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Approach of Interlinking between the Migration Directorate-General and the National Independent Electoral Commission for Efficient Sharing of Resources and Information

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Abstract: The emergence of new information and communication technology is currently experiencing a spectacular rise; artificial intelligence, robotics and home automation is always a top event in many of the technological achievements of our era. Data must be carefully exploited in order to really help people's daily lives. Efficient sharing of data simply means another way: making life easy in communion than doing these exploits alone and putting too much weight on oneself and others. The typical example of sharing which is increasingly being observed in the field of telecommunications is one of the great proofs of the century, and I am convinced that tomorrow other actions along these lines will be taken to make things more flexible and accessible to all. In view of the many difficulties observed at the checkpoints of the Migration Directorate-General, difficulties often due to the lack of accuracy in the authentication of the document presented by the passenger, verbal information and authenticity in all cases. These checkpoints are mostly the country's airports and airfields but also internal land barriers and those bordering our neighboring countries.

Keywords: *Interconnexion CENI, DGM.*

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I. INTRODUCTION

In view of the many difficulties encountered at the checkpoints of the Directorate-General for Migration, often linked to a lack of precision in the authentication of documents presented by passengers, as well as the verbal information provided and the authenticity of documents in some cases, it is important to note that these checkpoints are mainly located at airports and aerodromes in the country, but also to internal land barriers and those that border our neighbouring countries.

It will be necessary to set up a system to ensure the interconnection of DGM checkpoints with the population database, consolidated by those of the voters of the CENI and the ONIP/BCR. The objective is to facilitate movement control while preserving the proper functioning of each entity within the interconnected network. Given the multiplicity of checkpoints, the interconnection method we will deploy will serve as a prototype applicable to all checkpoints of the DGM, the PNC, and other services that may need it.

Interconnect 2 structures by a teleintecific network, comes to master and take into account many notions of character not only computer but also telecommunications character. From the network by passing topology, addressing, routing, layers,... and telecommunications via the model of interconnection through point-to-point radio loop bridge, multipoint with direct visibility (LOS) or (NLOS) and bridge via satellite but also through interconnection via remote VSAT sites (remote) to the mayor site which is the teleport.

Interconnect the databases of the Directorate-General for Migration (DGM) and those of the Independent National Electoral Commission (CENI) through the local radio loop

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(BLR) and by satellite via the CENI iDirect 5IF Telecom Hub.

II. METHOD AND DIFFICULTIES

- For the collection of data, we made use of observation techniques; documentary (books, memoirs, internet, syllabus) and also the method of questioning or interview

- The database of voters provided by the CENI is a base just fill the major voters at the last enlistment, we will be unable to trace any passenger other than the one that exists in the bases. 5

No minor passengers, no foreigners, no military personnel, so we will be able to trace a large number of passengers if the census is properly organized in the country.

III. NETWORK INTERCONNECTION TECHNOLOGIES

In order to ensure the smooth operation of this new system, it is essential to guarantee the efficiency of the local networks at each site and their interconnection. This will allow all agents, regardless of location, to access the mail server and be able to view and write emails.

In this context, we discussed the various equipment needed to establish a local network, as well as the different topologies that we could implement for interconnection.

➢ *There are Several Interconnection Technologies, Including.*

- Radio beams;
- Local radio loop with VSAT;
- Local radio loop with WIMAX, etc.

➢ *WIMAX Technology*

WIMAX (Global Interoperability for Microwave Access) is a technology standardized by the IEEE according to the IEEE 802.16 standard, intended to create a metropolitan-scale wireless data network, connecting various client sites or local networks. It is particularly suitable for developing countries, such as ours, because it offers an efficient solution to access the Internet, especially in the absence of a cable infrastructure or a national operator capable of providing telephony and data transmission services. The local radio loop is part of wireless data transmission technologies, although it is important to note that this technology is still in an experimental phase in our country. WiMAX enables data transfer rates reaching several tens of megabits per second across a maximum distance of a few tens of kilometers.. It mainly targets the market of metropolitan networks, such as HiperMAN's MAN (metropolitan area network), as well as peri-urban and rural areas lacking adequate wired telephone infrastructure. The acronym WiMAX encompasses several standards and norms: some are dedicated to fixed uses, such as the "local radio loop" (where the user is equipped with a home station and an outdoor antenna), while others concern a mobile version, "802.16e", which enables high-speed connectivity in mobility situations, the first standard being published by the WiMAX Forum at the beginning of 2006. These wireless data transmission technologies can be classified by: These wireless data transmission technologies can be classified by:

- *PAN Network: Personal Area Network*

These personnel interconnect over a few meters personal equipment such as: GSM, mobile phone,... All from the same user

- *LAN: Local Area Network*

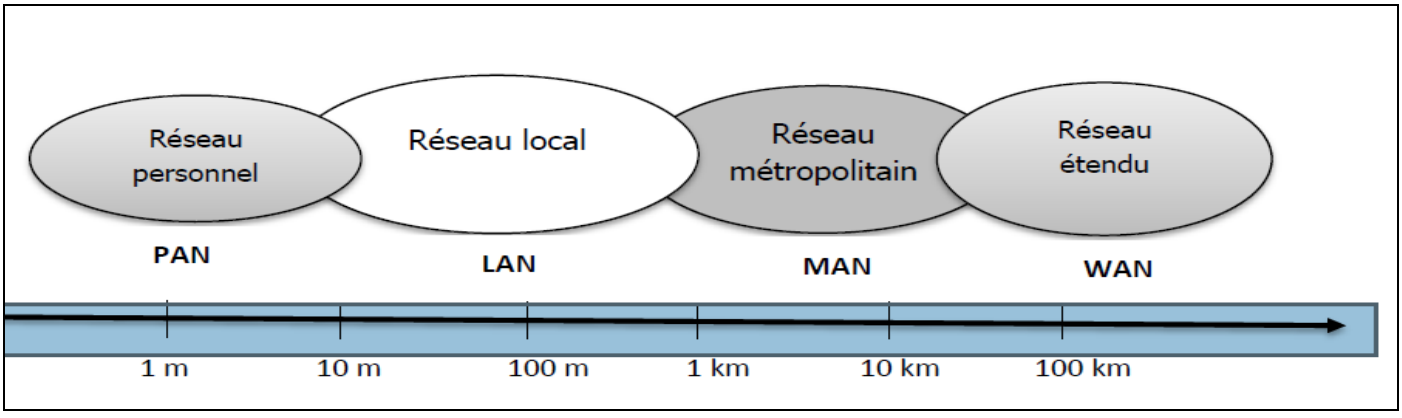
Otherwise known as RLE (Enterprise local area network) corresponds to the size of the company network, they are used to transport all the digital information of the company. The wiring distance is a few hundred meters

- *MAN: Metropolitan Area Network*

It allows the interconnection of companies or departments on a specialized high-speed network. This type corresponds to an interconnection of a few buildings located within a city, campus, ...

- *WAN: Wide Area Network*

This network is intended, as its name suggests, to transport digital data over distances across a country or even across one or more countries. Network is either terrestrial, and it uses infrastructures in the middle of the ground mainly large optical fiber networks or hertzian like satellite networks. Fig 1. shows the classification of networks according to their respective sizes.



ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

Fig 1 Classification of Networks by Size

➢ *Microwave Beam*

A radio beam is a system of transmission of signals, mainly digital nowadays, which can be unidirectional or bidirectional and is generally permanent, connecting two fixed geographical sites. This system uses radio waves, with carrier frequencies ranging from 1 to 86 GHz (in the microwave range), which are focused and concentrated using directional antennas. It transmits various types of signals, such as sound, radio, video, television channels or telephone communications, and also facilitates the exchange of these data between the different points of the network served by it.

A "radio network" that integrates and combines radio relays is capable of covering a region, territory, country or even continent.

These transmissions are particularly sensitive to obstacles and masks (terrain, vegetation, buildings, etc.), precipitation, refractive atmospheric conditions, as well as electromagnetic interference. They are also strongly affected by reflection phenomena, especially for analog signals, although digital modulation can to some extent mitigate the transmission error rate caused by these disturbances.

Due to geographical distance limitations and "visibility" requirements, the radio path between two terminal equipment is often segmented into several sections, called "bonds", using relay stations (such as the Vigen Tower). Under optimal conditions (clear profile, favourable climate, low flow, etc.), a hertzian jump can reach more than 100 km.

➢ *Local Radio Loop*

The Local Radio Loop (BLR) is a telecommunications solution that provides continuous, high-speed Internet access without the need for cable installation. Its principle is based on the use of radio waves as a means of transmission, which has many advantages for companies.

- *Two Main Applications of the Radio Local Loop (or BLR) can be Identified:*

✓ Access networks for the business sector
✓ Residential access networks

The LCO is a proven technology, adopted by many Internet service providers around the world to provide high-speed Internet connections to their customers.

The Local Radio Loop (BLR) operates two frequency bands, ranging from 3 to 6 GHz. This choice of frequencies is motivated by their ability to guarantee excellent operation outside the line of sight (NLOS) as well as a large radio capacity, thus facilitating its deployment even in areas with high density.

The LCO consists of a base station (BS) that is connected to a transmission network, thus enabling the distribution of Internet access to end-user equipment (EPC).

- *The Base Station Consists of Two Main Components:*

✓ An Access Point (AP): this element ensures the coverage of a sector in terms of transmission and reception;
✓ An access point controller (IDUH): this device is connected to the APs to manage the equipment.

- *On the users' Side, CPE is Divided into Two Parts:*

✓ The outdoor unit includes the antenna (ODU) which is installed outside of the building, for example on the roof;
✓ The indoor unit consists of a POE equipment that connects directly to the antenna, facilitating the connection between the ODU and the customer's equipment (router or switch).

➢ *VSAT*

A very low aperture terminal (VSAT) is a two-way ground station capable of transmitting and receiving data via satellites. This type of terminal can send both narrowband and broadband information to satellites in Earth orbit in real time. Data transmitted in this way can be redirected to other terminals or remote centres around the world. This telecommunication technology is particularly effective in areas requiring connection in highly isolated areas. VSAT systems provide reliable Internet access, whether at the bottom of a mine or in open water.

The demand for VSAT satellite services continues to increase, especially since the recent emergence of HTS (High-Speed Satellite) technology, which allows to reach rates up to 20 times higher than fixed satellite services (FSS) for an equivalent amount of orbital spectrum.

This improved capacity means that VSAT services, once considered obsolete, are now a crucial part of connectivity in Africa. They meet the broadband requirements of today's businesses and consumers at competitive prices.

- *Interconnect Support*

Networks use a wide variety of interconnecting media, ranging from metals to fibre optic cables and radio beams. We will present the main characteristics of these different types of supports. These supports include:

✓ Twisted metal wires. These wires can sometimes be made of aluminum. Four-wire links of standard quality connect the PBX to the routing autonomy. The major disadvantage of telephone wires is their significant weakening, which is all the more pronounced as the diameter is reduced. In rural areas, the maximum attenuation threshold is quickly reached, requiring the regular addition of signal regenerators.
✓ Coaxial cables: Coaxial cables, consisting of two cylindrical conductors of the same core separated by an insulator, are increasingly used to minimize interference from external noise. It is established that the ratio between the diameters of the two conductors must be 3.6.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

The different cables are identified by their diameters in millimetres; the two most common types are 2.6/9.5 and 1.2/4.4. Amplifiers must be installed every 4.5 km and 3 km for these two examples respectively. These cables are mainly used by PTT for the multiplexing of telephone channels, allowing simultaneous transmission of several communications, each with a dedicated frequency range.

- ✓ FIBER OPTIC : Optical fibers are devices designed to direct light through a protected propagation medium, while minimizing degradation. The benefits associated with optical fibre are manifold. Its outer diameter is about 1/10 of a millimetre and its weight does not exceed a few grams per kilometre. This compactness and lightness facilitate its use (1 GHz for 1 km), thus allowing the multiplexing of a large number of TV channels, telephony, etc. In addition, the low attenuation of the fibres allows for a wider spacing between the regeneration points of the transmitted signals.

For example, for a system operating at 140 Mbit/s, an optical fibre operated at a wavelength of 0.85 mm and with a loss of 3 dB per km allows a regeneration spacing of 1.5 km.

Light emitters used in fibre transmission systems fall into two categories:

- ✓ Light-emitting diodes, which do not require a short laser
- ✓ The laser diodes

Regarding light detectors, which convert light into electrical current, they are also divided into two types:

- ✓ Conventional light detectors
- ✓ Avalanche light detectors.

- *Presentation of the CENI*

The Independent National Electoral Commission (CENI), formerly known as CEI until March 2011, is an «institution supporting democracy» in the Democratic Republic of the Congo. It was established as a result of the transitional constitution and the comprehensive and inclusive agreement. This Congolese public body enjoys autonomy both administratively and financially, and is characterized by its neutrality as well as its legal personality. The INEC's mission is to organize elections in the Democratic Republic of the Congo, and it has notably supervised the constitutional referendum held on 18 and 19 December 2005. The Telecommunications Directorate has the task of providing electronic data transmission solutions to ensure communication between different CENI structures. By communication, we mean voice transfer, email, file transfer, remote access to applications, file sharing, etc. All these applications have been made possible throughout the national territory through a two-pronged strategy. The first aspect was to focus on the inherent reliability and confidentiality of the transport tool. To this end, the bulk of the data transport was carried out on a private infrastructure, owned and managed by CENI. The latter has ensured and continues to ensure between CENI structures in Kinshasa and in provinces, voice exchange, private electronic messaging, file transfer, Remote access to applications and file sharing The other aspect was to transfer some of the traffic over public networks. It took into account operational requirements, including staff mobility and the establishment of temporary structures, called operational, which could not be supported from the point of view of electronic communication, by the CENI's private infrastructure for two main reasons. The first transportation segment is the CENI VSAT network, which includes a teleport as well as VSAT stations located in all provincial and territorial capitals and in some sectors.

To this structure has been added another segment, that of operators. This second segment was used to transport traffic from locations where the CENI network is not present, such as polling stations. It has extended our communication services where the CENI's transportation infrastructure is lacking. To achieve this, there were three possibilities:

The transmission of data directly from the TVS (Touching Voting System, commonly known as voting machine) in areas covered by 3G or EDGE. In these areas, the TVS equipped with a GSM SIM card was able to transmit its data to the headquarters via a private APN (Access Point Name) without going through internet;

- ✓ Transmission using a satellite transmission device (RTS) via a satellite service access provider;
- ✓ The transmission of consolidated TVS data to local results compilation centres.

Roughly, several telecommunications links have made the transmission of data across the entire Democratic Republic of the Congo possible. Private satellite links between the HQ and the dismemberments, back-up links via mobile phone operators between the CENI HQ and its dismemberments, secure dedicated links between the CENI HQ and the data center of service providers, radio links between the TVS and the points of presence of GSM operators, satellite links for RTS, Internet links that have been used to deploy secure tunnels. Fig 2. shows the topology of the data transmission network as it matured during the December 2018 election.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

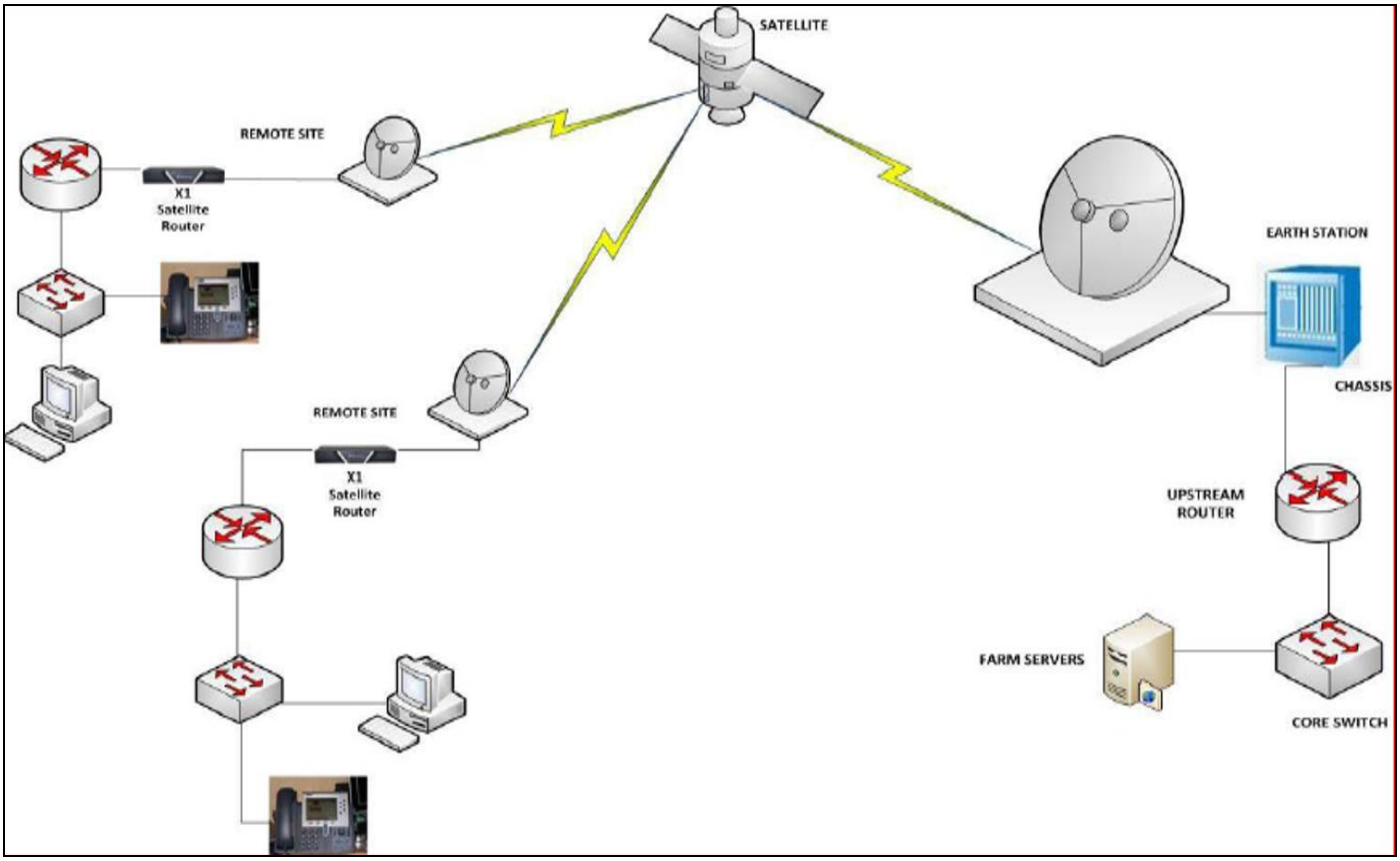


Fig 2 The Data Transmission Network Topology

- *Architecture of the Existing CENI Network*

It is a VSAT network with a star architecture centered on a hub located at headquarters, with VSAT terminal stations located in the territorial and provincial capitals,That is to say, in the branches where the results compilation centres and provincial executive secretariats have operated. Coverage of the city of Kinshasa was achieved through a local radio loop.

- *VSAT Infrastructure*

At the heart of this infrastructure is a iDirect 51F multi Hub, version IDX 3.0, connected to two parabolic antennas 6.2m in diameter and 4.5m, operating respectively in the C-band and in the Ku-band. Satellite bandwidth is distributed as follows: 4.4 Mbps for C-band on the NSS12 satellite and 10Mbps for Ku-band on the New Dawn satellite.

A total of 169 VSAT stations have been installed in provinces, including 15 C-band and 154 Ku-band. The deployed modems are iDirect 3x Evolution. Routing within this network is implemented in a CISCO 3845 router (router 1 on figure 2. Above using the Rip version2 protocol).

The power supply of the various VSAT stations is provided by solar panels of 230W for Ku-band stations and 275W for C-band stations.

- *Directorate-General for Migration*

The General Directorate of Migration (DGM) is a public entity under the aegis of the Ministry of the Interior, Security, Decentralization and Customary Affairs, acting in accordance with the provisions that will be presented below. Given the sensitive nature of the subjects discussed, we commit ourselves to rely entirely on the documents provided by the relevant departments of the DGM.

Decree-Law no. 002/003 of 11 March 2003 stipulates that the DGM is a public service of the Congolese state, enjoying both administrative and financial autonomy.

- ✓ The implementation of government policy on immigration and emigration,
- ✓ The management of the foreign police,
- ✓ The regulation of entry and exit from national territory, also known as border police,
- ✓ Issuing ordinary passports to Congolese citizens and visas to foreign nationals,
- ✓ Cooperation in the tracking of criminals and suspects reported by the International Criminal Police Organization, Interpol. It should be noted that to date, the issuance of ordinary passports is still carried out by the Ministry of Foreign Affairs and International Cooperation. In accordance with current legislation, the DGM exercises its powers throughout the national territory as well as in the diplomatic missions of the Democratic Republic of the Congo abroad. However, the deployment of migration officers in these offices is not yet operational.

Under the technical direction of the Ministry of the Interior, Decentralization and Security, the DGM is managed by a Director General, assisted by a Deputy Director General.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

IV. IMPLEMENTATION OF THE INTERCONNECTION MODEL

Having acquired a thorough knowledge of the CENI's telecommunications infrastructure, we now wish to determine how to implement the solution that will allow us to ensure the interconnection between CENI and DGM in this specific context.

The objective is to ensure this interconnection through a predefined medium, while allowing, thanks to this same medium, a secure and efficient exchange of resources and data. The current CENI Telecom HUB, branded IDIRECT and version IDX 3.5.2.0, ensures the connection between the headquarters of the CENI and 203 remote stations spread over all the capitals and territories of the republic.

Oriented to the EUTELSAT 3B satellite, it is located at 3° East of this satellite, with a bandwidth distribution of 40 Mbps in download and 20 Mbps in upload. The size of the dish is 7.3 meters.

➢ *The Size of the Dish is 7.3 Meters. On the Current CENI Network, Resources already in Place are :*

- Electronic messaging on the intranet,
- The transfer of data,
- Voice over IP (VOIP).

➢ *Description of iDirect4 HUB*

- Multi HUB SIF universal IDx version 3.5.2.0 with TRANSEC in optional mode and can receive up to 5 satellites in different bands: Ku, Ka, C, L or X,
- The HUB also has 6 Lines Cards, 2XLC-T and HXLC-R,
- CENI currently uses the Ku-Bnad channel,
- Managed by the NMS (Network Management Systems) server; installation meets major security and redundancy standards,
- Operating and management software is fully integrated

Fig 3 shows the Rack and its 42U components.

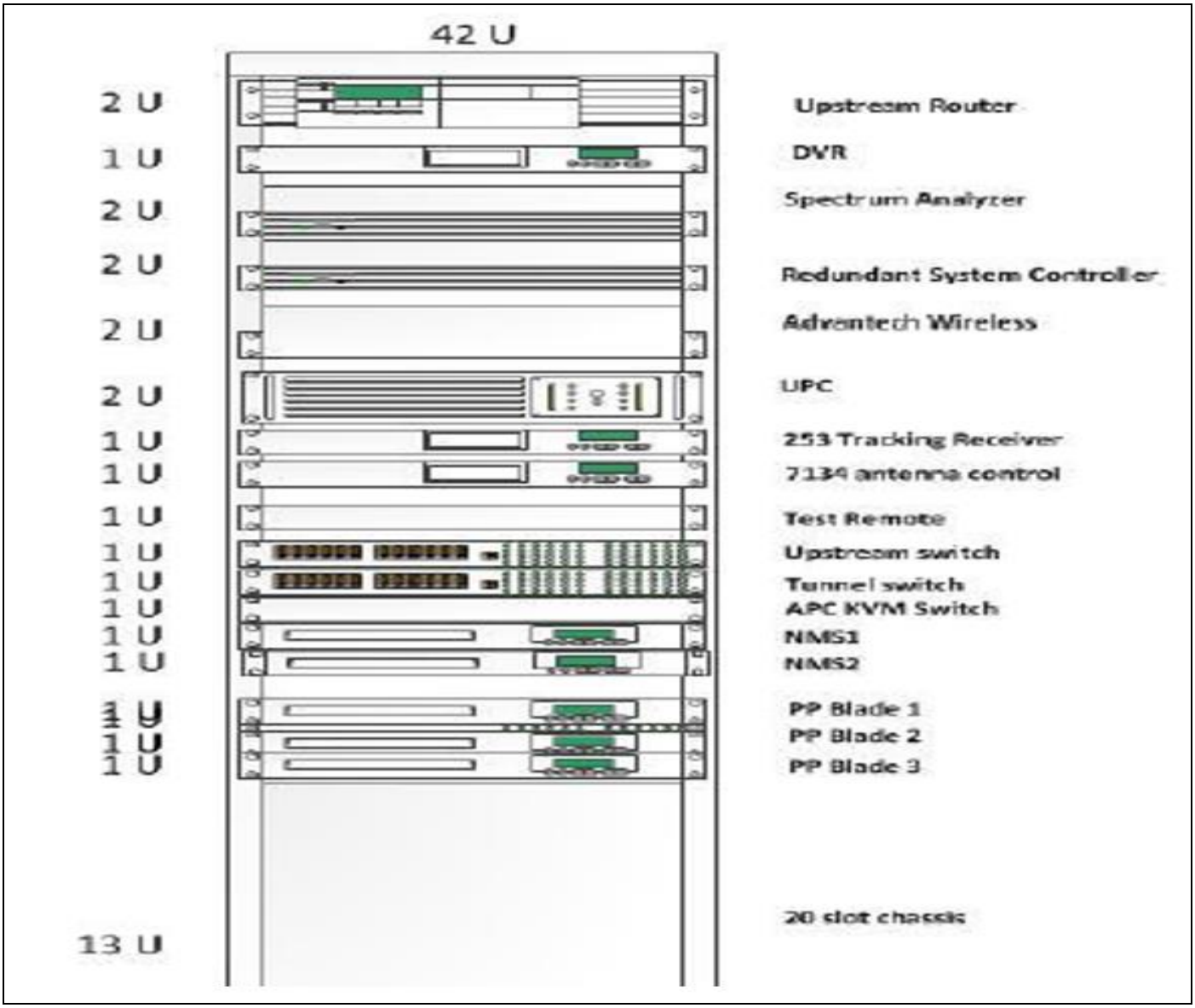


Fig 3 RACK and its Components 42U

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

The CENI telecommunications infrastructure's indoor and outdoor installations will be the synthesis of the essential elements and results of the interconnection model we are about to develop.

- *Presentation of the Existing iDirect 5IF Hub Network Tree of CENI.*

Divided into two inroute groups; the CENI network, through iBuilder management and iMonitor monitoring software, manages up to 203 remote VSAT sites installed in all the divisions of the national territory.

With an initial power of -7dbm, the data transmission is easily carried out both in UP and in DOWN, that is to say from the seat to the dismemberments and vice versa. After analysis of the traffic, it is clear that the demand is very high, illustrating that DOWN is more important than UP, because data from the dismemberments to the headquarters of the CENI are most frequent, while those in the other direction exist, but are less significant in terms of memory capacity and speed.

The remote stations are distributed throughout the national territory and, according to the EIRP of the Eutelsat 3B satellite at 3.1° east, coverage is 75% everywhere, except in the extreme west, notably at MATADI and MOANDA, where we observe a percentage of satellite coverage. With respect to our work, we wish to make available to the DGM Branch a national population database, enriched and updated on a regular basis, Includes the CENI voter databases and those of the BCR and the ONIP population census and identification. The pooling of operations for the revision of the electoral register of the CENI in 2022, the census of the population of the BCR in 2022 and the identification of the population by the ONIP in 2022-2023; 3 population databases will be available and consolidated by each entity according to its headings. So there will be interconnection of the networks of these 3 entities to consolidate the data of their respective databases. Third-party databases of the CENI, ONIP and BCR already consolidated and pooled will be replicated to the DGM for consultation and update. In practice, the DGM will be able to find real and accurate information about each citizen internally, and those entering and leaving national borders. It will assist ONIP and the BCR in obtaining regular and continuous updates of their databases. As the DGM and the CENI are all in the same geographical area and close together, we envisage a radio bridge interconnect in redundancy of that of the existing optical fibre via the SCPT.

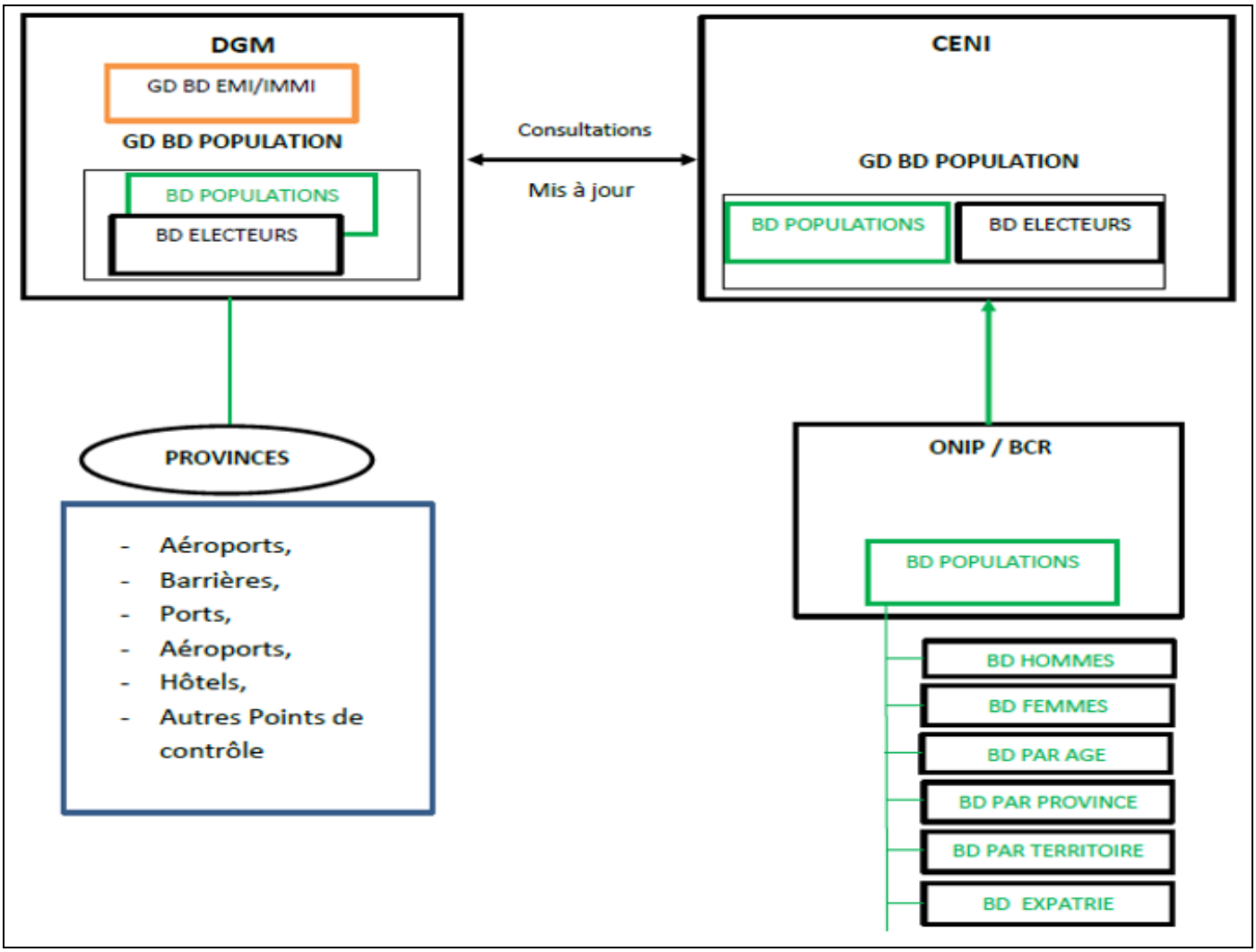


Fig 4 Population Data Query Architecture

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

The architecture that we have just presented to you above follows the trace of the consultation of data relating to voters that comes from the CENI, the data of the population that comes from the ONIP/BCR. After the pooling of operations between CENI, ONIP and BCR institutions, data will be transmitted by in a single package and the occasional update of the data of voters of the CENI, ONIP and BCR after census. Figure 4 5 illustrates the transmission chain of a remote hub-satellite-remote station.

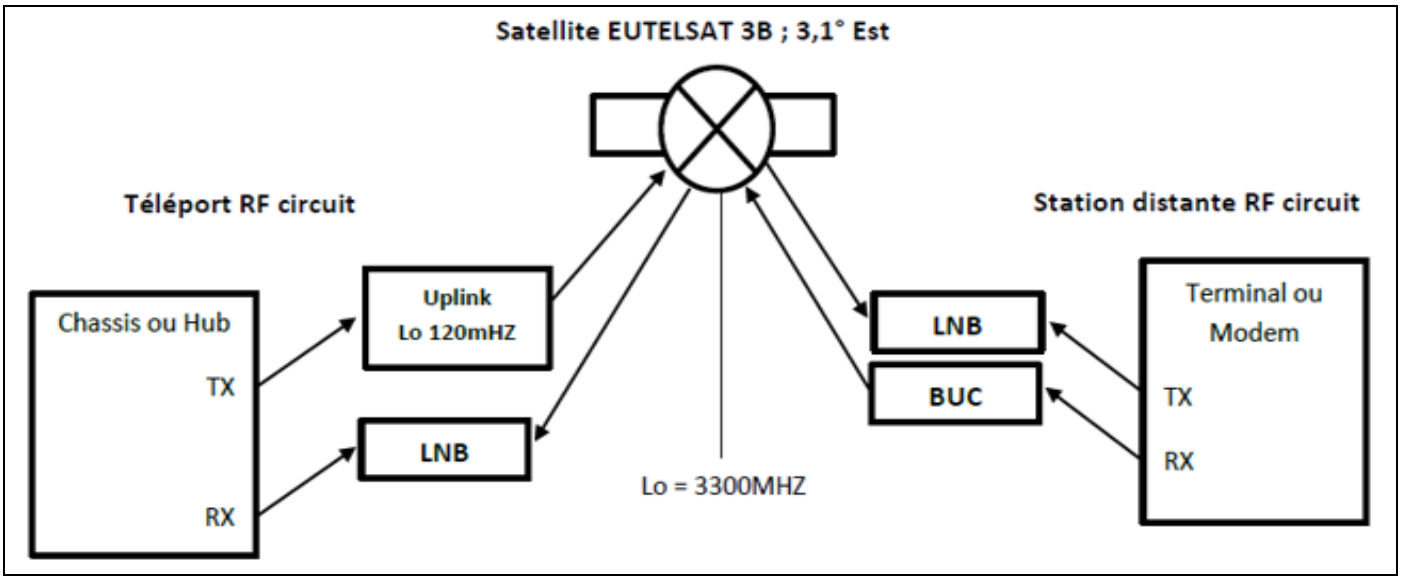


Fig 5 The Transmission Chain from a Remote Station Hub-Satellite-Remote Station

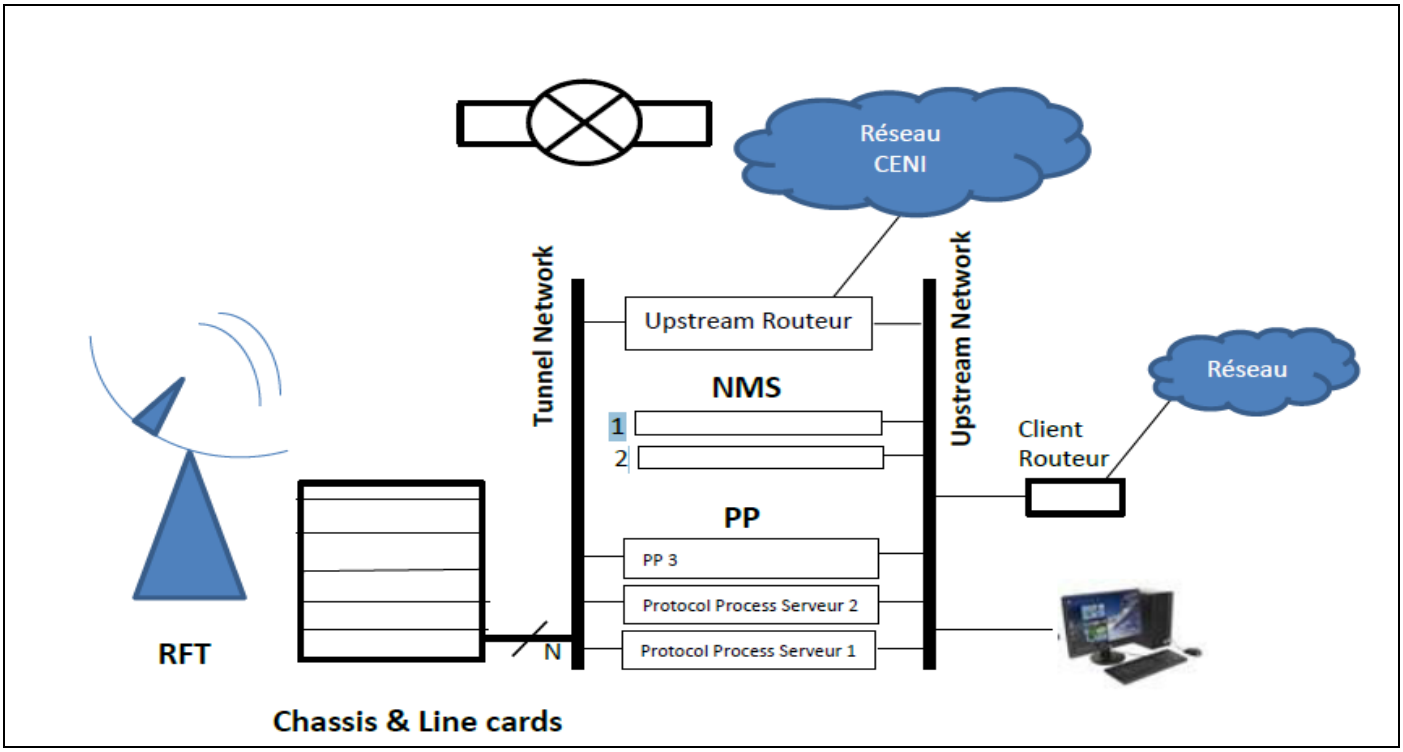


Fig 6 Typical Diagram of the CENI iDirect HUB

Fig 6 represents the bulk of the CENI HUB's basic structure, and this infrastructure helped us build our interconnection and plan for future interconnections, given the institution's up and down capacity.

Note that any other institution that needs to be connected to the CENI network for data exchange or that is interconnected to its system via the CENI network will all be considered remote stations relative to the central teleport. Hence, the connection of all dedicated lines will be managed by a single service managing the various connection lines.

In the case of the General Directorate of Migration, we will implement a hybrid interconnection model to connect and interconnect different control points. Note that, in this case, the CENI is experiencing a high demand for DOWN

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traffic, i.e., from the branches to the headquarters. In the opposite direction, i.e., UP, the demand is not at all high. The 7.3m dish is motorized on azimuth, elevation and polarization, the satellite tracking is done automatically on azimuth and elevation and the fixed value is the most optimal possible.

➢ *Possible Methods of Interconnection*

- *Point to Point*

Point-to-point communication is the most widely used due to its easy installation, the weight of the antenna, and the relatively low civil engineering requirements, which only require visibility of both antennas (the transmitter and the receiver).

This requirement is not really required in the case of point-to-point via satellite.

Point-to-multipoint is the most complex form of this technology and extends the interconnected network to a mesh format that can reach MAN and even WAN dimensions.

- *By VSAT*

For remote locations where line of sight is compromised after the site survey, we will establish remote VSAT stations at all relevant points. The VSAT antennas will be oriented either towards the usual satellite or towards another satellite, as up to five (5) satellites can be managed.

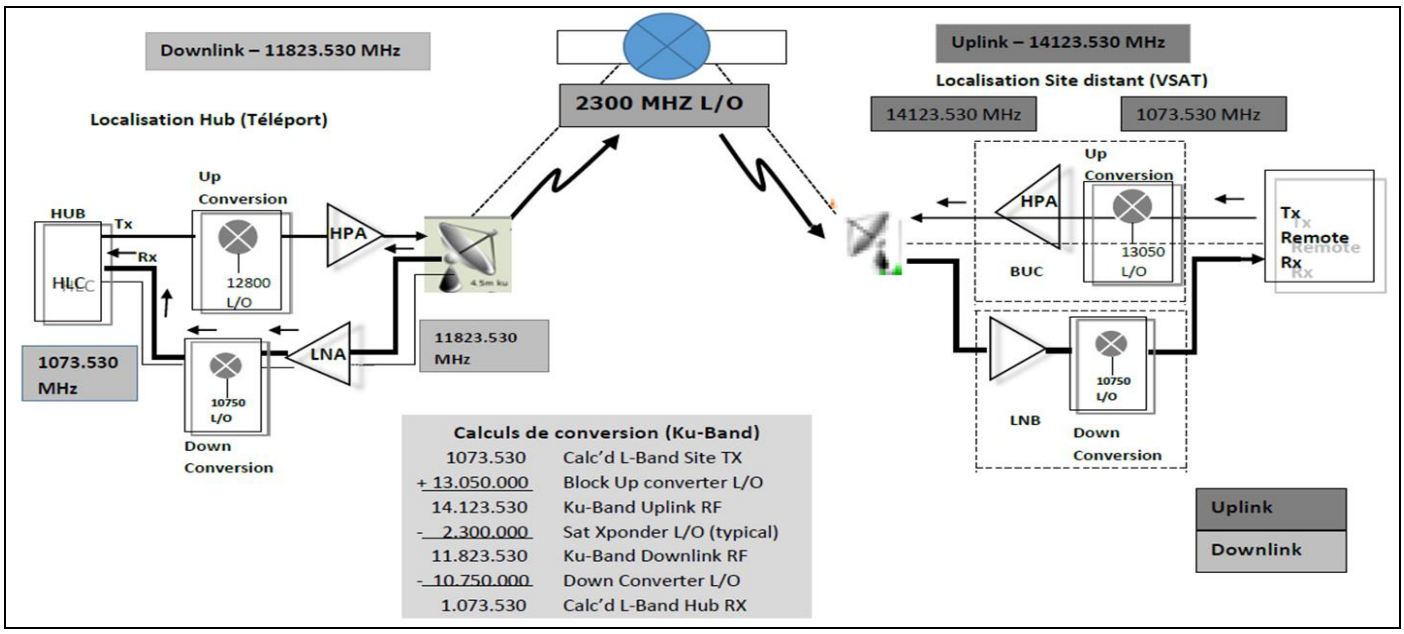

Fig 7 Diagram of the Establishment of a Satellite Link between the Teleport and its Remote Site

➢ *Architecture DU Modele D' Interconnexion DE LA CENI et La DGM*

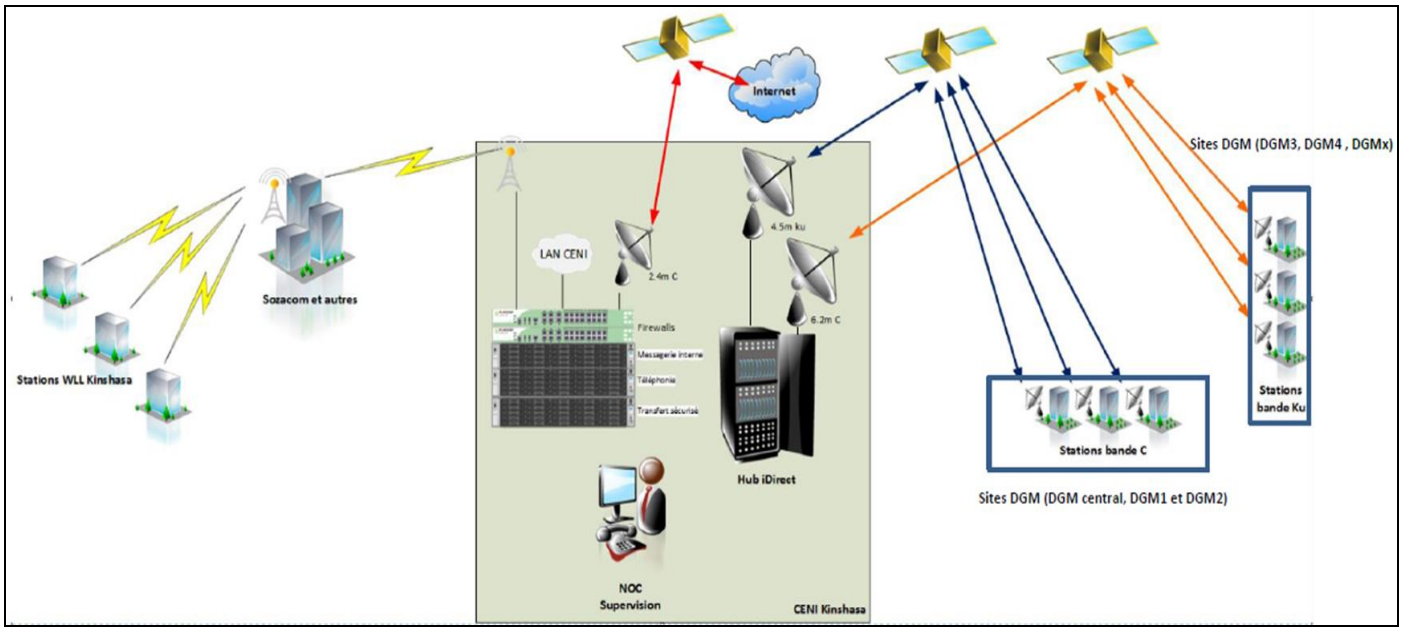

Fig 8 Architecture of the Interconnection Model between CENI and DGM

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun660

The diagrams above, marked in Figure 8, explain the topology of our large mixed interconnection network that will be deployed between the DGM and the CENI for all the functionalities mentioned in the previous articles.

The CENI, colored gray, includes all the primary equipment that will ensure the connection with all the other remote sites simulated at DGM control points and also existing traditional CENI sites.

The point-to-point listed on the left of the diagram represents a model of point-to-point connection to urban areas offering direct visibility via major towers in the city.

The tangible example of the direct connection between the Directorate General of Migration and the teleport shows that (1) from the roof of the CENI, an AP is placed that overlooks the roof of the DGM headquarters, which is not so far from each other. The VSAT connections that must be implemented must exist and cannot be multiplied except in extreme cases requiring implementation.

V. CONCLUSION

The interconnection mode to be taken into account is generally difficult to be applicable everywhere given the relief, environment and especially the satellite coverage or worse on each point of the globe except for rare cases. which means that the interconnection mode is determined to be hybrid, either by wimax or other point-to-point technologies for urban environments with easy visibility. vsat interconnection is a technology that makes us more flexible and autonomous. ceni's idirect 5if hub, idx version 3.5.2.0, features internal encryption that cannot be easily cracked.

In addition to encryption protection, ceni's infrastructure at its headquarters uses the f5 firewalls provided to protect by filtering internal traffic flows, and vice versa. among the mandatory prerequisites we must set up a large noc in order to identify and know how to label each control point that we add and be able to recognize it so easily in the common management interface of the ceni and the dgm for our case, but also with many other services and or institutions that will require interconnection via the ceni telecom hub. we are working only on the basis of voters registered by the ceni. after the census, which will take place in the near future, we hopefully will have the entire population basis with the possibility of subdivided it into different small bases. our system will have to control and question everyone who appears at the point, and the response will be clear and authentic. we are willing to clarify the lanterns with the details to whoever appears with contributions and positive criticism in order to continue to improve interconnection solutions in the telecommunication field.

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