Network Infrastructure Design

GAIA Inc.

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1. Introduction

GAIA, LTD is a large retail corporation and has planned to switch the bulk of two kinds of fish product purchases from Peru. GAIA will mainly import frozen shrimp and fish fillets plus scallops and trout from this country. Frozen shrimp and fish fillets are the two predominant fish products imported from Peru to the United States over the past five year. If the agreement is made, Peru will provide GAIA with about 70 percent of its frozen shrimp, 60 percent of its fish fillets, and other kinds of fish product including scallops and trout. Those combined values around $30 million a year. Based on this business, GAIA needs to understand the network infrastructures in Peru and analyze how it can support their daily business communications with suppliers in Peru. The main focusing areas are the availability, proximity, security, reliability and cost. This report will analyze the country Peru in terms of its political, legal and economic environment, regulation and legal environment, and four major internet service providers (ISP) in terms of their size, coverage, and types of service. Then we will make recommendation for GAIA the feasible location and one ISP for its supplier outsourcing business based on the analysis. In addition, we will also give security recommendations based on that.

2. Country Overview

Area (sq km):	1,285,220
Population 2017 (million):	31.8
Households 2017 (million):	8
Capital:	Lima

Language:	Spanish, Quechua
Exchange rate annual average (2017):	USD 1 = PEN 3.26
GDP 2017 (USD billion):	207.1
GDP per capita 2017 (USD thousand):	6.5

2.1 Key Dates in Peru's History

1532-33 - Spanish conquistadors defeat the Incas, whose empire subsequently becomes part of the Viceroyalty of Peru with its capital in Lima.

1780 - Failed Inca revolt against Spanish led by Tupac Amaru II.

1824 - Peru is last colony in South America to gain independence from Spain.

1849-74 - Some 80,000-100,000 Chinese workers arrive in Peru to do menial jobs such as collecting guano.

1866 - Peruvian-Spanish war.

1879-83 - Peru and Bolivia are defeated by Chile during the Pacific War in which Peru loses territory to Chile.

1941 - Brief border war with Ecuador over disputed territory. The two countries clash again in 1981.

1948 - Military government installed following coup.

1963 - Peru returns to civilian rule, but in 1968 military takes over again. Gen Juan Velasco Alvarado introduces populist land reform programme and carries out large-scale nationalisations.

1980 - Return to civilian rule.

1980-2000 - Civil war involving Shining Path, or Sendero Luminoso, guerrillas seeking to overthrow the government. The conflict is estimated to claim 70,000 lives.

2000 - Congress sacks President Alberto Fujimori, who is later jailed for abuse of power and ordering death squad killings.

2011 onwards - Anti-mining protests.

2.2 Political Profile

Peru borders the South Pacific between Chile and Ecuador. Its topography ranges from coastal plains in the west, rugged highland in the central Andes zone, and the lowland jungle of the

Amazon Basin. The country is a constitutional republic with a president and a powerful executive body, the Congreso de la República, members of which are elected for a five-year term.

The most recent presidential elections took place in April 2016 and whilst Keiko Fujimori – the daughter of controversial former President Alberto Fujimori – came out on top in the first round, she fell short of the 50% majority needed to avoid a second round. The run-off saw Ms Fujimori go head-to-head with economist and former PM Pedro Pablo Kuczynski. Mr Kuczynski won the second round by an extremely narrow margin of 50.12% to 49.88%, with less than a quarter of a percentage point separating the two candidates. Mr Kuczynski's presidency proved short-lived, however. After facing impeachment proceedings in December 2017 over allegations that he had taken bribes from construction firm Odebrecht, another scandal in early 2018 prompted a second impeachment process. This second process sparked further controversy when videos emerged showing the president's allies offering bribes to vote down the second impeachment. Mr Kuczynski resigned in March 2018, and was replaced by his VP Martin Vizcarra. Peru's political establishment continued to be rocked by corruption scandals, as more tapes were published revealing under-the-table deals between judges, businessmen and politicians.

2.3 Economic Development

Peru's largely export-based economy has been one of the fastest growing in the region for more than a decade, with a favourable external environment, prudent macroeconomic policies and structural reforms contributing to create high growth and low inflation. GDP expansion slowed from 5.9% and 5.8% in 2012 and 2013, respectively, to 2.4% the following year, as falling prices and lower production of minerals impacting the nation's export revenues. Improvements in the mineral and metal export industry, combined with growth in manufacturing, fishing and service

sectors led to economic growth of 3.3% in 2015 and 4.0% in 2016. Successive corruption scandals through 2017 and 2018 led to a drop in investment, and GDP growth slowed to 2.5% in 2017, although the IMF expects that figure to reach 4.1% in 2018 and 2019.

3. Telecommunication Market Environment

a. Regulatory bodies and Policymakers:

- Supervisory Agency for Private Investment in Telecommunications (Osiptel)
- Ministry of Transport and Communications

b. Regulations for provision of telecom networks and services

Peru's telecommunications markets are regulated by the Supervisory Agency for Private Investment in Telecommunications (Organismo Supervisor de Inversión Privada en Telecomunicaciones, Osiptel), which was created by Legislative Decree 702 in July 1991 and began operations in January 1994. The agency reports directly to the chair of the Council of Ministers and is responsible for ensuring the development of a free and fair telecoms market and guaranteeing the quality and efficiency of services provided to end users. In terms of powers, Osiptel has the authority to issue regulations, investigate and punish infractions, resolve complaints and arbitrate disputes, and monitor the compliance of operators. Policy is dictated by the Ministry of Transport and Communications (Ministerio de Transportes y Comunicaciones, MTC). The ministry also handles the issuing of licenses, and manages scarce resources such as spectrum and numbering.

In April 2015 the MTC published new legislation governing the installation of telecoms infrastructure with the aim of speeding up and streamlining the process. The Law for the Strengthening of Telecommunications Infrastructure Expansion (Ley para el Fortalecimiento de la

Expansión de Infraestructura en Telecomunicaciones No. 29022) sets out a standardised process and requirements for automatic approval to install mobile towers. Among the highlights of the legislation are a simplified procedure for environmental certification and methods of camouflaging infrastructure, with the MTC noting that antennas that are 'in harmony' with their surroundings will have less of a visual impact and be 'more friendly to the urban landscape'.

1. Wireless Legislation
2. Broadband Legislation
3. Wireline Legislation

3.1 Wireless Regulatory Overview

Peru's mobile sector is regulated by telecoms watchdog the Supervisory Agency for Private Investment in Telecommunications. The Ministry of Transport and Communications (Ministerio de Transportes y Comunicaciones, MTC) is responsible for licensing, although the Agency for the Promotion of Private Investment (Agencia de Promoción de la Inversion Privada, ProInversion) manages the sale process where auctions are necessary.

3.1.1 Liberalization

Peru's mobile market was opened to competition in the early 1990s with licences being allocated to BellSouth subsidiary Celular 2000 and state-owned Compañía Peruana de Telefonos (CPT) for mobile services in Lima in 1991. The licences were later expanded nationwide; in the case of CPT, sister company Empresa Nacional de Telecomunicaciones (Entel) was issued a concession for the other regions in 1992 and the two companies were combined in 1994 to form Telefonica del Peru (TdP) – the wireless services were spun out into a separate unit, Telefonica Moviles Perú (TEM Peru) in 2001. Celular 2000, meanwhile, was awarded a licence for the other regions in 1998, following which the company was renamed Comunicaciones Moviles de Peru.

3.1.2 4G Licensing

Having initially planned to auction 4G licenses with spectrum in the 700MHz band, the MTC ultimately changed tack and instead opened a tender for AWS frequencies (1700MHz/2100MHz). Two licenses within the 1710 MHz-1770MHz/2110MHz-2170 MHz range were tendered in July 2013 and Viettel, Claro, Movistar and Americatel were cleared to take part in the sale, with the latter two walking away with the frequencies. Movistar was awarded the 'A' band for USD152.23 million – more than double the reserve price of USD 63.4 million – and Americatel Peru, the Peruvian arm of Chile's Entel, won the 'B' band with a bid of USD 105.51 million.

3.1.3 Consumer Protection

Recent years have seen Osiptel increasingly turn its attention towards improving the rights and powers of consumers. In October 2013 Osiptel introduced new regulations requiring companies to provide at least 30% coverage of the provinces, districts and towns where they claim to operate within twelve months of the implementation of the rules, increasing to 45% and 60% over the subsequent two years.

On 2 January 2015, meanwhile, new rules came into force banning the locking of handsets to a particular network and obliging cellcos to unlock devices for free at the request of their customers. Osiptel has since continued to tweak rules to improve customer protections and in October 2018 introduced new rules that require providers to send out a message to their subscribers.

3.1.4 MVNO Legislation

The Law for Establishing Measures to Strengthen Competition in the Public Mobile Services Market (Ley que Establece Medidas para Fortalecer la Competencia en el Mercado de los Servicios Publicos Moviles, Ley No. 30083) was approved by parliament in September 2013 but did not come into force until late December 2015. The law established the regulatory framework for

providing virtual mobile services, including the rights and obligations of resellers, as well as the licensing process for MVNOs. In May 2018 a senior Osiptel confirmed that the government has no plans to alter MVNO rules, stating that it was not a priority for the regulator. The official added that they did not expect many more MVNOs to emerge due to the high level of competitive pressure in the wireless market.

3.2 Broadband Regulatory Overview

Peru's broadband sector is regulated by telecoms watchdog the Supervisory Agency for Private Investment in Telecommunications (Organismo Supervisor de Inversion Privada en Telecommuniciones, Osiptel). Licences are awarded by the Ministry of Transport and Communications (Ministerio de Transportes y Comunicaciones, MTC), while the Agency for the Promotion of Private Investment (Agencia de Promocion de la Inversion Privada, ProInversion) handles the auctioning of concessions where necessary.

3.2.1 3.5G Licencing

Movistar, Orbitel Peru and Millicom Peru were each awarded a regional concession for 3.4GHz-3.6GHz spectrum in August 2000. The 20-year licences permit the provision of fixed wireless data transmission, internet access and fixed telephony. Americatel Peru was awarded its own 3.5GHz concession in 2001. Meanwhile, Millicom's licence – covering the main coastal cities – was passed to Nextel del Peru (now Entel Peru) in October 2006, when the latter purchased Millicom's Peruvian unit for approximately USD 5 million. Claro purchased a concession for 3.5GHz spectrum in Lima and Callao in October 2005 for USD4.95 million, fending off bids from Nextel and Impsat. In January 2006 the MTC established a 50 MHz spectrum cap on operators using the 3.5GHz band.

3.2.2 National Backbone Network and FITEL

The government has been proactive in encouraging the rollout of broadband services across the country, with a particular emphasis on the numerous rural areas. As such, from 2008 onwards ProInversion held tenders to install, operate and maintain broadband and fixed telephony infrastructure on a region-by-region basis funded by the universal service obligation (USO)-bankrolled Fund for Investment in Telecommunications (Fondo de Inversion en Telecomunicaciones, FITEL).

3.2.3 Consumer Protection (Pricing, transparency and net neutrality)

As part of its efforts to improve consumer protection, in February 2014 Osiptel implemented new measures to alter tariff regulations obliging providers to charge less for individual voice, internet and pay-TV services than multi-play packages. Osiptel approved amended regulations for quality of service (QoS) standards in October 2014. The regulator announced in August 2018 that it was considering overhauling the rules for minimum service provision and, to that end, would be analysing average access speeds compared to the advertised rate.

In December 2016 Osiptel approved net neutrality regulations that came into force in January 2017. The new rules establish principles of freedom of access and equal treatment in the use of networks and transparency to end users. The regulations bar providers from imposing restrictions, additional charges or quality limitations on applications that access the internet and set out acceptable uses of traffic management tools, liming their implementation to the preservation of networks' security and integrity.

3.3 Wireline Regulatory Overview

Peru's fixed line sector is regulated by telecoms watchdog the Supervisory Agency for Private Investment in Telecommunications (Organismo Supervisor de Inversión Privada en Telecomunicaciones, Osiptel). The Ministry of Transport and Communications (Ministerio de Transportes y Comunicaciones, MTC) is responsible for licensing, although the Agency for the Promotion of Private Investment (Agencia de Promocion de la Inversion Privada, ProInversion) typically manages the sale process where tenders are necessary.

3.3.1 Liberalization

On 15 April 2003 Osiptel introduced carrier pre-selection (CPS) on a call-by-call basis, giving each operator a predetermined prefix. In July 2008 the MTC awarded Claro Peru a national 20-year fixed telephony concession.

3.3.2 Price Controls

In July 2007 Osiptel established a new 'productivity factor' to balance Movistar's rates against its economic and financial success. Osiptel sets the factor every three years and uses it to lower Movistar's price ceilings every quarter. Further, tariffs for Movistar's fixed line services must be approved by Osiptel.

3.3.3 FITEL

Peru's universal access fund – the Fund for Investment in Telecommunications (Fond de Inversión en Telecomunicaciones, FITEL) – is financed by a 1% levy on the gross operating revenues of all telecoms companies. FITEL aims to fund rural service expansion through direct subsidization, but has come under fire in recent years for not performing effectively enough. Numerous companies have bid for, and won, contracts to provide a portfolio of telecoms services for regional areas.

3.3.4 WiLL Licencing

In December 2007 Osiptel announced that five operators had prequalified to bid for licenses to operate WiLL networks in the 900 MHz and 450 MHz spectrum ranges. wo companies prequalified to bid for the 900 MHz frequencies – Telefonica's Movistar Peru and America Movil's Claro – with the former securing rights to provide fixed-wireless services in Lima and Callao using the 894 MHz-899 MHz band, and to the rest of the country using the 894 MHz-902MHz/939 MHz-947MHz range. Movistar was announced as the winner in January 2008, having committed to roll out 501,000 lines in the two cities over a three-year period.

4. Internet Service Providers

According to the *State of the Internet* report by Akamai Technologies, Peru has an average network connection speed of 6.2 Mbps comparing to 7.2 Mbps of global average speed and 18.7 Mbps in USA. Peru also has an average peak connection speed of 47.5 Mbps Peru's average connection speed places it at 91 in the global rankings, out of 143 countries.

Internet access in Peru varies greatly depending on locations. Generally speaking, the fastest and most reliable internet connections are in Peru's major cities, and the slowest and least reliable ones are in smaller towns and villages further away from the cities. The capital city Lima has the fastest and most reliable internet connection in Peru.

The number of available internet service providers has increased greatly in the last decade. Where once Movistar and Claro were the dominant two for both telephone and internet services, they now have increasing competition from companies such as Bitel, Entel, Olo and DirecTV. We will mainly focus on the four predominant data and telecom companies:

1. Movistar Peru
2. Claro Peru
3. Bitel (Viettel Peru)
4. Entel Peru

4.1 Movistar Peru

4.1.1 Wireless

Movistar Peru owns 38.4% of the total wireless market and ranks first in the market by June 2018. Specifically, they own 42.3% of the 3G market share and 45.5% or the LTE market share. Currently, Movistar has 16.3 million subscribers, and the number is still growing. Movistar first launched 3G data services in October 2004, and wireless mobile data services were not fully implemented by the cellco until 2009. The system was upgraded with HSPA+ technology from W-CDMA network two years later. Meanwhile, Movistar launched its LTE commercial services in Lima in early January 2014. Later in July 2016, they went on to utilize the new spectrum to launch LTE-A services with peak downlink speeds of 250 Mbps. By June 2018, Movistar's LTE-A service - referred to as '4.5G' by the cellco - was available in 80% of districts in Lima, as well as some urban areas of Pasco, San Martin, Ancash, Ayacucho, Huanuco and Ucayali. Movistar expects to make 5G services available in Peru in 2020. Currently, they hold spectrum of 450, 700, 850, 900, 1700, 1900, and 3500MHz,

4.1.2 Broadband

Movistar has 75.4% of the total market share. They provide DSL access of 10 Mbps to 20 Mbps downstream speed with monthly cost from $18 to $25 and LAN/FTTx access of 30 Mbps to 200 Mbps downstream speed with monthly cost from $31 to $74. Among all the network providers, Movistar is the only one that provides fiber-to-the-home (FTTH) networks. Meanwhile, by the end

of 2018, Movistar plans to deploy FTTH to more than 1,600 districts across 22 cities. They also announced in April 2018 that it was planning investment totaling PEN1.4 billion over the course of the year to improve fixed and mobile networks.

4.1.3 Wireline

By the end of 2017, Movistar has 2.3 million total PSTN lines for local, long-distance, and international network communication, which consists more than 90% of the total PSTN subscribers. The most frequencies that they acquired, like the 450 MHz and 900 MHz bands, were embedded in lines in Lima and Callao.

4.2 Claro Peru

4.2.1 Wireless

Claro owns 31.5% of the total wireless market share, of which they have 29.9% of the 3G market share and 29.2% of the LTE market share. Currently, Claro has 12.8 million subscribers in Peru. By end-October 2018 the cellco's 3G/3.5G network coverage had expanded to an estimated 82% of the population. Whilst the estimated 4G population coverage had expanded to 74%. Claro also launched an LTE-A upgrade in June 2018 with theoretical peak download speeds of 300 Mbps to users in areas of Lima, Arequipa, Cusco, piura, Lambayeque, La Libertad, Ancash, Ica and Huanuco.

4.2.2 Broadband

Claro has 18.1% of the total market share. They provide cable access of 20 Mbps to 200 Mbps downstream speed with monthly cost from $20 to $70 and TD-LTE access of 6 Mbps to 10 Mbps with monthly cost from $23 to $28.

4.2.3 Wireline

By the end of 2017, Claro has 0.5 million VoIP subscribers. In addition, their services are aimed at the residential market instead of business market.

4.3 Bitel (Viettel Peru)

4.3.1 Wireless

Bitel owns 17.5% of the total wireless market share, of which they have 16.4% of the 3G market share and 17.8% of the LTE market share. Currently, Bitel has 5.3 million subscribers in Peru. Bitel has introduced a free messaging app for customers, BChat, which offers free unlimited picture and text messaging to other BChat users. Following the launch of its LTE network in December 2016, but the coverage is not comparable to three other major network providers.

4.4 Entel Peru

4.4.1 Wireless

Entel owns 12.6% of the total wireless market share, of which they have 11.5% of the 3G market share and 7.6% of the LTE market share. Currently, Entel has 7.4 million subscribers in Peru. By June 2016, their 4G network achieved peak downlink speed of more than 240 Mbps in areas of Lima. In January 2018, Entel commercially launched the upgraded LTE-A service, and it helped increase the cellco 4G coverage to all of the country’s major towns, cities and highways by December 2017.

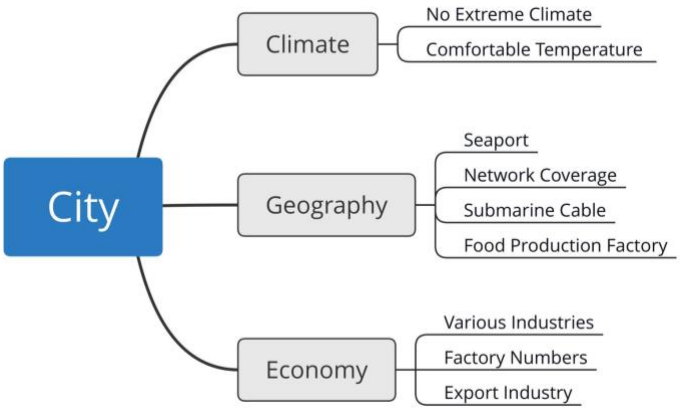
4.4.2 Broadband

Entel has 4.6% of the total market share. They provide FDD-LTE access of 2 Mbps to 8 Mbps downstream speed with monthly cost from $15 to $43. They only provide network services to residential customers.

5. Recommendations: Location, ISP, and SWOT Analysis

5.1 Location

We recommend the city Lima as the best location for supplier outsourcing. Lima is the capital and the largest city of Peru. It is located in the central coastal part of the country, overlooking the Pacific Ocean. Togher with the seaport of Callao, it forms a contiguous urban area known as the Lima Metropolitan Area. With a population of more than 9 million, Lima is the most populous metropolitan area of Peru and the third-largest city in the Americas. Apart from that, there are three main factors when we consider Lima as the best location for supplier outsourcing.

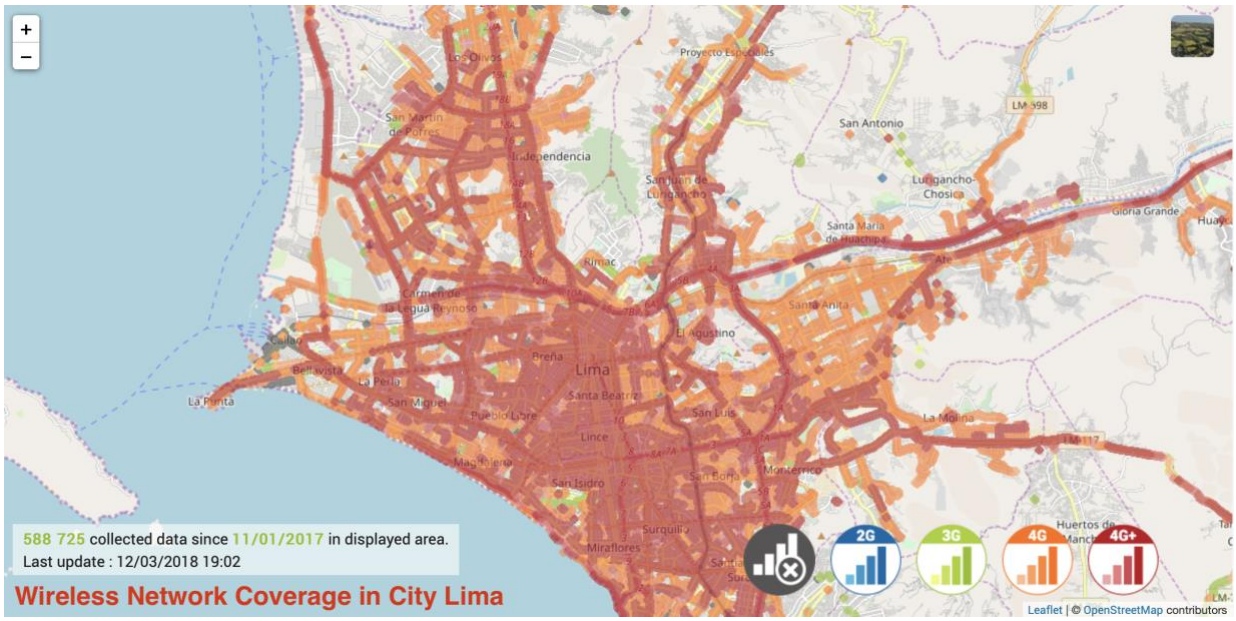


5.1.1 Climate

The climate is a very important factor we've taken into consideration. We don't want any extreme climates to have negative effects on network communications with our suppliers while it happens a lot to seaports. Based on the research, we found out the climate in Lima is fairly moderate

throughout the year. The average temperatures range from 12°C/54°F to 18°C/64°F (low) and 24°C/75°F to 28°C/82°F (high). Therefore, it is a very suitable city to start outsourcing the business.

5.1.2 Geography



As we are running fish product business with local suppliers, we hope the location of the factory is close to the harbor because it can save time and be convenient for packing and shipping. Meanwhile, more importantly, it has to be within the network coverage range of high speed network. Lima, as the capital city, has the most network connection coverage rate among all cities in Peru, as the figure above shows.

The submarine cable South America-1 that connects the United States and Peru reaches Lurin, the very district contiguous to the Lima District. Meanwhile, the factory Inversiones Perú Pacífico S.A in Callao, the city also adjoins Lima, is a major seafood production and export factory in the country. Lima's proximity to the port of Callao allows Callao to act as the metropolitan area's major port and one of Latin America's largest. Callao hosts nearly all maritime transport for

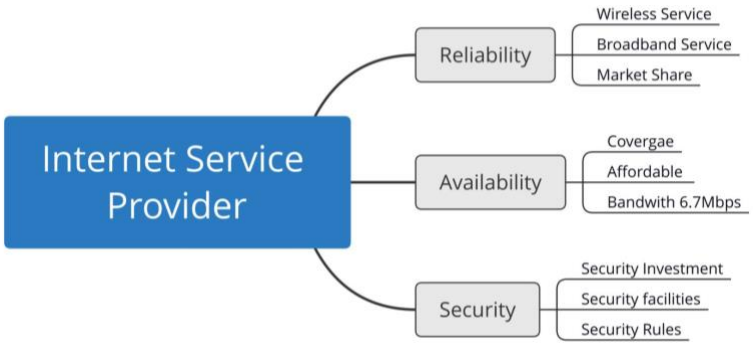
the metropolitan area. This also gives Lima a clear advantage to be the favorable location for the business.

5.1.3 Economy

Lima is the country's industrial and financial center and one of Latin America's most important financial centers, home to many national companies. It accounts for more than two thirds of Peru's industrial production and most its tertiary sector. The Metropolitan area, with around 7,000 factories is the main location of industry. Fish and oil derivatives are manufactured and processed. Much of the industrial activity takes places in the west of the city, extending to the airport in Callao. Lima has the largest export industry in South America and is a regional center for the cargo industry. Therefore, it gives Lima the edges to run this business with GAIA.

5.2 Internet Service Provider

Since we recommend Lima as the best location for outsourcing the business. It wouldn't be a problem to choose a wireless carrier. As we talked about the four predominant internet service providers, each one of them has almost full network coverage in the Lima District. No matter GAIA sends their staffs there to run the office or communicating with the local supplier, it would not make much difference in terms of choosing wireless carriers. The point here is to decide which internet service provider fits the best for GAIA's outsourcing business in terms of broadband network. After careful consideration and the research we did, we recommend Movistar as the broadband service provider for GAIA's business, and we will further explain this and will mainly focus on the broadband service of Movistar.



5.2.1 Reliability

Peru's broadband market is dominated by fixed line incumbent Movistar with 75.4% of the market share. Movistar holds two concessions for fixed line services, issued on 16 May 1994 originally with a 20-year tenure but subsequently extended until November 2027. Movistar offers a full suite of telecoms services over DSL, HFC and most recently, fiber-to-the-home (FTTH) networks, and they are the only internet service provider that provides the FTTH service for now. Over the past decade Movistar has gradually rolled out inter and intra-city fiber infrastructure, in support of both

its fixed and mobile internet services. When we go back to GAIA's business, we definitely need high speed fiber optical network to handle the supply chain management system and daily transmission for email and transaction records. The following table is the current service live for Movistar's broadband services.

Provider	Access	Technology	Launch	Network Details
Movistar Peru	Cable	HFC	1993	Oct-18: 2.3m homes passed (est.); Oct-17: 1.7m homes passed; Oct-15: Lima, Piura, Chiclayo, Trujillo, Arequipa and Cusco
Movistar Peru	DSL	ADSL	2001	Oct-18: major cities in all regions
Movistar Peru	LAN/FTTx	FTTH	2017	Oct-18: 2.5m homes passed (est.), 3.7m scheduled to be passed by end-2018; Oct-17: five cities including Puno, Juliaca and Chincha

5.2.2 Availability

We also want to talk about the cost. The table below shows the different types of services that Movistar has right now. Based on GAIA's requirement, we assume that they have regular email communications that have will create five pictures with 10 MB each at most, and will take one minute at most to travel across. Therefore, the smallest bandwidth based on this requirement would be (5*10*8) / (1*60) = 6.7 Mbps. In this case, the lowest DSL service would meet that requirement. Even if GAIA chooses to go higher end, it's still affordable when it comes to only for daily communications.

Access	Product Name	Downstream	Cap/Limit	Set-up Fee	Monthly Cost	Local Currency
DSL	Movistar Internet	10Mbps	None Stated	None Stated	USD18.37	PEN59.90
DSL	Movistar Internet	20Mbps	None Stated	None Stated	USD24.51	PEN79.90

LAN/LTTx	Movistar Internet	30Mbps	None Stated	None Stated	USD30.64	PEN99.90
LAN/LTTx	Movistar Internet	40Mbps	None Stated	None Stated	USD36.77	PEN119.90
LAN/LTTx	Movistar Internet	60Mbps	None Stated	None Stated	USD49.04	PEN159.90
LAN/LTTx	Movistar Internet	120Mbps	None Stated	None Stated	USD61.31	PEN199.90
LAN/LTTx	Movistar Internet	200Mbps	None Stated	None Stated	USD73.58	PEN239.90

5.2.3 Security

The wireline services are more secure than the wireless ones. In addition, more market share means more investment in network infrastructure, and that brings better security protection on transmitting data. They would pay more focus on how to protect user information, otherwise they could loss subscribers in case any security issues happen. That's how Movistar is. They hold the most market share and provide the fastest and most reliable network connection to their customers. Movistar also have better security facilities than other internet service providers. Meanwhile, they made more security rules on their services. Therefore they have the most secure protection on user data than any other ISP in this country.

5.3 SWOT Analysis for Movistar

Strengths	**Weaknesses**
● Quality signal and fast internet access. ● The only ISP in Peru that provides wireless and commercial broadband services. ● Predominant market share in every service market.	● They see a high attrition rate in the workforce, meaning that they have to spend a lot more on the training of its employees. ● Less spending on research and development when compared to others in the market. ● Weak demand forecasting adds unnecessary costs due to inventory build up.
Opportunities	**Threats**
● Technological developments allow operations to be automated in order to lower costs, employees to interact with clients virtually, and enables better data to be collected on customers to improve marketing efforts. ● Peru's low inflation rate brings stability to the markets, and as their interest rates remain low compared to past years, it provides Movistar with the opportunity to undergo expansion projects financed through loans.	● Decreasing market share for every market over the past decade. ● Among the threats facing Movistar are competitors with slightly better performance metrics in mobile networks, specifically Entel ● There are high entrant barriers to the particular markets and product segments that Movistar may want to expand into.

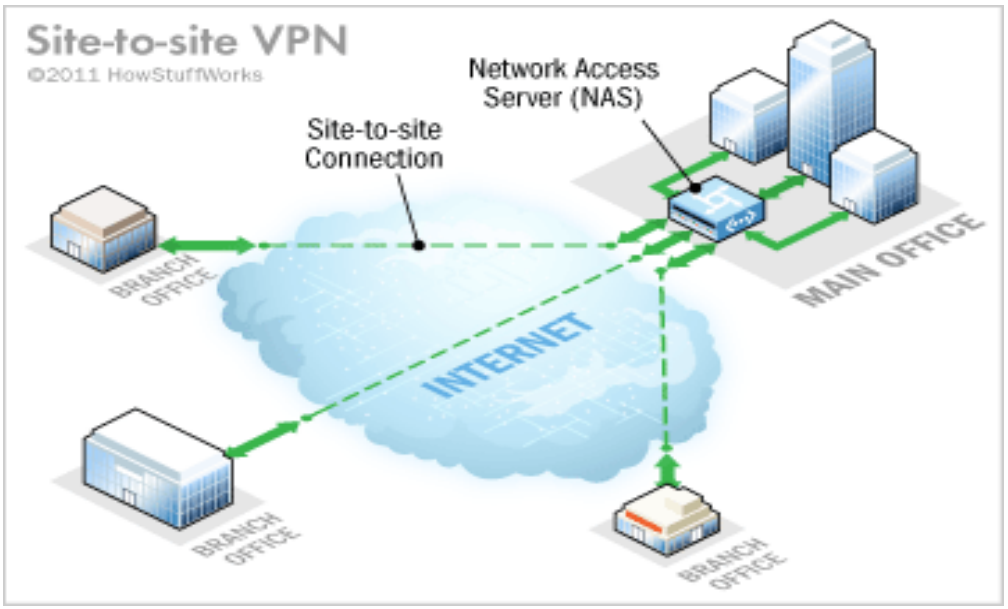
6. Recommendations for Security

At the supplier office in Peru:

- Setup firewalls and antiviruses on systems and keep all computer software patched.
- Password Authentication with endpoint security for the computers
- Access Control (Multi factor Authentication on the application)
- Access Controls using multi-factor authentication
- Setup Wi-Fi in office using SD-WAN and Secure Internet Gateways (SIGs)
- Physical Security measures
- Uninterrupted Power and Internet Supply
- Disaster Recovery Plan
- Training sessions for employees to follow Best Practices

Link between Peru and the United States office:

- Encrypted Virtual Private Network
- Pretty Good Privacy (it's free) for encrypting email and transaction records
- Use of dedicated circuits



To prevent threats from getting in, your business must deploy a strong frontline defense at the edge of the network. Traditional firewalls are no longer sufficient. Hence, we should use next-generation firewalls (NGFWs) that integrate Advanced Malware Protection (AMP), Next-Generation Intrusion Prevention System (NGIPS), Application Visibility Control (AVC), and URL filtering. With these capabilities, NGFWs protect organizations from modern threats.

For the United States headquarters:

- Setup Firewalls and Antiviruses on all systems
- Intrusion detection systems
- Multi factor authentication
- Isolate supply chain site from the main systems
- Backup Data Center
- Disaster Recovery Plan
- Training sessions for employees to follow Best Practices

Any business that uses IT systems linked to a network, faces threats on many fronts and the more users, devices and applications we add, the more vulnerable our business becomes. Protecting the

data for some companies is the most important priority as the data is the biggest asset of the company. When transmitting the data, the communication channel should not be vulnerable to attack. Securing the network is just as important as securing the computers and encrypting the message.

When developing a secure network, the following need to be considered:

- Confidentiality: data confidentiality and privacy; Protection of data from unauthorized disclosure of customers and proprietary data.
- Integrity: both data & systems; Assurance that data / systems have not been altered/destroyed.
- Availability: accessible for intended purpose; Providing continuous operations of hardware and software so that parties involved can be assured or uninterrupted service.

We are talking about a global transmission of data, since the supplier office is in Peru and the supply chain office of GAIA in the U.S. It is important that the network to transmit data, which is VPN (Virtual Private Network) is also protected. A direct link is not feasible due to the cost involved. So, we recommend the use of VPN for the data transmission.

At the supplier office in Peru:

Our main concerns are the threats to business continuity. We are considering how to prevent disruption, destruction of data, and disaster.

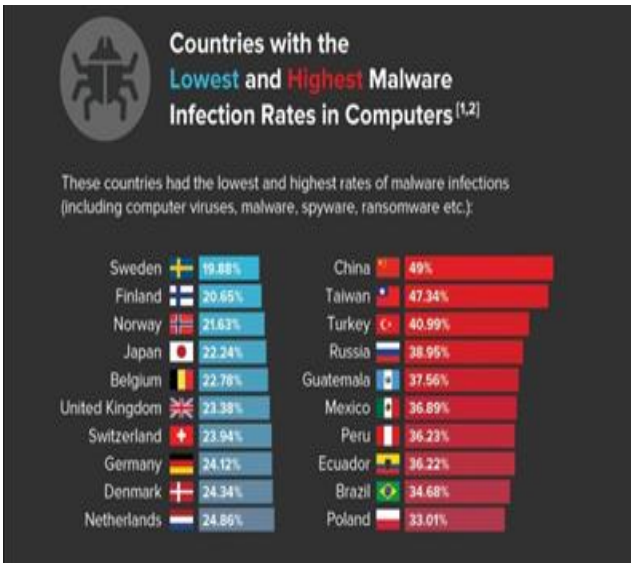
- **Disruption: Loss or reduction in network service**

Almost all developing economies have a common problem that is, there is a dearth of continuous power supply. The network has to have a constant supply of electricity and hence the supplier

office must be equipped with a UPS (Uninterrupted Power Supply) or a Diesel generator which can make up for the shortfall in supply.

- **Protection from Unauthorized Access**

The usage of end-point security in the systems and a multifactor authentication on application will provide a secure environment which will prevent unauthorized usage of client terminals in Peru.



- **Cyber Threat – loss of files or crash of hard disk**

According to a research done by the IT Governance data, Peru has the dubious distinction of being one of the most attacked countries in the world. Considering this, a real emphasis must be put on cyber security and the IT ecosystem must be reinforced with antivirus and Firewalls. An in-house cyber security team would seem like a sound investment. Building a cloud based infrastructure is another way to tackle this program as the infrastructure providers would provide additional protection against cyber threats.

- **Disaster: Natural or manmade disasters**

Peru is prone to earthquakes and tsunamis and since much of the country is at sea level, the country is prone to flooding. The country often experiences as many as 200 small quakes each year, with

one major quake occurring every five to six years on average. A solution would be to build the supplier office in the northern region which is relatively more stable, and flooding is minimal. Another way is to build the office with elevated earthquake resistant platforms, so the tremors and flood water don't affect the infrastructure. If in house data centers are going to be used, then it would be preferable to have a secondary data center off site.

- **Link Between Peru and the US Office:**

VPN Link Protection: VPN (Virtual Private Network) is generally a safe way of transmission of data as it uses discrete routes and encrypts all data which makes it hard for hackers to intrude. Hackers generally steal keys which acts like passwords during transmission as breaking into VPN itself is very hard. Using VPN which are based on OpenVPN and SHA -2 protocols offers highly secure protection compared to other protocols.

At the United States Headquarters:

This location includes the Supply chain department and rest of the corporate system. Hence, our main concerns are about the threat of unauthorized access and cyber-attacks.

- **Intrusion: Protection from Unauthorized Access**

The usage of endpoint security in the systems and a multifactor authentication on application will provide a secure environment which will prevent unauthorized usage of terminals in the supply chain office. Training should be imparted to employees regarding the best security practices by a monthly newsletter or a Bi yearly test.

- **Cyber Threat – Loss of files**

According to the Cyberthreat Real Time Map provided by Kaspersky (2018-12-04 16:30 EST), the U.S. is the fifth most attacked country in the world. We recommend the use of Antivirus on all terminals and running regular scans for viruses on all systems by the IT securities team.

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