entity with the power to unilaterally dictate the conditions, terms and prices of the software. This dependency directly affects the technological sovereignty of the country, forcing it to accept ruinous conditions that oppose the concept of freedom and sovereignty.

The Politic Reason: In order to strengthen state sovereignty, the use of free technologies must become a state policy of governments. The evolution of the administrative and political processes that include ICTs, favor a more dynamic public administration, which provides a better state of social welfare. Public policies are the foundations of the effectiveness of public management, and in the times of the information society, their implementation is essential for social welfare [15]. The modernization of management based on technologies raises the degree of efficiency in response to social requirements

The Social Reason: If governments stopped buying private software licenses, they could spend those resources to better attend to their constitutional duties such as healthcare, education, security and social welfare. The philosophy of free software is coherent with the models of social sustainability of nature. It is a cooperative-collaborative model based on mutualism, with its only goal being the welfare and growth of the community [16].

The Economic Reason: Private Operating Systems have their origin and commercial basis in other countries. This implies that the acquisition and user licenses derive from a technological importation, which must be paid in foreign currencies that are sent abroad. This means that although the programs are used inside national territory, its usage implies a deficit in the commercial balance, due to the fact that its usage requires payment in foreign currency to make the computer work.

The Temporal Reason: Free Software guarantees that the source code of the program will always be available to analyze, study, modify and distribute. This guarantees that the knowledge added to the software is independent from companies that maintain it, and even if these disappear, there will always be a community available to maintain it. Artificial obsolescence induced by companies that make private software don't have effect over software that is always updated and accessible. These perpetual software updates are guaranteed, without the need to pay again for each update, a problem that occurs with private software.

The Moral Reason: Government management must go further than just using programs just for their brand, or because "it's being used by everyone". Users must know the concepts and fundamentals of the inner workings of the tools that they're using, and avoid being simple consumers of "product" software, nor should they induce the illegality of obtaining and using copies of private software. In doing so, they would incur in a crime.

The Security Reason: Companies that provide private software argue that they improve security by obfuscation. That means that only they have access to the source code of the programs, offering a false sense of security. But it has been widely proved that delays in solving vulnerabilities from private software is one of the major causes of data loss due to malicious software like ransomware. It's unacceptable for the state to relegate matters of information system security and control of critical infrastructure to hidden processes for which there are no ways to access for inspection. On the other hand, private systems continually send information about their inner workings to the companies that produce them. This is known as software telemetry, many times done without the knowledge or consent of the user, which involves the activity and use of the software in a clear excess of data compilation. In the worst of cases, companies offer informatic services and cloud based data storage, which implies that government data is stored in foreign corporate servers, giving such companies information that should be safeguarded by the state. According to managed service providers (MSPs), 91% of ransomware attacks targeted

Windows PCs. This was followed by Windows servers with 76%. [17].

Blind [18] in his work on the impact of open software and hardware on technological independence, competitiveness and innovation in the economy of the European Union affirms that they are a factor that has an impact on the growth of exports and on value-added trade. He highlights its influence on international competitiveness and, consequently, on international trade. So, open source software is obviously not only a positive engine for development, but also for international trade. In short, the EU's national gross domestic product (GDP) and thus also its economic growth benefit substantially from open source software. If contributions from Member States were to increase marginally in the future, the GDP of the EU, including the UK, would increase significantly even above €100 billion a year.

In 2015, the United Nations approved the 2030 Sustainable Development Agenda [19], The Agenda has 17 Sustainable Development Goals, which include from the elimination of poverty to combating climate change, education, women's equality, defense of the environment or the design of our cities. Goal 17: "Revitalize the Global Partnership for Sustainable Development" in its target 17.7 promotes the development of environmentally sound technologies and their transfer, dissemination and diffusion to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed. In this sense, the "GobMis GNU/Linux" project promotes the Global Alliance for Sustainable Development Goals, strengthening technological capabilities in the region through technology transfer and Free Software.

The European Commission approved a regulation that favors free access to the software they produce, as long as there are potential benefits for citizens, companies or other public services [20]. This regulation is based on a recent study on the impact of open source software in areas such as technological independence, competitiveness and innovation in the European Union economy. This same Commission had launched the program "Interoperable Delivery of European eGovernment Services to Public Administrations, Businesses and Citizens" which gave rise in 2011 to the "Joinup" [21] observatory, a platform that provides a common place that allows public administrations, businesses and citizens to share and reuse IT solutions and best practices, and facilitates communication and collaboration on IT projects across Europe. It is currently developing the "Open Source Strategy 2020-2023", with which the European Commission intends to extend and strengthen the objectives of the digital strategy and the contribution to the Digital Europe program. Currently a spin-off project of GobMis, a twin but aesthetically neutral distro called "GobLin GNU/Linux. The Linux for Governments" is part of JoinUp's catalog [22] of open solutions for governments.

In the member countries of the Association of Southeast Asian Nations (ASEAN), those with a GDP per capita of less than \$10,000 are among the highest adopters of Free-Libre open Source Software (FLOSS). This includes Indonesia, Malaysia, the Philippines, Thailand and Vietnam, as these countries pursue greater technological independence through low-cost "leapfrogging" technologies. These countries have adopted policies favoring FLOSS in the hope that it will provide them with greater security and sovereignty through greater independence and transparency of software code. Countries such as Malaysia and Vietnam have set clear targets for FLOSS adoption and use, while Indonesia prefers to remain neutral in terms of software adoption and use. Interestingly, the highest adoption of FLOSS occurs in this country, which officially has a neutral opinion on the subject [23].

a) Criticism of the proprietary and free software models

Although the basic purpose of an operating system is to serve as an interface between the user and the hardware, both software distribution models have factors for and against them. The discussion of criticisms is a controversial field because there is a very marked and strongly defended position by users of both models. Stallman [24], Raymond [25] and Adekotujo [26] arguments for and against each model are presented, some being subjective opinions, as well as facts shaped by practice. Following we present some of the most frequent criticisms on both sides of the models.

b) Criticism of the proprietary software model

- Dependence on a single vendor and product continuity.
- Restrictions on the use of the software.
- Very high Total Cost of Ownership (TCO). License updates have to be paid for again.
- Forced imposition of non-standard file formats that impede interoperability.

- Complexity in custom development.
- It offers false security by obfuscation, which prevents to find and repair quickly the vulnerabilities in applications.
- No one can improve it.
- It is based on Cognitive Capitalism, closing the access to knowledge to be exploited economically by a company.
- The dominant position of monopolistic companies forces users to buy hardware with pre-installed proprietary software. They create a technological paradigm ensuring that users are not aware of other possible solutions.

c) Criticism of the Free Software model

- Fewer people use free software.
- There are few technical people who know about FLOSS, due to the technological paradigm where most use proprietary software.
- In some cases, there is no company to provide technical support for the applications, and it is necessary to resort to the community of users and developers.
- Confusing freedom with free. The syntax is the same, but semantically they are different things. Free software can be commercial.
- The learning curve is higher, due to the previous learning of other interfaces and the time needed to adapt.
- Absence of guarantees. Most free software is offered for use “as is”, and the developers are not responsible for the use of the software.
- Less availability of hardware drivers.
- As some companies do not respect standards for data exchange, problems may occur when opening files created with privative software.
- Some commonly used applications are not available for the GNU/Linux operating system.
- User interfaces in applications are not aesthetically pleasing, because efficiency is prioritized over aesthetics.

3.1. Cost analysis

The solution offered by GobLin is an “all-in-one” package, that is, in a single installation, having available all the software that a government office might need for normal operation. In the Table 1 we show the unit cost of configuring one basic office computer with proprietary software that provides the same features that GobLin offers at no additional cost. Cost of proprietary software to set up an office computer of government.

Table 1. Cost of proprietary software to set up an office computer of government.

Software included in GobLin GNU/Linux	Alternative privative software	Cost in USD
Devuan 4	Windows 10 Pro [27]	199.99
LibreOffice	Microsoft Office Professional 2019 [28]	249.99
Thunderbird	Microsoft Outlook [29]	139.99
GIMP	Adobe Photoshop [30]	251.88 per year
Inkscape	Adobe Illustrator [30]	251.88 per year
Deja-dup	Acronis True Image [31]	49.99 per year
NextCloud	OneDrive for Business (Plan 2) [32]	120.00 per year

Dia	Microsoft Office Visio [33]	180.00 per year
Atril PDF reader	Acrobat Reader Standard DC [34]	156.00 per year
BleachBit	AVG TuneUp [35]	59.99 per year
Total Cost (First install / per year)		1,659.71

Of course, governments can contract cloud solutions, or buy large-scale licenses and get volume discounts. But regardless of what costs may decrease, they will always be tied to the constant buy-back of licenses for upgrades and will never have control of their computing.

4. Methodology

With the vision of endowing the government offices with advanced management tools and software, we created a distribution of the GNU/Linux Operating System, adapted to the requirements of a modern administration, integrating free software tools. GobLin GNU/Linux is an own adaptation built on the base of Devuan [36] GNU/Linux distro, a robust operating system derived from Debian [37] GNU/Linux, is resistant to failures, and widely used on internet servers, which guarantees stability in the execution of systems, and is the base on which other widely known distributions like Ubuntu and Mint are based. Designed specifically for government offices, it incorporates application software that focus on productivity and management.

Public administrations have well-defined administrative roles and duties, so they must have tools that adapt to their work methodology. This is why we consider that a standard multipurpose distribution is not the best solution to meet their computing needs. In this sense, we redesigned the contents starting from a generic distro, and created a specific distro for government offices.

This is a project specifically designed for public administration, focusing on technological sovereignty, standardization, interoperability and office productivity. Considering the underlying benefits in terms of technological sovereignty, minimal production costs, ease of maintenance, security, interoperability, reduced time and increased production, this project is essential for effective government management.

As it is an open project, the functionality can be adapted to any scope or level of government, transcending its initial purpose, since it can be implemented both at an institutional and private level. With a few modifications, it can become a technological mainstay for SMEs, substantially saving its investment in technology.

We took the generic Devuan distribution, and in the first instance we removed all of the software associated with games, entertainment and non-office related stuff. We then analyzed and prioritized the inclusion of packages related to productivity, security and communications. This included adding package repositories that were not included in the generic distro. We use the “live-build” tool [38] provided by the Debian operating system, a set of tools that uses a configuration directory to fully automate and customize all aspects of building a live image. The result is a highly custom distro contained in a bootable ISO file designed specifically for administrative efficiency.

To strengthen the security of the distro, and considering that we are creating a system that is not general-purpose for generic users, we limit the actions that the user can take with respect to system modification. In that sense, the user is only allowed to do some activities related to data backup, installation, application updates and basic configurations of his working environment, but hardware maintenance and more specific system modifications are reserved to the root user. This greatly reduces the impact of malicious actions or user errors, while facilitating the maintenance of the computing infrastructure.

a) General Characteristics:

- **Fast:** Based on Devuan GNU/Linux, it's a 64-bit operating system that guarantees processing speed and higher productivity.
- **Free:** It has a free license. Without production or distribution costs, it can be copied with liberty.
- **Specific:** Designed for office use. For its creation, the best office tools and software were selected.
- **Friendly:** With a modern, intuitive and user-friendly interface.
- **Stable:** It's a mature, stable and tested system that guarantees functionality of the hardware.

- Standard: It fully respects the Open Standard for Office Documents (ODF: OpenDocument ISO/IEC 26300/06), using LibreOffice as the default office suite.
- Cloud enabled: Includes NextCloud, the client to connect to cloud-based work platforms, and corporate and private networks virtual with OpenVPN.
- Safe: Resistant to virus attacks, malicious software and ransomware. Uses the The GNU/Linux security architecture, separating the user's work environment from operating system functions. Viruses and malware spread by other operating systems do not run-on GobLin. The user's environment is isolated and limited so that the system cannot be tampered with maliciously.

b) Specific Characteristics:

- Base System: Devuan GNU/Linux v.4 Chimaera X86_64 bits.
- Kernel: Linux 5.12 liquorix amd64.
- Desktop: XFCE.
- Windows Manager: Metacity.
- Productivity software included: LibreOffice, Firefox, Thunderbird, Enigmail, Lightning, Osmo, Calibre, NextCloud, IPTux, Pidgin, Planner, PDF Arranger, Nextcloud client, Gnote, Telegram-Desktop, Atril PDF reader, Gnome Maps.
- Graphics/Multimedia: GIMP, Inkscape, Dia, VLC, Clementine, Brasero, Shutter.
- Image Viewer: Eom.
- Utilities: Deja-Dup, Synapse, KeePassXC, USBGuard, DosBox Emu, Stacer, Midnight Commander, File Compression, BleachBit, Grsync.

c) Development Environment:

It is distributed as an ISO image file size of 2 Gb. The image is created with the live-build tool from a configuration file that contains a list of programs and packs that are included in the distribution. The source of packages needed to configure the build is in: <https://distro.misiones.gob.ar/iso/goblin/>

d) Design Requirements:

Operative System: Devuan 4 or Debian 11 64-bits Tool: Live-build.

Space Needed in Drive: 20Gb.

The Installation of GobLin GNU/Linux is made by generating a bootable device (DVD or pendrive) from the ISO file itself. To generate a booting pendrive, we recommend the balenaEtcher utility. To generate the DVD, any application is acceptable to such an end. The ISO image is generated also as a "live" version, this means that any time the PC is booted with the device on, the user can boot up the system without installing it, and try the functionalities without affecting the host computer.

Once the computer boots, the user is shown the options to run the system in live mode or install it on a storage device in three languages of their choice: English, Spanish or Portuguese, as shown in Fig.1. During the installation process, the status is indicated with a progress bar as shown in Fig. 2. And once the installation is finished, the computer restarts from the device where it was installed, and the user's desktop is displayed as is shown in Fig. 3.

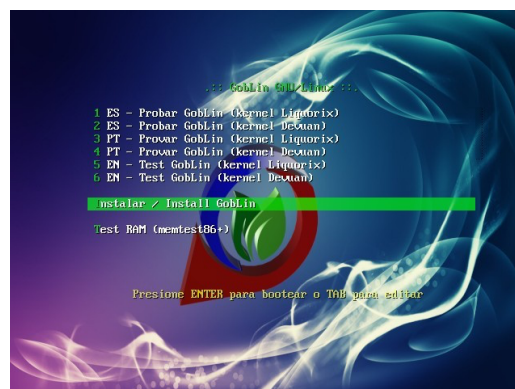


Figure 1. Test/Install boot screen.



Figure 2. Installation Process.

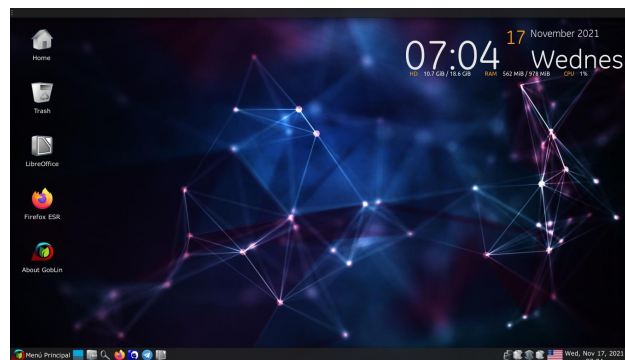


Figure 3. User Desktop.

Minimum System Requirements for Installation: 64-bits processor, 2GB of RAM and 20GB of disk space. We want many more people to know and benefit from the features of this operating system. You can help by inviting others to visit the GobLin GNU/Linux website so that they can download it and use it on their computers. Download URL: <https://sourceforge.net/projects/goblin-gnu-linux/>

5. Innovation and change of paradigm

This project represents a deep change of computer science paradigm on the matter of conception and use of base software in public administrations. The users assume that there only exists one operating system, “the one that everyone uses” and “the one the computer came with”. However, these people have not internalized the underlying problematic of maintaining the systems: older versions of the operating system, application updates, backup copies, protection of digital assets, network threats, and others. Suffering from format incompatibilities, consequences from the loss of information due to the use of malicious software, or the damage done for having computers out of service while technicians format them constantly, appears to be habitual and even tolerable.

The GobLin GNU/Linux project encourages governments to have a unified operating system, safe, under their own control, with standard applications and respectful of open formats, that will always be updated to their latest versions, with automated backup copies, and without the continuous prepayment to use privative software licenses. This implies substantial monetary savings on maintenance of the IT infrastructure, and the elimination of dead time due to machines being remitted to service technicians for continual disk formatting. In addition to the personnel training processes, the process of learning a new universal interface and standardized programs is simplified. The learning curve is lowered and learning times are made shorter.

5.1. Adoption, not migration

Rather than thinking of a massive migration of all government computers, we suggest a gradual, step-by-step, bottom-to-top strategy that allows feedback for continuous improvement.

We understand that the best strategy to achieve the success of the project is to propose an “adoption process”, supported by awareness-raising, training and user support actions. We firmly believe that the user must be convinced and motivated to make the process their own and adopt the system of their own free will.

6. Roadmap

In April 2015 Debian version 8 was released, identified with the name “Jessie”. One of the characteristics of this version was the adoption of the default startup system: “systemd”, claiming faster startup times, cgroups for services and the possibility of isolating part of the services. This startup and service manager system was originally developed by Red Hat and later adopted by most other popular distributions such as Ubuntu or Mint. This situation generated controversy within the community, and a group of developers argued that the mandatory addition of systemd broke portability, ignored backward compatibility, and replaced existing services. Criticisms against systemd include the lack of portability to other UNIX variants and the associated risk of seeing Linux-based systems separate from the UNIX world. OpenBSD, FreeBSD and other BSD operating systems are in fact incompatible with systemd, or rather, systemd is incompatible with UNIX variants which do not run Linux. As a consequence of this dissent, the “Init Freedom” initiative was created, and a fork of the Debian project was developed, which they called Devuan.

Devuan GNU/Linux was born as a fork of Debian, which offers users control over their system by avoiding unnecessary entanglements and to guarantee Init Freedom. The main goal of the project is to provide a Debian variant without the complexities and dependencies of *systemd*. In May 2017, the first stable version of Devuan “Jessie” based on Debian 8 was released, which was followed in June 2018 by version 2, “ASCII”, based on Debian 9; in February 2020, was released version 3 “Beowulf” based on Debian 10 and recently, in August 2021 version 4 “Chimaera” based on Debian 11 was released. Devuan has its own package repository, which while following the Debian package guidelines, incorporates local modifications only when deemed necessary to maintain non-systemd init systems. GobLin GNU/Linux is configured to periodically check the repositories, to ensure that the system is always up-to-date with the latest versions of installed software, thus ensuring that the system will never become obsolete.

GobLin GNU/Linux is a fork of the GobMis GNU/Linux project [14], a project that was specifically designed to deliver a custom operating system for the government of the province of Misiones. But in order to share this system with other levels of government, we designed a neutral aesthetic and internationalized the languages, adding the English and Portuguese languages to the initial configuration that is in Spanish. In November 2021 we released version 1.0 based on Devuan 3, and we updated it to version 2.0 in December 2021 with the release of Devuan 4. From that date, GobMis and GobLin will be launched simultaneously, as shown in Fig. 4.



Figure 4. GobLin and his Timeline.

7. Beneficiaries

The direct beneficiary of this project is the State on all levels of government, and in this context, the biggest impact is manifested in technological sovereignty, information security and savings on technological investment. The indirect beneficiary is the society as a whole, as it can potentially receive the positive transitory effects of the improvement in government management. Considering that the implementation at the distribution scale requires the specific training of the technical maintenance teams, the training of human resources on the subject of free software is a potential community benefit that will multiply the supply of technicians and trainers at the provincial level.

To determine the degree of user satisfaction with the operating system design, an online survey [39] was conducted on issues that relate their usual way of working with the system. The survey was announced by user groups on the Telegram messaging platform, inviting voluntary participation. The questions to measure the degree of satisfaction were: A): Very satisfied, B): Satisfied, C): Somewhat Satisfied, D): Neutral, E): Somewhat dissatisfied, F): Dissatisfied, G): Very dissatisfied. And Overall performance: H): Characteristic weighting using the OWA operator.

$$P = \sum_{(i=1..n)} O_i * w_i, (-1 \leq w \leq 1)$$

$$(A*1.0+B*0.75+C*0.25+D*0+E*-0.25+F*-0.75+G*-1.0)$$

The weighted results of the user responses are shown in Table 2.

Table 2. Users response expressed in percentages.

Questions / Answers from users	A	B	C	D	E	F	G	H
Easy to use	26	53	0	11	11	0	0	63
Choice of programs to be included in the system	21	47	0	32	0	0	0	56
Compatibility with connected hardware	21	42	0	21	16	0	0	49
Software compatibility	26	57	0	21	0	0	0	69
Security	32	47	0	11	5	0	0	66
Ability to integrate with other applications	21	58	0	11	5	0	0	63
Consistency of the user interface	37	42	0	11	11	0	0	66
Documentation	16	53	0	26	0	0	0	56
Clarity of documentation	16	58	0	21	0	0	0	60
Accessibility to local technical support	21	53	0	21	0	0	10	51
Technical support quality	26	37	0	32	0	0	0	54
General reliability	26	53	0	11	11	0	0	63
System performance	26	58	0	16	0	0	0	70

Given your experience with the system, would you recommend its use to a friend or colleague? Yes:100%, No: 0%. Overall, the survey values indicate that users are mostly satisfied with the features that were prioritized in the design of the distro: Ease of use, performance, software compatibility and security.

8. Results

GobLin is a fork of the GobMis project that was developed by the Management Modernization and Electronic Government Directorate of the government of the province of Misiones, Argentina. Both distributions are similar in structure and package content, with the difference that the GobMis distro has a specific aesthetic for the government of Misiones and the GobLin distro has a “neutral” aesthetic, so that any level of government can install it and customize it. At the moment, there are already several ministries and offices of the government of Misiones that have already adopted the operating system, and the process continues with the addition of more organizations.

- Ministry of Ecology and Renewable Natural Resources.
- Training Institute for Public Management.
- Institute of Higher Studies of Misiones.
- Under secretariat of Civil Protection.
- Under secretariat of Community Relations.
- Under secretariat of Strategic Management.
- General Council of Education.
- Social and Economic Monitoring System.

The installation process of GobMis began in 2019 and currently reaches approximately 500 computers of the government of Misiones, with the objective of reaching 5,000 administrative computers in the next few years. This can be computed as an actual direct saving in proprietary software licenses of USD 750,000, and in the future, it may reach a saving of USD 7,500,000. If computers from the education, health and safety management sectors are added, the number would increase by 5,000 units. This implies an additional saving of USD 7,500,000. In total, the amount of public money that the State could save in payment of private licenses amounts to USD 15,000,000. Without having the repayment for license renewal that occurs every two or three years. Being a project that is in an early implementation process, other more complex indicators can be evaluated later.

In April 2022, the GobLin GNU/Linux project received the “u-GOB Award for Public Innovation” in the category Digital Transformation and Government granted by the u-GOB Lab, the Laboratory of Innovation and Digital Transformation for Better Governments in Ibero-America. u-GOB Lab is a training and promotion center for better governments in Ibero-America, which promotes the continuous professionalization of the public administration and the strategic linkage for innovation and digital transformation between the public sector, private initiative, academia, social organizations and citizens, with the purpose of enhancing human development and quality of life. The u-GOB Public Innovation Awards seek to recognize the best public innovation projects at the federal, state and municipal levels in Ibero-America, which are capable of transforming the lives of citizens for the better.

9. Conclusions and future work

GNU/Linux is a mature system that offers a valuable opportunity for governments that have chosen it over proprietary alternatives. This translates into achieving technological sovereignty, lower cost, independence from software manufacturers and the ability to make custom modifications. And it is not just limited to servers and supercomputers, but applies to everyday desktop applications. GNU/Linux is much more than a cost-cutting alternative. For governments, it offers independence and opens up new opportunities for innovation [23].

We make available to governments a free, robust, highly tested and secure operating system that will allow them to take control of their computing, save costs on software licenses and maintenance time for their computers. We present GobLin “The Pombero”, the GNU/Linux for Governments, a specifically adapted GNU/Linux operating system to the government administrative offices requirements, incorporating free software tools. It is based on the Devuan Operating System (Debian), and contains the tools commonly used in government offices, covering all the IT needs of a modern and efficient administration. The adoption of the GobLin distribution of the GNU/Linux operating system allows to reaffirm the technological sovereignty of the government, reduce public spending, promote interoperability, and contribute to providing equal opportunities for society to access knowledge.

Starting from the low budget required for the implementation of the project, and the fact that there are successful experiences such as the Huayra and EtherTics projects, its field of application can be extended to all

levels of government that have a minimum technological floor, with a possibility to reproduce the project in any other public body. GobLin GNU/Linux was conceived as an open and collaborative initiative, and for this purpose, free access and reproduction project management and documentation platforms such as GitLab and ReadTheDocs were used. At the same time the GNU/GPL and Creative Commons licenses were adopted to facilitate the use and reproduction. Considering the fact that GobLin GNU/Linux is based on an Universal Operating System like Devuan, technical teams resort to a unified source for solutions. The knowledge acquired can be easily shared with the international community, and solutions to problems are well documented.

The GobLin GNU/Linux project produced the first functional version of the system in June 2021, and is based on the GobMis project that started in 2019. Based on the principles that motivated its creation, the province of Catamarca in Argentina developed its own project [40] and others are already studying it. Future work will focus on creating a community of government users at the national level to encourage all provinces to develop their own system, with the aim of soon having a national GNU/Linux distribution of the state. The State is able to develop the applications that each component of the administration needs based on its requirements and needs, while raising security standards.

10. Conflict of Interest

The authors declare that they have no have no conflicting interests or personal relationships that could have appeared to influence in the content of this article.

11. References

- [1] Government of the Province of Misiones. (2022). *GobLin GNU/Linux*. <https://distro.misiones.gob.ar/goblin/bienvenida/en-index.html>
- [2] CLAD. Latin American Center for Development Administration. (2007). *Ibero-American Charter of Electronic Government*. <https://bit.ly/3A6GWst>
- [3] Harper, N. (2020). *Why Linux is the Most Popular Operating System*. <https://bit.ly/3nk7hfd>
- [4] Richter, D., Zo, H., Maruschke, M. (2009). *A Comparative Analysis of Open Source Software Usage in Germany, Brazil, and India*. Fourth International Conference on Computer Sciences and Convergence Information Technology. Seoul, Korea. <https://doi.org/10.1109/ICCIT.2009.169>
- [5] TOP500.org. (2022). *List Statistics: Operating System Family Category*. <https://www.top500.org/statistics/list/>
- [6] Android. (2022). *Kernel overview*. <https://source.android.com/devices/architecture/kernel>
- [7] Amazon Web Services Inc. (2022). *Find, buy, and deploy Linux on AWS*. <https://aws.amazon.com/mp/linux/>
- [8] Linux.com. (2022). *Estonians Break Ground, Vote Online*. <https://www.linux.com/news/estonians-break-ground-vote-online/>
- [9] Chae, B., McHaney, R. (2006). Asian trio's adoption of Linux-based open source development. *Communications of the ACM*, 49 (9), 95–99. <https://doi.org/10.1145/1151030.1151035>
- [10] Thorbergsson, H., Björgvinsson, T., Valfell, Á. (2007). *Economic benefits of free and open source software in electronic governance*. 1st International Conference on Theory and Practice of Electronic Governance. Macao, China. <https://doi.org/10.1145/1328057.1328095>
- [11] Lunduken, B. (2014). *Why Linux Works for Government*. Linux.com. <https://www.linux.com/news/why-linux-works-government/>
- [12] Argentine Ministry of Education. (2022). *Huayra GNU/Linux*. <https://huayra.educar.gob.ar/>
- [13] EterTICs. (2022). *EterTICs GNU/Linux. Free distribution for Community Radios*. <https://gnetertics.org/>
- [14] Brys, C., San José, G., Obregón, J. (2020). *GobMis: Distribución del Sistema Operativo GNU/Linux para el Gobierno de la Provincia de Misiones*. 14° Simposio de Informática en el Estado. 49° Jornadas Argentinas de Informática. Salta, Argentina. <https://49jaiio.sadio.org.ar/pdfs/sie/SIE-19.pdf>
- [15] Rodríguez Valdez, J. C., Portillo Molina, R., Vélez Vázquez, M. G., Miranda López, R. (2015). Políticas públicas como detonante eficaz de la administración pública. *Revista de Investigación en Tecnologías de la Información (RITI)*, 3 (6), 1-12. <https://www.riti.es/ojs2018/inicio/index.php/riti/article/view/93>
- [16] Alonso de Magdaleno, M. I., García-García, J. (2015). Sustainability and social responsibility reporting in open source software. *International Journal of the Commons*, 9 (1), 369–397. <http://doi.org/10.18352/ijc.503>

- [17] Datto. (2020). *Annual Global State of the Channel Ransomware Report*. <https://bit.ly/3NpDYTd>
- [18] Blind, K., Böhm, M., Grzegorzewska, P., Katz, A., Muto, S., Pätsch, S., Schubert, T. (2021). *The impact of Open Source Software and Hardware on technological independence, competitiveness and innovation in the EU economy*. European Commission. <https://data.europa.eu/doi/10.2759/430161>
- [19] United Nations. (2022). *The Sustainable Development Agenda*. <https://www.un.org/sustainabledevelopment/development-agenda/>
- [20] European Commission. (2022). *Commission makes software available to all to benefit businesses, innovators and areas of public interest*. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6649
- [21] European Commission. (2022). *JoinUp Observatory*. <https://joinup.ec.europa.eu/>
- [22] European Commission. (2022). *JoinUp Catalog website. GobLin GNU/Linux*. <https://bit.ly/3buoNdY>
- [23] Mindel, J. L., Mui, L., Verma, S. (2007). *Open Source Software Adoption in ASEAN Member Countries*. 40th Annual Hawaii International Conference on System Sciences. Waikoloa, Hi, USA. <https://doi.org/10.1109/HICSS.2007.412>
- [24] Stallman, R. (2002). *Free Software, Free Society*. GNU Press. <https://www.gnu.org/philosophy/fsfs/rms-essays.pdf>
- [25] Raymond, E. (1999). *The Cathedral and the Bazaar*. O'Reilly Media. <http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/>
- [26] Adekotujo, A., Odumabo, A., Adedokun, A., Aiyeniko, O. (2020). A Comparative Study of Operating Systems: Case of Windows, UNIX, Linux, Mac, Android and iOS. *International Journal of Computer Applications*, 176 (39), 16-23. <https://doi.org/10.5120/ijca2020920494>
- [27] Microsoft Corporation. (2022). *Buy Windows 10 pro for business*. Microsoft Store. <https://bit.ly/3A5uTM8>
- [28] Microsoft Corporation. (2022). *Microsoft Office Home & Business 2021*. <https://bit.ly/3y0bjhC>
- [29] Microsoft Corporation. (2022). *Outlook*. <https://bit.ly/3xTAwdL>
- [30] Adobe. (2022). *Plans and pricing for Creative Cloud apps and more*. <https://adobe.ly/3nk7OOf>
- [31] Acronis International GmbH. (2022). *Backup and recovery*. <https://bit.ly/3nlIE1O>
- [32] Microsoft Corporation. (2022). *Compare OneDrive cloud storage pricing and plans*. <https://bit.ly/3brBVk6>
- [33] Microsoft Corporation. (2022). *Compare Visio options*. <https://bit.ly/3Acrj33>
- [34] Adobe. (2022). *Adobe Acrobat DC Plans & Pricing*. <https://adobe.ly/3ONMD2R>
- [35] AVG. (2022). *Discover all AVG products for your PC*. <https://www.avg.com/en-us/store#pc>
- [36] Dyne.org foundation. (2022). *Welcome to Devuan*. <https://www.devuan.org/>
- [37] Software in the Public Interest, Inc. (2022). *Debian the Universal Operating System*. <https://www.debian.org/>
- [38] Software in the Public Interest, Inc. (2022). *Building a custom Debian ISO image*. <https://bit.ly/3OGyYKO>
- [39] Government of the Province of Misiones. (2022). *GobLin User Satisfaction Survey*. <https://bit.ly/GobLinSurvey>
- [40] Government of the Province of Catamarca. (2022). *SMELinux*. <https://distro.catamarca.gob.ar/>