An alternative backbone for the Ecuadorian research and academic network

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***Abstract*—The investigation proposes an alternative backbone for the Ecuadorian academic and research network as a backup to improve service and underpin government cooperation. The study reckons the state of the art of CEDIA and the support of TRANSELECTRIC.**

Keywords— backbone, advanced networks, academic and research networks, IXP, peer research collaboration, high availability

I. Introduction

This work is the investigation's outcome of the current state of the Ecuadorian academy and research network, leading to propose a redundant public backbone to strengthen the network services allowing high availability, efficiency and security. As a result, the academic and research net would be a public good [1] for cooperation [2], rather than a private business only. Thus, this is a technical feasibility study proposing a coexistence of the current academic and research network provided by a private company, with a backup backbone provided by a public company of the Ecuadorian state. The investigation had the technical support of TransElectric and information supplied by CEDIA. The article has three sections: the analysis result of the current situation of the CEDIA network, TransElectric infrastructure, and the alternative backbone proposal.

II. Methodology

The research starts with two assumptions: (i) The Ecuadorian academic and research network does not have a backup backbone; (ii) It is possible to implement the backup backbone through the infrastructure of a public company. The proposed methodology to confirm or deny these assumptions is as follows:

1. Literature review of the creation, purpose and management model of the Ecuadorian academic and research communication network.

2. Interview and on-site visit to CEDIA to confirm its business model and network services to universities and research centres.

3. Visit universities to verify the connection provided by CEDIA.

4. Technical feasibility study of connecting Ecuadorian universities and research centres to TRANSELECTRIC's fibre optic backbone.

5. Design of the interconnection proposal of a main and a backup backbone for the Ecuadorian research and education network.

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III. Interconnection Infrastructure of Advanced Networks for Academic and Research in Ecuador

CEDIA is the Ecuadorian Corporation for Development Research and Academia. CEDIA is formed by Ecuadorian universities and research centres, managing the interconnection of its members for commercial Internet and the advanced network such as the Latin American Cooperation of Advanced Networks (CLARA).

This chapter presents the status up-to-date of CEDIA and the outcome of the analysis carried out in situ in three places (CEDIA, PUCE, EPN) on the interconnection of advanced networks.

A. Non-Commercial Internet

In the early years, the National Science Foundation promoted Internet connection among universities to scientific and technological collaboration. The utter led to access to public information. Universities and governments in some countries needed to create organisations to administer academic and research networks. In this way, in the EU, GÉANT was born, which is the pan-European high-bandwidth research and education backbone that interconnects the National Research and Education Networks (NREN) throughout Europe and offers global connectivity across links with other regional networks.

Since its inception, GÉANT allows European researchers to lead global and international collaboration through its backbone daily. GÉANT provides more than the infrastructure for academic research, establishing itself as a compelling example of European integration and a cornerstone to integrate Latin American universities, among others [3].

In 2002, Latin America, with the primary objective of analysing the immediate interconnection between the pan-European research network, GÉANT, and its national equivalents in Latin America, the alliance between the National Networks of Education and Research (RNEI) of Portugal (FCCN) and Spain (RedIRIS) besides DANTE (GÉANT) was emerged around the completion of a feasibility study called CAESAR (Connecting All European and South (Latin) American Researchers).

Which was funded by the European Commission through the General Directorate for Information Society Technologies (EC DG IST); CAESAR was ready in October 2002. It only took eight months for the vision was being clear: it was needed to create a regional backbone in Latin America and connect it to GÉANT.

Thus, since 2004 the Latin American Advanced Networks Cooperation (RedClara) has provided regional interconnection and connection to the world across its links to GÉANT (advanced pan-European network) and Internet2 (United States) and, through them, to advanced networks in Africa (UbuntuNet Alliance, WACREN, ASREN), Asia (APAN, TEIN, CAREN) and Oceania (AARNET) [4].

In Ecuador, in March 2002, the idea of a National Consortium for the Development of Advanced Internet (the original name for CEDIA) was considered along with the Internet connection. In this way, through CEDIA on June 9, 2003, the country begins to form part of RedCLARA [5].

B. *RedClara*

The CLARA network "Latin American Advanced Networks Cooperation" is the Latin American space for development and collaboration for education, science, and innovation; this is the interconnection of national NRENs.

A National Research and Education Network (NREN) is internet providers dedicated to supporting research and education requests inside a country. The main objective is to provide research centres and higher education institutes with high-quality connectivity by interconnecting each other and the rest of the Internet [6].

"Since 2004, RedCLARA provides regional interconnection and connection to the world over its links to GÉANT (advanced pan-European network) and Internet2 (United States) and, through them, to advanced networks in Africa (UbuntuNet Alliance, WACREN, ASREN), Asia (APAN, TEIN, CAREN) and Oceania (AARNet), among others. Hence, the largest academic community in Latin America formed, connecting academic and research groups to work on multiple projects with international peers [7]. At present, RedClara has 13 member states who meet twice a year to define the lines of action and policies.

National Research and Education networks (NRENs) have supplied national and international connectivity to research and education communities. NRENs have also provided strategic collaboration in e-Learning, e-Science and e-Research, allowing virtual room for coordination, selection and deployment or development of services at the national and regional level [8].

C. *CEDIA*

The Ecuadorian Corporation for Research Development and the Academy, CEDIA, was made up of the top universities, research centres and some institutions in the country. Through CEDIA, its members have a connection to RedCLARA [9]. Originally, CEDIA's objective was to access the Internet at lower prices and connect with RedCLARA as a secondary objective.

Nowadays, CEDIA connects its members through a logical IP / MPLS network to RedClara. CEDIA uses Telconet's dark fibre (several strands within the fibre optic cable) through an IRU (Indefeasible rights of use) contract for 15 years. In that way, CEDIA controls the physical environment (fibre threads that extend along the TelcoNet backbone), applying IP / MPLS transmission technology, which according to current standards and CEDIA analysis, is the most suitable for its requirements [10].

D. *CEDIA's configuration for members*

In a standardised way, CEDIA connects, configures and manages the access and data traffic to both the advanced network and the commercial Internet through a main and a backup configuration, warranting the availability of the service [11]. The connection configuration bases on layered protocols complying with the MP-BGP (LDP), IGP (OSPF), and MPLS.

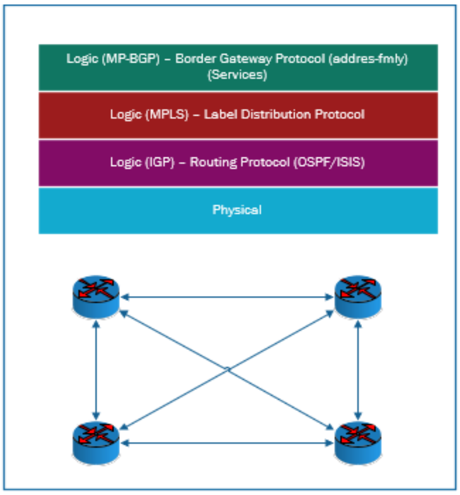

Figure 1 Logical Connection Structure
Source: [11]

CEDIA provides standard equipment for members to provide efficient connection services to commercial Internet and advanced networks. Thus, CEDIA controls and maintains its members' connection and services centrally. The two leading standard equipment are routers Nokia Alcatel-Lucent 7705 sar-x Equipment and Cisco Router Equipment 7604. Both routers use high redundancy VRRP (Virtual Router Redundancy Protocol) protocols that discard the single point of failure inherent in the static default route environment [12]. Figure 2 shows CEDIA's basic configuration to members.

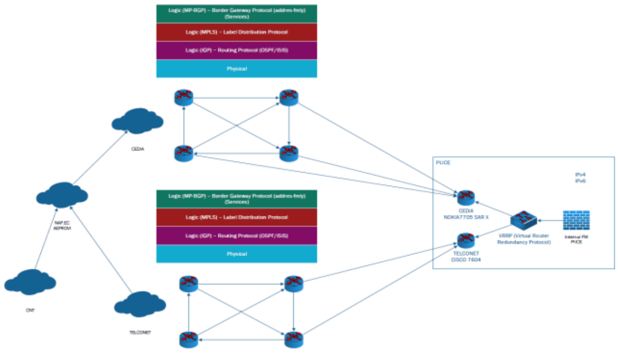

Figure 2 CEDIA-PUCE up-to-date connection structure
Source: [11]

The local visit to PUCE (Pontificia Universidad Católica del Ecuador) and EPN (Escuela Politécnica Nacional) confirms CEDIA's configuration. In addition to the standard configuration, PUCE has a Cisco 7200 VXR brand backup router equipment. Internally, EPN has a backup centre. Both internal organisations do not imply changes in the standard configuration of CEDIA. Externally, PUCE and EPN connections come from the Gosseal node of TelcoNet, during the backup from the Muros node of Telconet. Gosseal and Muros correspond to the name of the streets of Quito, where the MPLS network nodes owned by Telconet are placed [13].

E. *Network risks*

CEDIA does not own a physical data link to connect Ecuadorian universities and research centres, a backbone, but controls the dark fibre of Telconet through an IRU-type contract. The direct connection labelled "CEDIA" goes through the dark fibre of Telconet, and the backup connection labelled "Telconet" goes through Telconet links. Therefore, redundancy, high availability and security, depend exclusively on one provider. Redundancy and high availability are essential to detect and recover from failure as quickly as possible. Nevertheless, CEDIA's network availability is up to 99.97 in the last two years (2019-2020), giving the idea of a robust solution [27].

The alternative is to own infrastructure or rely on another backbone to assure redundancy, high availability, and security for academic and research networks.

IV. State of the Art Analysis

The analysis reckons the suitability of the IRU contract between CEDIA and Telconet and TransElectric backbone.

CEDIA's IRU contract with TelcoNet seems an appropriate option, according to CEDIA. As part of the feasibility study, this paper theoretically analyses the convenience of this kind of contract.

Due to the lack of an advanced network backbone in Ecuador, for security, reliability, and availability, the proposal uses the TransElectric backbone as a physical backup for Ecuador's advanced science and technology network.

A. "Indefeasible Right of Use" - IRU Contract

Also known as the "Right of irrevocable use", it is a contractual agreement, which cannot be undone. The contract is to rent dark fibre of the fibre optic cable owned by a telecommunications provider. IRU contracts are generally long term, between 20 to 30 years, giving the buyer the right to lease some capacity to another person [14]. According to CEDIA, this contract is further convenient for leasing technology since it is a contract based on Opex expenses instead of Capex. Below there is a discussion of both types of contract.

1) CAPEX

It is the abbreviation of CAPital EXpenditure, which refers to expenditures made by companies to acquire physical assets or update those they currently own. It is identified as capital investment and is given by the sum of real estate, machinery and equipment. CAPEX investments are paid at the time of purchase, but they are omitted immediately as cost or expense but amortised over time as depreciation. It involves significant investments in assets; they appear in the company's assets and depreciate throughout the asset's life. There are two forms of CAPEX: (i) Maintenance expenses, used by a company or organisation to extend the useful life of existing assets; (ii) Expansion expenses, those that an organisation incurs to make it grow.

In mobile technologies, the cost of the network core (like cabling, nodes, servers, gateways) is proportional to the number of access points and can be included in the CAPEX factor. The factor is made up of costs associated with an investment in equipment and costs to design and implement the network infrastructure, site acquisition, civil works, power, antenna, and transmission system. The equipment includes base stations (access points, AP), radio controllers (BSC and RNC), and all core network equipment [15].

2) OPEX

OPerational EXpenditures refer to recurring cash movements of the organisation, registered as expenses in the profit and loss. OPEX is made up of the sum of all costs except those related to the acquisition of possessions. They can include employee salaries, subcontracted services, expenses of facilities such as rent, among others [16].

In the case of mobile technology, the OPEX cost [15] includes (i) Customer-driven costs to reach customers, terminal subsidies; (ii) Revenue driven, fabricated of costs to obtain a subscriber to use network services and related costs to generated traffic, service development, marketing personnel, sales promotion and interconnection; (iii) Boosting by the network, they comprise the associated costs with the operation of the network, transmission, site rental, operation and maintenance. The dominant factors are related to customer acquisition, marketing, customer service, and interconnection.

3) CAPEX vs OPEX

Table I shows the advantages and disadvantages of operating with CAPEX-type movements.

TABLE I. CAPEX: Pros and Cons

CAPEX	
ADVANTAGES	**DISADVANTAGES**
It is an investment to the organisation	The value of the acquired property depreciates.
It can generate long-term profitability.	It involves a high expenditure of funds in the short term.
It generates tax breaks for depreciation of assets.	To be profitable should allow payback in the short term.
It provides a margin of predictability in future outlays.	

Table II shows the advantages and disadvantages of operating with OPEX-type movements.

TABLE II. OPEX: Pros and Cons

OPEX	
ADVANTAGES [16]	**DISADVANTAGES [17]**
Suitable for rapidly growing companies and changes in their technology needs, as the commitment to the well is reduced to using time	It can increase the company's operating expenses
It does not imply more financial obligations.	It does not constitute investment
In the TICs area, the speed of innovations makes programs and equipment obsolete in a short time. Spending on OPEX allows access to constant updates and adaptation to new findings.	More significant variability in expenses.
Using OPEX expenses requires less immediate capital for investment, and funds are released for other purposes, taking advantage of new investment opportunities that would occur. It is less exposed to companies' de-capitalisation and implies lower training costs to personnel.	

In conclusion, an IRU-type contract involving OPEX costs, like the one between CEDIA and TelcoNet is more convenient than a CAPEX investment.

B. The alternative of a government backbone

There are two government-owned backbones in Ecuador, one of TransElectric and the other of CNT. The analysis reckons TransElectric backbone due to the cooperation of this public enterprise. TransElectric was born as an Anonymous

Company on January 13, 1990, after the Ecuadorian Institute of Electrification (INECEL).

TransElectric is responsible for transmitting energy throughout the country, using a ring-shaped power grid designated national SNT Transmission System. Executes and builds new projects across the country to expand and strengthen the current infrastructure [18].

1) *TransElectric Infrastructure [19]*

The National Transmission System Infrastructure (SNT) has 6015.91 Km, 66 substations, 5582 Km of ground wire types OPGW and ADSS containing fibre optic with two international Internet connections. SNT technology is SDH (502.04 Gbps) and OTN (6620 Gbps). SCADA systems control SNT operation.

2) *Ground wire*

An OPGW (Open Ground Wire) fibre wire is a type of cable used to construct electric power transmission and distribution lines, combining grounding and communications functions. OPGW contains optical fibres surrounded by layers of aluminium and steel wires. The OPGW cable has two sections: the exterior with steel and aluminium wires for protection, and internally, fibre optic allowing to transmit data at high speeds and over long distances [20].

The optical fibre contained in the OPGW is the physical medium for data transmission; thus, the fibre binds the TransElectric substations with OPGW cable multiplexer equipment. These devices have interfaces that support some network standards, including Ethernet. TransElectric uses equipment with the MPLS protocol (Juniper brand).

Electric transmission lines are air electrical conductors supported electric band towers. For conductor protection,

OPGW cable (1138-2009 IEEE standard) (OPtical Ground Wire) or Optical to Ground Cable is used that has two functions: grounding and data communication. Grounding protects the transmission line from electric shocks such as lightning, external electrical noise, and disturbing sounds [20].

V. The Alternative BackBone Design

Due to the lack of an advanced network backbone in Ecuador, for security, reliability, and availability, the proposal uses the TransElectric backbone as a physical backup for Ecuador's advanced science and technology network. Due to its line of business, TransElectric might not provide the last-mile service to CEDIA members but through CNT (Corporación Nacional de Telecomunicaciones). The proposal is to utilise TransElectric's backbone as a backup for the Ecuadorian academic and research network.

Bearing in mind the fibre that expands through the TransElectric and Telconet networks, the proposal considers an IXP design to manage the connection between both backbones. IXP's location can determine whether CEDIA houses its data centre or in a TransElectric substation or a CNT office. This IXP resolves connections from Transelectric, CNT, TelcoNet, and, if applicable, nearby universities.

A. The architecture

The proposal follows CEDIA's standardised architecture. The physical backbone of operation corresponds almost entirely to the current reality (light blue continuous line). The proposed backbone is TransElectric, which would have last-mile support from CNT towards universities (represented with dotted lines).

Figure 3 shows TelcoNet's dark fibre leased to CEDIA under IRU contract (red line). Something similar may or may not happen between CEDIA and CNT/TransElectric, i.e. leasing the data transit backup service between Ecuadorian universities, RedClara and the commercial Internet, such as leasing dark fibre to control the same services. These possibilities with CNT/TransElectric are green or light blue, dotted line.

B. IXP

The proposal needs an IXP to exchange traffic between both backbones, the commercial Internet and RedClara. The IXP would work physically in CEDIA (whether in the offices in Cuenca or another city) or some hosted CEDIA rack within a provider date centre (TelcoNet, CNT, TransElectric). The requirement to determine this location is that it must be a site where the networks of all three are physically converged: TelcoNet, CNT, and TransElectric.

The technical implementation of IXP is up to a router-switch with iPv4 and iPv6 capabilities like the Cisco ISR 4461 router-switch [22].

C. Technical feasibility

One of the reasons CEDIA chose Telconet is because of its coverage [5]. It is the same reason to choose TransElectric's backbone as a backup for the Ecuadorian academic and research network. The question is if it is feasible to interconnect all current CEDIA members with the TransElectric Network?

Table V (located after "References") presents the result of TransElectric's study on the feasibility of interconnecting each of CEDIA's universities and member institutions to The TransElectric backbone. TransElectric made the study in response to the request made by DPhil Rafael Melgarejo for this investigation. The result is that 87% of university nodes are easy to connect, while 13% are complex.

D. Cost estimation

The cost estimation considers: (i) new equipment for each university (many of them already exist); (ii) peering costs between CNT-Telconet-TransElectric that CEDIA would pay. Interconnection costs from universities to the TransElectric backbone are not considered as they vary and would be accountable by the ISP: CNT. Table III shows the costs.

TABLE III. Physical Equipment Costs [23] [24] [25]

PHYSICAL DEVICES				
#	**EQUIPMENT**	**PRICE**	**CONDITION**	**LOCATION**
1	Nokia Alcatel-Lucent 7705 sar-8	$ 564.20	Refurbished	Every university
1	Router Cisco 7604	$ 3 000.00	New	
1	Rack 19 I600 22U 600 x 800	$ 416.86	New	On the IXP (one)
1	Router Cisco 4461 ISR	$ 15 131.89	New	

The required equipment proposed for IXP (Rack 19 I600 and Cisco 4461 Router) would have a one-time cost. It is necessary to add the costs of placing and leasing the physical premises where the rack would be with the router, which can be around

$1000 per month [26]. Additionally, CNT, Telconet or TransElectric may charge for transporting data to and from the IXP, a total value of $6000 per month (Íbid). The three suppliers are relatively close to each other at a point such as the Prosperina in Guayaquil (where the Telconet data centre is currently located and close to a TransElectric substation). The value of $6000 per month per peering or data transport is relative, like based on traffic. Table IV shows peering costs by traffic volume, taken from [26]. These two ways of calculating costs provide inputs for trading between CEDIA and the three suppliers.

TABLE IV. COSTS PER MBPS OF PEERING TRAFFIC [26]

Assigned peering cost over traffic volume				
		Peering cost		
Mbps exchange	100	$	170.00	per Mbps
	200	$	85.00	per Mbps
	300	$	56.67	per Mbps
	400	$	42.50	per Mbps
	500	$	34.00	per Mbps
	600	$	28.33	per Mbps
	700	$	24.29	per Mbps
	800	$	21.25	per Mbps
	900	$	18.89	per Mbps
	1000	$	17.00	per Mbps

VI. CONCLUSIONS

The Ecuadorian academic and research network does not have a proper backup backbone for its network. CEDIA provides the main and the backup service renting the private infrastructure of the same provider for both.

Technically, it is possible to connect all universities members of CEDIA to the TRANSLECTRIC backbone; thus, the latter might convert into the backup backbone of the Ecuadorian research and academic network. Connection costs can be up to whether to universities, CEDIA or the government.

Collaboration among universities and research centres might improve towards effective collaboration with foreign peers [28], thus increasing the interest of the science and technology community, creating projects from their country of origin with resources from other academic institutions.

The IXP would resolve the exchange of information between backbones: the one of CEDIA with the threads leased by IRU contract to Telconet, and the backup of TransElectric to which the universities will connect directly or through CNT.

CEDIA is currently a private provider. The university rectors conform its directory. So far, CEDIA maintains an efficient commercial and advanced Internet provision service. For this reason, the proposal is not to change CEDIA's business model but to improve the access support currently given by CEDIA to universities with the same physical fibre optics of Telconet. The proposed design is that CEDIA provides direct access with fibre threads that lease Telconet, and the backing is with TransElectric fibre and CNT's last-mile service.

The government as a backup backbone provider through TransElectric infrastructure might increase the collaboration between universities and the government enterprise.

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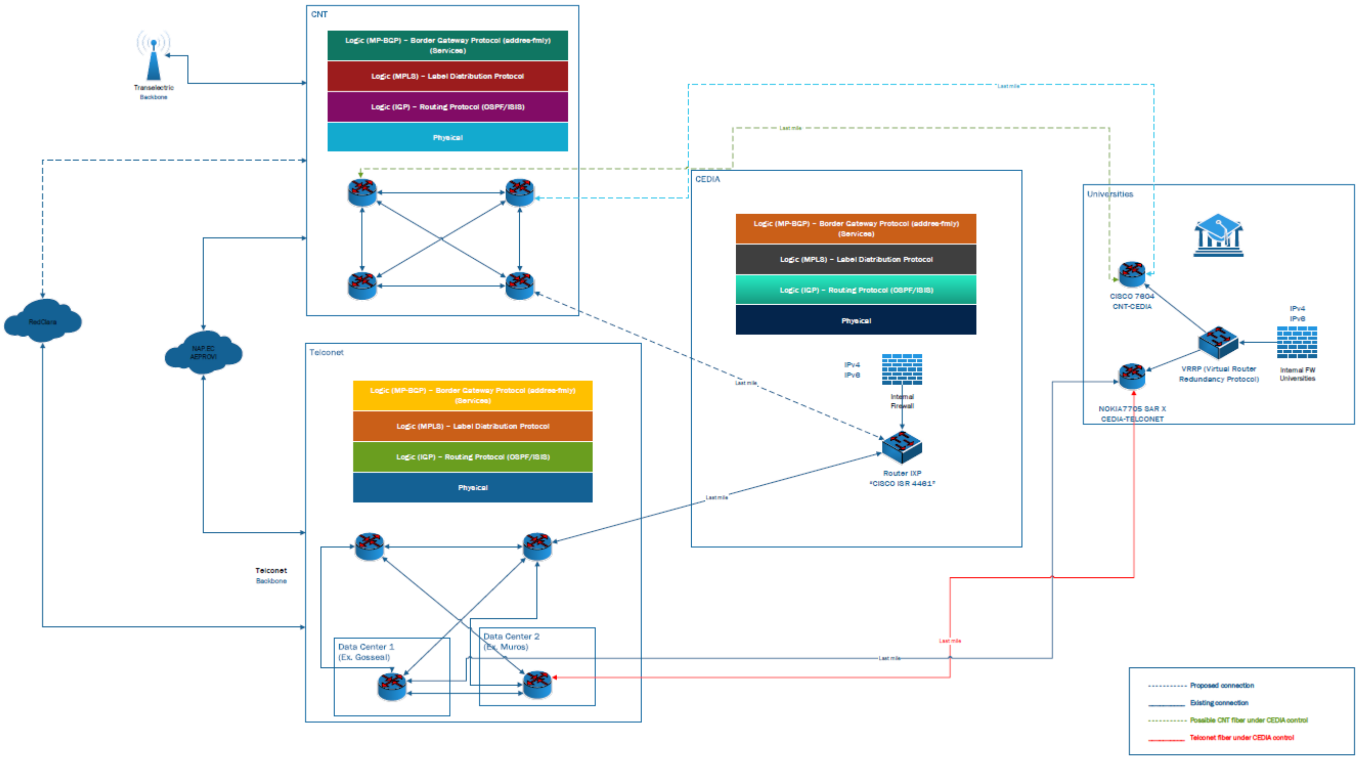

Figure 3 Infrastructure Proposal

TABLE V. TRANSELECTRIC TECHNICAL FEASIBILITY [18]

Feasibility of the backbone with transelectric to june 2019						
#	**University**	**City**	**Node celec Transelectric**	**Distance aprox.(m)**	**Infra Structure**	**Feasibility (1 – viable 2-complex)**
1	Universidad de las artes	Guayaquil	Of. Policentro	4470	Posts and underground	1
2	Universidad estatal amazónica	Puyo	S/e puyo	1610	Posts	1
3	Universidad nacional de educación	Azogues	Of. Hidroazoguez	1000	Posts	1
4	Universidad regional amazónica	Archidona	S/e tena	10800	Posts	1
5	Universidad politécnica estatal del carchi	Carchi	S/e tulcan	4870	Posts	1
6	Escuela superior politécnica de manabí	Calceta	S/e chone	18800	Posts	1
7	Instituto oceanográfico de la armada	Guayaquil	S/e trinitaria	4290	Posts	1
8	Universidad técnica de machala	Machala	S/e machala	1770	Posts	1
9	Universidad técnica estatal de quevedo	Quevedo	Pdp quevedo	3240	Posts	1
10	Universidad yachay tech	Urcuquí	S/e ibarra	19200	Posts	1

11	Universidad nacional de loja	Loja	S/e loja	7600	Posts	2
12	Universidad estatal de bolívar	Guanujo	Pdp cnel bolivar	2500	Posts	1
13	Universidad laica eloy alfaro de manabí	Manta	Pdp manta (escuela de pesca)	1800	Posts	2
14	Universidad nacional de chimborazo	Riobamba	S/e riobamba	1300	Posts	1
15	Universidad estatal de milagro	San francisco de milagro	S/e cnel milagro	1300	Posts	1
16	Escuela politécnica nacional	Quito	Edif. Transelectric	400	Posts	2
17	Universidad de las fuerzas armadas espe	Sangolquí	S/e vicentina	10600	Towers 230kv y posts (e.28 ros-vic)	2
18	Universidad técnica del norte	Ibarra	S/e ibarra	890	Towers 69kv y posts	1
19	Escuela superior politécnica de chimborazo	Riobamba	S/e riobamba	2900	Posts	1
20	Universidad central del ecuador	Quito	Edif. Transelectric	3000	Posts	2
21	Universidad de cuenca	Cuenca	S/e cuenca	3400	Posts	1
22	Escuela superior politécnica del litoral	Guayaquil	S/e salitral	1570	Towers lt pascuales - salitral	1
23	Universidad técnica de ambato	Ambato	S/e ambato	6340	Posts	1
24	Universidad san gregorio de portoviejo	Portoviejo	S/e portoviejo	3200	Posts	1
25	Universidad de israel	Quito	Edif. Transelectric	1100	Posts	1
26	Universidad del pacífico	Quito	Edif. Transelectric	1800	Posts	1
27	Universidad internacional del ecuador	Quito	S/e vicentina	4950	Towers lt sta. Rosa - vicentina, e37	1
28	Universidad autónoma de los andes	Ambato	S/e totoras	750	Posts	1
29	Universidad tecnológica indoamérica	Quito	Edif. Transelectric	3660	Posts	1
30	Universidad técnica particular de loja	Loja	Pdp san cayetano	800	Posts	1
31	Universidad del azuay	Cuenca	Pdp rayoloma	5534	Eercssa: 2550 m en low voltage line(posts) 2530 m online subtransmission (towers)	1
32	Universidad de las américas		Edif. Transelectric	4479	Low voltage line(posts) eeq	1
33	Universidad tecnológica equinoccial	Quito	Edif. Transelectric	2150	Low voltage line(posts) eeq	1

34	Universidad católica santiago de guayaquil	Guayaquil	Of. Policentro	6689	Low voltage line(posts) cnel guayas 1000 channelled	2
35	Universidad san francisco de quito	Quito	S/e vicentina	7520	Posts y l/t pom-vic (e.15)	1
36	Universidad católica de cuenca	Cuenca	Pdp rayoloma	2400	Low voltage line(posts) eercssa, to junction box lt subtransmission	1
37	Universidad politécnica salesiana	Quito	Edif. Transelectric	915	Low voltage line(posts) eeq	1
38	Pontificia universidad católica del ecuador	Quito	Edif. Transelectric	660	Low voltage line(posts) eeq	1
39	Pontificia universidad católica del ecuador sede manabí	Portoviejo	S/e san gregorio	3928	Low voltage line(posts) eeq	1
40	Pontificia universidad católica del ecuador sede ibarra	Ibarra	S/e ibarra	950	Low voltage line(posts) eeq	1
41	Pontificia universidad católica del ecuador sede ambato	Ambato	S/e totoras	2700	Posts	1
42	Pontificia universidad católica del ecuador sede esmeraldas	Esmeraldas	S/e esmeraldas	8300	Posts	2
43	Pontificia universidad católica del ecuador sede santo domingo	Santo domingo	Pdp htv	3700	Posts	1
44	Opusquil s.a.	Guayaquil	S/e caraguay	3000	Posts	1
45	Instituto tecnológico superior sudamericano	Loja	S/e loja	4000	Posts	1
46	Centro educativo integral ceneica s.a.	Guayaquil	Of. Policentro	510	Posts	1
47	Unidad educativa san felipe neri	Riobamba	S/e riobamba	620	Posts and underground	1
48	Unidad educativa particular javier	Guayaquil	S/e salitral	4120	Posts	1
49	Unidad educativa particular borja	Cuenca	Pdd rayoloma	5970	Posts	1
50	Unidad educativa particular bilingüe principito & marcel laniado de wind	Machala	Pdp peñaloza	2400	Posts	1
51	Fundación liceo internacional	Quito	Edif. Transelectric	760	Posts	1
52	Asociación cultural academia cotopaxi	Quito	Edif. Transelectric	2350	Posts	1
53	Tecnológico espíritu santo	Guayaquil	Of. Policentro	2500	Posts	1
54	Instituto tecnológico superior vida nueva	Quito	S/e santa rosa	5380	Posts	1
55	Unidad educativa particular cristo rey	Portoviejo	S/e portoviejo	3200	Posts	1

56	Fundación colegio americano de quito	Quito	Cot	4100	Posts	1
57	Instituto tecnológico superior honorable consejo provincial de pichincha	Quito	Edif. Transelectric	2200	Posts	1
58	Instituto tecnológico cordillera	Quito	Edif. Transelectric	3700	Posts	1
59	Instituto tecnológico superior josé chiriboga grijalva	Ibarra	S/e ibarra	2920	Posts	1
60	Instituto tecnológico bolivariano	Guayaquil	Of. Policentro	4100	Posts and underground	2