Guaracabuya
Organo Oficial de la
Sociedad Económica de Amigos del País

Republic of Cuba
Telecommunications
Fundamental Plan

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Summary

The purpose of this study is to evaluate the existing telephone network in Cuba, to recommend an interim plan for the essential communications with the rest of the world (after a transition from the current government), and to provide an order of magnitude analysis for the cost to modernize the current network to meet the short and the long-term demand.

The Republic of Cuba has approximately 610,000 telephone access lines of which 210,000 are in La Habana Metropolitan Area. The telephone switching equipment is a combination of crossbar, step-by-step and only a small digital switch (1,200 access lines) serving the International Airport in La Habana, until ETECSA[1] installed a few more digital switching systems and a fiber ring in La Habana since 1998. The fiber ring is used to supplement the data carrying capabilities of the existing network.

Long distance service is provided by a combination of crossbar switching systems and cord boards. Cuba has access to the International Direct Dial Plan for most countries. Direct distance dial within the island is made possible by a crossbar toll tandem network. The local network consists of a copper and lead feeder and distribution cables whose average age is approximately 25 years.

In La Habana Metropolitan Area some of the cables are placed in conduit or buried underground, but the majority of the cables are pole mounted. These cables require high maintenance due to the age and exposure to elements. Interoffice facilities in the local networks are served by copper based digital carrier systems conforming to the CCITT (European) standards (32 channels per system).

The toll network is served by a combination of a microwave backbone and a coaxial carrier system. Assignment and maintenance practices are similar to the techniques employed in the United States prior to the mid 1970's. These methods require at least three times the labor force as the mechanized methods currently used in the United States and require close coordination among various departments. Details of the present communications infrastructure can be found in the "Present Environment". Recent updates based on ETECSA[1] are included in the sections the ETECSA and Cubacel sections that provide a status report of recent improvements and financial results of the current operation.

The primary short-term need in the island is communications to the United States currently being provided by outmoded and limited capacity systems. The additional capacity can be provided by satellite-based systems similar to the systems established in Saudi Arabia during the Gulf War, and more recently in Pakistan during the Enduring Freedom Coalition against terrorism.

These systems can be deployed very quickly (within days) and integrated to the current telephone network, which has sufficient capacity to handle the marginal demand. The high profitability of international long distance service make it attractive for the international long distance carriers to deploy this technology within weeks after the fall of Castro's government.

Demand for these services will be inelastic due the immediate need for communications with the United States. The various long distance carriers via fiber-based cables linking the United States to Cuba will

[1] ETECSA Empresa de Telecomunicacciones de Cuba Sociedad Anonima is a company formed by an Italian company, a conglomerate of international banks, and the Cuban Telecommunications Company. This company, along with Cubacel, have made recent improvements in data wireless, data, and internet services in the island.

eventually provide access to the International Network. Competition on the international long distance arena will ultimately ensure lower costs for the consumer.

The Long Term Plan for the island is to have a privately owned telephone network similar to networks being established in most of the Latin American countries. The franchise will be awarded based on a bidding process to be established by the new Cuban Government.

This franchise should cover all services within the island including domestic long distance, wireless services, and Internet access. This company should be a regulated monopoly to provide safeguards for the consumer. Various competing carriers, to optimize the benefits of competition, should provide International Long Distance Service, and the actual Internet service. Eventually the telecommunications server could also provide cable TV access. Most telecommunications companies in the United States are converting to provide all services.

This document provides a macro analysis of the potential demand on the island, provides the basis for determining the value of the current network, and detailed description of the current telephone network including recent modernization steps. The following information can be inferred form the analysis:

1. The value of the existing telephone network
2. The capital requirements for modernization
3. Capital deployment strategies
4. The average cost per access line required for providing telephone service
5. Profitability data for each sub-market.

Table 1 depicts the results of the macro analysis. The method used on the analysis described in detail on Section 3 of the document consisted on developing an expected market price (or average revenue per line) for the product based on profitability requirements for telephone companies investing in foreign markets, and demand parameters being experienced in countries similar to what can be expected in Cuba.

The implementation costs as well as maintenance costs were based on macro study models used by telephone companies in the United States. The demand was estimated based on population distribution on the island and the expected telephone service penetration. The cost includes Internet access, as well as other data services. Both of these factors will increase the demand for telecommunication services.

The average revenue per line ($427 per year is approximately 55% of the average revenue in the United States) combined with the existing demand (609,000 access lines) was used to determine the current value of the existing equipment. The estimated capital requirements for implementation of the network are $2.5 billion, which will be required over the next 10 years. The current value of the equipment is estimated at $210 million.

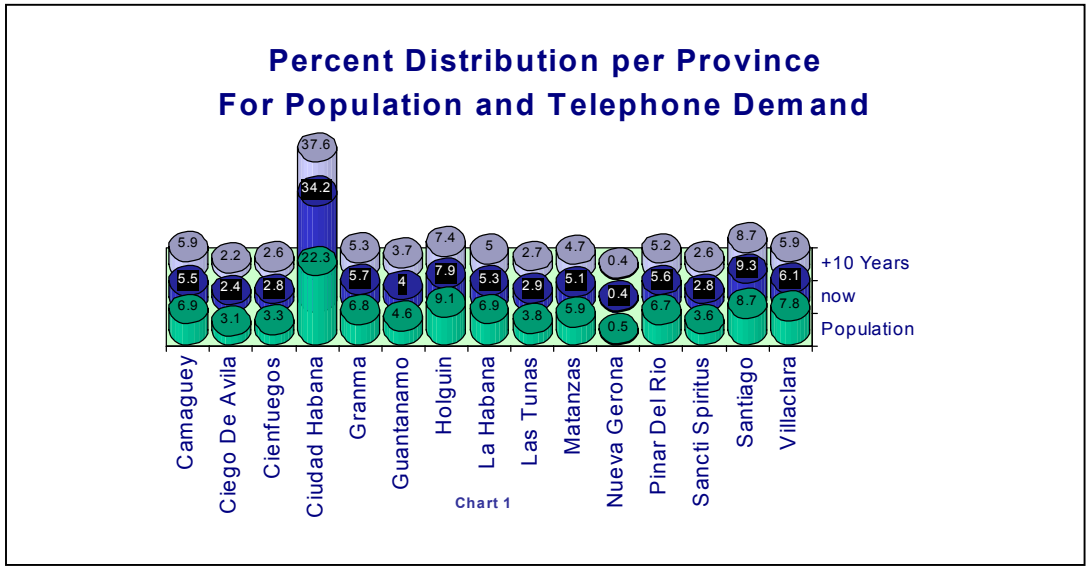
One possible strategy to be followed by the serving telephone company could be to initially modernize the major markets where the density of demand and profitability will be higher and to continue modernization over a 10-year deployment horizon. The current equipment although not capable of proving enhanced services can continue to be used during the transition period. The current population and demand profile is depicted in chart 1. Most of the current equipment in the island can be used as a bridge to newer replacing equipment.

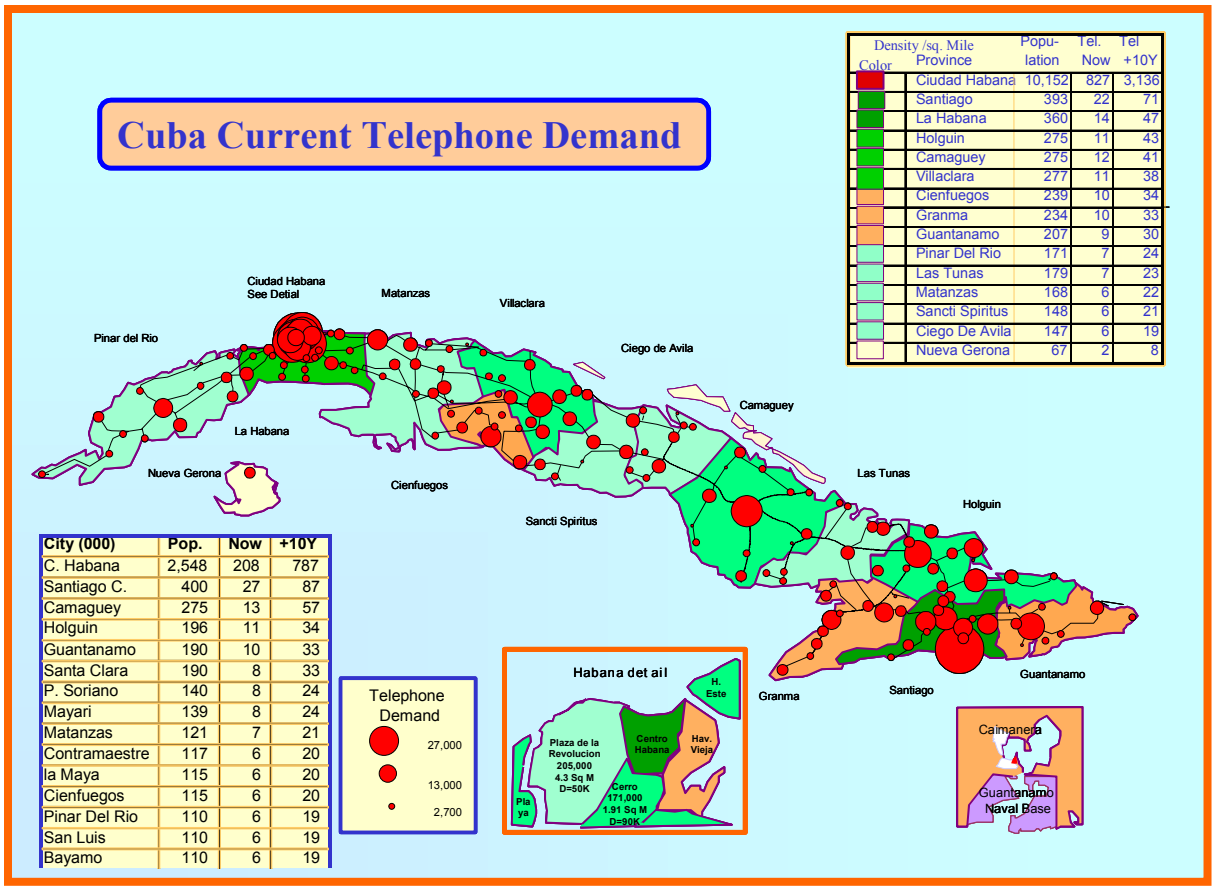
A second strategy could be to provide a parallel Cellular network, replacing some equipment to provide a supply of reused equipment to provide for interoffice facilities to connect both networks, and to serve the marginal demand with wireless services.

SUMMARY OF MAJOR STUDY RESULTS

VALUE OF EXISTING EQUIPMENT	**$210,392,000**
10 YEAR CAPITAL REQUIREMENTS	**$2,456,312,000**
AVERAGE ANNUAL REVENUE REQUIREMENTS PER LINE (Annual Cost per line to Customer)	**$427**
RATE OF RETURN	**20.00%**
CURRENT ACCESS LINE DEMAND	**609,400**
ACCESS LINES PER 100 POPULATION CURRENTLY	**5.3**
ESTIMATED ACCESS LINE DEMAND 10 YEARS AFTER CASTRO	**2,098,800**
ACCESS LINES PER 100 POPULATION AFTER 10 YEARS	**15**

Table 1





Present Environment (up to 1996, before ETCSA)

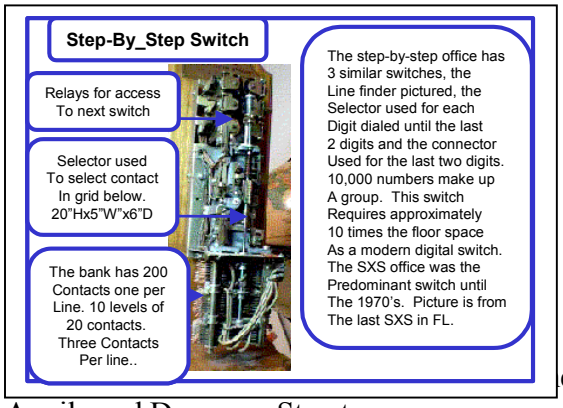
Local Telephone Service

La Habana

The city of La Habana has 17 Central Offices with a capacity of approximately 210,000 access lines. About half of these Central Offices are equipped with Step-by-Step[2] (SXS) and half with Crossbar[3] (XB) switching equipment. Some Central Office locations are:

[2] Step-by-Step Switching Systems are direct dial control switching systems based on the Stroger Switch developed in the very early 1900's. This system was the first automatic dialing system widely deployed worldwide. The last new Step-by-Step office in the United States was placed in service in the mid 1950's. This electromechanical analog system is not capable of handling multi-frequency touch tone signals and cannot provide Enhanced Automatic Number Identification necessary for E911 service.
The Step-by-Step Offices were removed from the U. S. network during the 1970's and early 1980's due to the limitations for providing Touchtone Service, and the lack of capability for providing custom calling features which were marketed to consumers.

[3] Crossbar systems are non-electronic program control systems that use relays for logic storage. Western Electric introduced this system in the United States as the No.5 Crossbar System in the mid 1950's. Other Manufacturers worldwide made crossbar equipment until the early 1980's. The Crossbar Office can provide Touch-tone service, but cannot handle custom calling features requiring electronic stored program control. These systems are not compatible with E911 service and were removed from the United States Network in the late 1980's. Crossbar systems can be used for local exchange offices and toll tandem offices.



Principe	Step by Step, about 40,000 lines (Groups 7, 70,71, 72)
	Vedado
	Step by Step and Crossbar, about 30,000 lines. (Groups 30, 31 32)
Guanabacoa	Step by Step
Monte	Step by Step
Buenavista	Step by Step and Crossbar (Hungarian)
Alamar	Crossbar (ATZ65, German)

e International Communications Complex in the intersection of Aguila and Dragones Streets.

There is a Tanden Office equipped with a Hungarian made Crossbar switch in the Ministry of Communications.

Interoffice facilities are copper for the most part. Japanese or German (GDR) Digital Carrier[5] conforming to CCITT standards PCM with 32 channels/system is used to connect far away locations. A Japanese NEC system is used to provide Interoffice (Trunk) Facilities between Marianao and the International Communications Complex.

Equipment

The crossbar switching equipment is mostly of German (GDR) manufacture, ATZ63, ATZ64 or ATZ65. The Step-By-Step switches are still the pre-Castro American made types manufactured by Western Electric. The Airport complex has the only digital switch[6] serving 1200 lines.

A typical Central Office switch has a capacity of 10,000 access lines in the larger metropolitan areas. Community Dial (Step by Step) offices with low subscriber penetration serve the smaller towns. As an example, an 80-line ATZ63 switch providing 15 public telephone lines and 65 private lines serves the town of Fomento.

Billing

The billing of service to private homes is computerized.

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[4] All Cord-boards (manual attended switching positions) were replaced in the United States during the early 1970's and replaced with Toll Tandem Switching Systems. The Cord-Boards were the foundation of toll telephony until the early 1950's.

[5] The world has two Pulse Code Modulation (PCM) Standards. The American Standard uses T-Carrier at 1.544 Megabits per Second providing 24 channels per System. The European Standard (CCITT) uses 2 Megabits with 32 Channels per System. Digital Carrier Systems were introduced in the early 1960's on copper based trunk facilities in the early 1960's. Digital Carrie systems were originally used for Interoffice facilities. Currently the systems are deployed using fiber based facilities and are used for both Inter-office facilities, and local subscriber facilities.

[6] Digital Switching Systems were introduced in the early 1980's to switch PCM signals in the Toll and Local Networks. These Switches are electronic program control systems with decentralized processors and as considered state of the art switching systems. These Switching Systems have been used to replace electromechanical switching systems, and are currently being used to replace analog electronic systems. By the year 2005 over 95% of the total demand in the United States will be served by Digital Switching Systems according to current plans.

Public Communications

Public communications is provided by pay phones of German and Japanese manufacture. A local call cost 5 cents and long distance calls are sent-paid only. Although directories are available they are not located in each pay phone location. Dialing 113 provides directory assistance. The operators use microfiche with auto- search to locate the requested numbers.

National Long Distance Service

Toll offices, called Centros de Mantenimiento de Telecomunicaciones (CMT), are located in each Municipal entity, "Municipios", according to the political structure of the pre-Castro Cuba. These offices are mostly Number 5 Crossbar of German (GDR) manufacture.

The toll interoffice facilities are either Microwave[7] or Coaxial cable[8]. The military uses mostly the coaxial facility due to its "privacy".

Numbering Plan

There is a Numbering Plan in place that allows Direct Distance Dialing (DDD) to any point in the Nation. Long distance lines are accessed by dialing "5" followed by the city code, the 1 or 2 digit exchange code and the 4 digit station number. A call from Havana to Matanzas would be dialed: 5 + 52 + NN-XXXX.

Microwave Network

The microwave facility network is shown in the figure. The Thompson (French made) equipment has a capacity of 960 channels (16 Supergroups of 60 channels) and it links Havana with the other old province capitals, Pinar del Rio, Villa Clara, Camaguey and Santiago (except Matanzas). The terminal equipment located in Villa Clara, Camaguey and Santiago is the French made LTT. At Pinar del Rio and other secondary points is the German (GDR) made VKM.

Coaxial Cable

This system has a capacity of 1920 channels out of Havana. The facilities terminal equipment is German made VLV or Telemecanica VKD. The repeaters are soviet made and all conform to CCITT standards. The cable runs by the new "Autopista" all the way to Cabaiguan and then follows the old “Carretera Central” to Santiago de Cuba. There are repeaters every 6.3 Kilometers located in huts above ground.

The facility has the following drops: S1 Sancti Spiritus, S2 Cienfuegos, S3 Villa Clara, S4 Villa Clara, S5 Camaguey, S6 Ciego de Avila, S7 Victoria de Las Tunas, S8 Villa Clara, S9 Camaguey, S10

[7] Microwave Systems require line of site between offices. The system is impacted by atmospheric conditions. Repeater locations can be used to extend the range of systems where line of site cannot be obtained.

[8] Coaxial cables are used to host Pulse Code Modulation systems. The system is subject to signal loss due to impedance and inductance. Repeaters are required to regenerate the signal. Coaxial Technology was widely used in the United States until the advent of Fiber based systems. The United States plans to replace all Microwave Systems and Coaxial based systems by the end of the 20th century. Since 1980, the facility Inter office facility of choice has been fiber. Fiber is also being introduced in the feeder network .

Camaguey, S11 Bayamo, S12 Santiago de Cuba, S13 Guantanamo, S14 Holguin, S15 Santiago de Cuba, S16 Cerro Pelado (24 Channels to Jamaica).

The drop in Cerro Pelado links to a microwave system and it is used for the Aerial Corridor communications (AICC). The equipment located at the old province capitals is terminal equipment. At other points, it links with the CW20 microwave facilities.

International Long Distance Service

Satellite

Two systems are in service:

1. IntelSat, an automatic Japanese system with 24 channels.
2. Intel-Sputnik, a Russian manual system with 60 channels.

Coaxial Cable

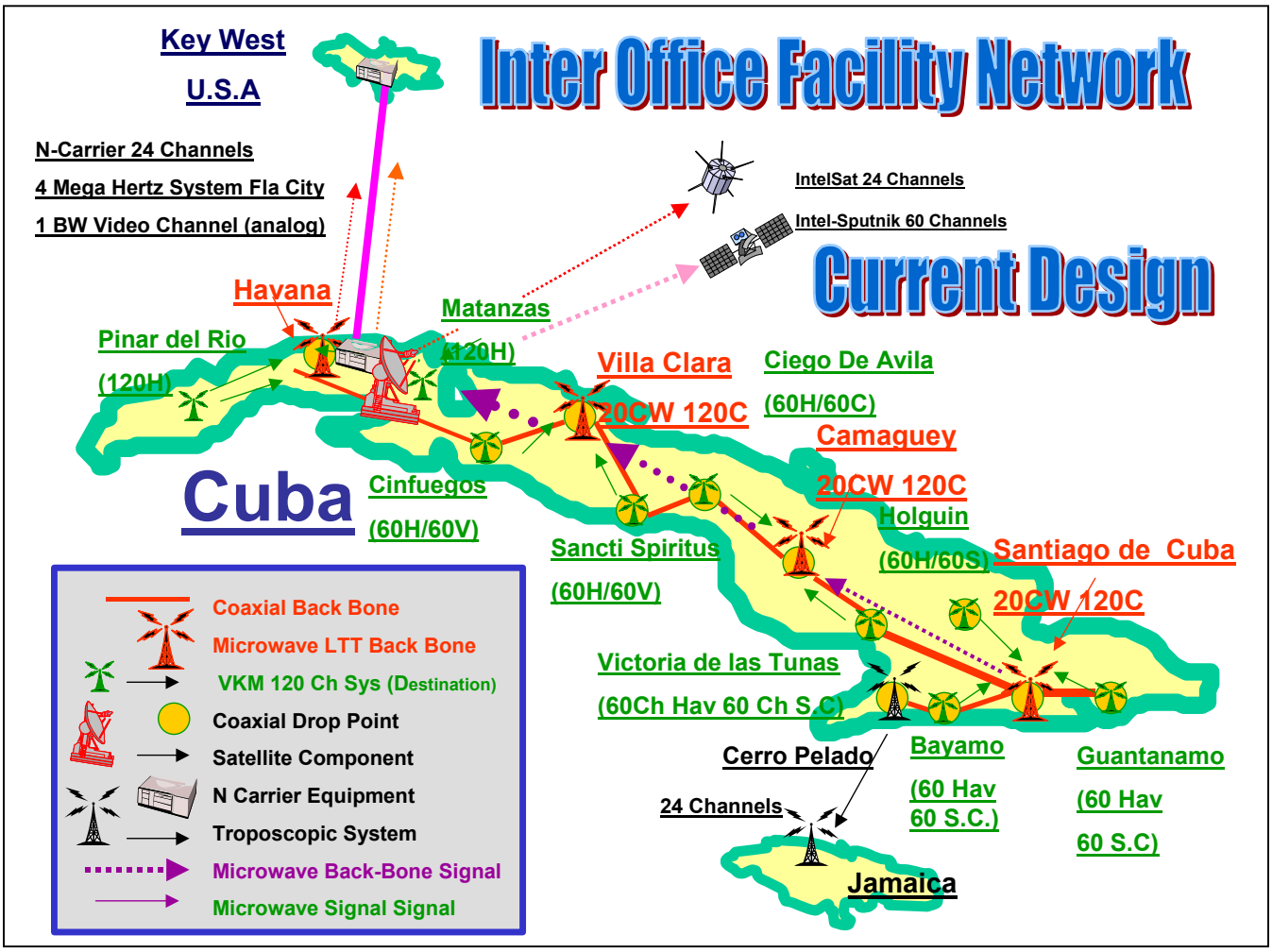
A submarine cable was installed in 1950 between Key West and La Habana using an analog Carrier System[9]. It is composed of two coaxial cables, one for each direction of transmission. It was originally designed to carry 24 voice channels. The terminal equipment for this system is located on the third floor of the former Cuban Telephone Company in Aguila and Dragones Streets. This equipment was damaged by fire several years ago. A new cable was placed by ITT from Key West to Caviar. From Caviar it terminates in the International Communications Complex in Havana with a capacity for 138 channels (PCM). The terminal equipment has not been installed due to the trade embargo with the island.

Microwave

An over the horizon tropo-scattering system was placed in service in September of 1957 for the transmission of one B&W video channel and 36 audio channels of 4 MHz. This system is composed of three radio spans. The first one operates at 3 GHz from Havana to Guanabo. The second operates in the UHF range between Guanabo and Florida City. The third operates at 3 Giga Hertz between Florida City and Miami, with a repeater located in Goulds.

In La Habana, the system terminated in the first floor of the Edificio Masonico, located in Carlos III No. 508. The TD-2 transmitters/receivers reside there along with the L-1 carrier equipment, both of Western Electric manufacture. In Guanabo, in addition to the microwave transmitters, there are two government systems operating at 10 Kilowatts at frequencies of 692 Mhz and 740 MHz, along with two receivers tunned at 840 MHz and 880 Mhz. Both are connected by waveguide to 60 ft. parabolic antennae.

[9] The system uses a 24 channel N-3 type Analog Carrier System. The Terminal equipment in Key West is terminated in the Second Floor of the Southern Bell Local Office and is transmitted over Bellsouth Facilities to The AT&T toll Office in Miami. This is the only N Carrier system in service in the United States. All other systems were replaced by 1977.



Data Communications

Data communications facilities are utilized for government related business only. In addition to government and military information, the government owned sugar industry is also a user.
The data network is composed of three hubs; Havana, Matanzas and Villa Clara. Packet switched data is used to interconnect mainframe computers in these locations. The transmission speed is 9600 bits per second[10].

There are 3 Local Area Networks (LAN) in La Habana, and one in Matanzas and Villa Clara. A token ring architecture is used in these LANs. Modems are used for data transmission through voice grade circuits at 300, 1200 and 9600 bits per second. These circuits are used mostly by the military and Prensa Latina.

We will expand further below on the new data/internet services.

[10] A voice channel is equivalent to 64,000 bits per second. The theoretical maximum transmission rate for data over voice is 56,000 bits per second because 8,000 bits per second are used to provide routing information. The objective in the United States is to transmit data at 56,000 bits per second over the telephone network using a data modem without need of a separate data network.

Maintenance

Most of the problems are in the central offices providing local service. These problems are usually due to a lack of spare parts.

The long distance service is in better shape as parts are more readily available.

Personnel

About 1,500 graduate engineers work in communications in the Ministry of Communications and for ETECSA in La Habana. About 50 of these belong to the Communist Party and hold the more responsible positions.

Recent Upgrades ETECSA (Empresa de Telecomunicaciones de Cuba S. A.)

The Cuban government decided to privatize a portion to of the telecommunications system to provide service based on market pricing. The sections labeled "ETECSA", Cellular Telephony", and "Cubacel" provide additional information. The main improvements of ETECSA include:

- Increment in the number of public telephones
- A fiber ring installed in La Habana
- Two digital electronic switches installed in La Habana
- Installation of a National Data Transmission Network (NDTW). The six main nodes are in La Habana, Pinar del Rio, Santiago de Cuba, Camaguey, Holguin, and Santa Clara.
- Secondary nodes branches to the adjacent provinces.
- The links operate at 35Mb/s[11], and use Alcatel equipment capable of operating at 155Mb/s.
- Provide Internet Infrastructure.

Cellular infrastructure is currently being provided by CUBACELL which started operations in 1993 and currently has a network serving several major population centers including La Habana, Varadero, Santiago de Cuba, Moa, and several other Cities. All of these private companies are owned by Mexican Investors.

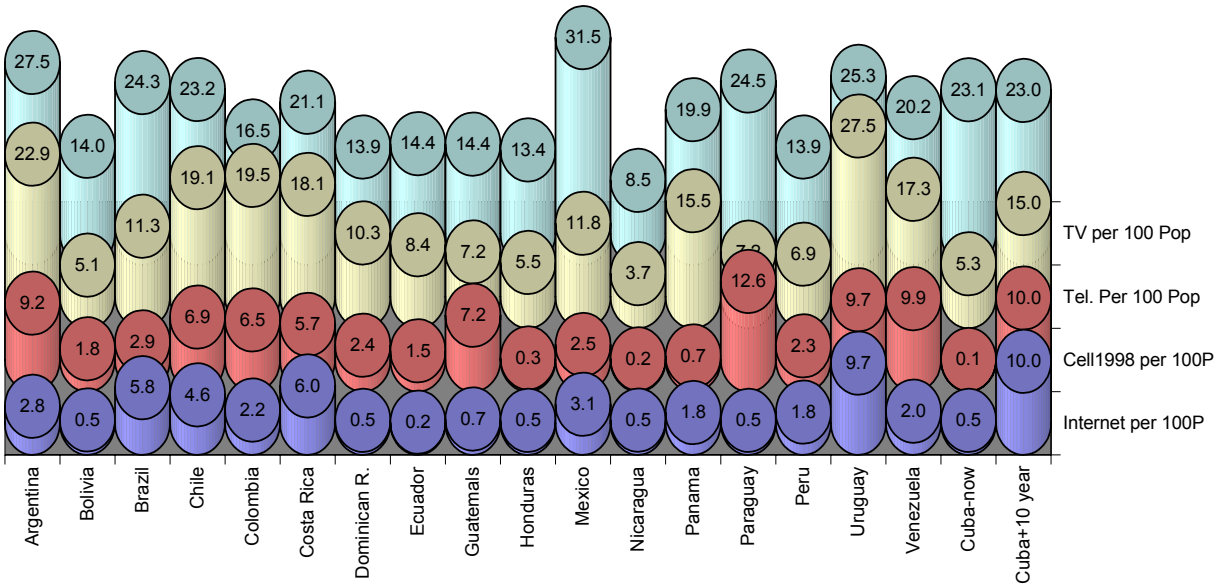
Long Term Plan (Market Analysis)

[11] A voice channel is 64 Kb/second. The 35 Megabit per second system has capacity for 544 voice channels. The US transmission Standard is 45Mb/s known as OC-1(Optical Carrier) 1. Most metropolitan subscriber systems operate based on OC-3 (3 OC1 signal). Long Distance carriers in the United States transmit at OC 96 and in some cases at up to OC-192.

The projected telephone demand in Cuba is based on an analysis of the telephone demand in countries in similar stage of development. The expected post Castro rate of economic development and the logistic constraints of implementing the new telephone network are depicted in the figure below labeled " Access Lines as a % of Population for Various Countries in World".

Based on this information, the demand for Cuba was estimated to be 15% within 10 years. This demand was used to estimate the Average Revenue Requirements per line for telephone service based on a complete replacement of all plant. Plant replacement is necessary in order to gain operational efficiencies to provide for a three-fold increase in market penetration . Specific assumptions and data sources are described in Section 3.2 and the methodology is described in Section 3.1. Study details are described in Section 3.3.

Comparison of Telecommunications Demand in Cuba to Rest of Latin America



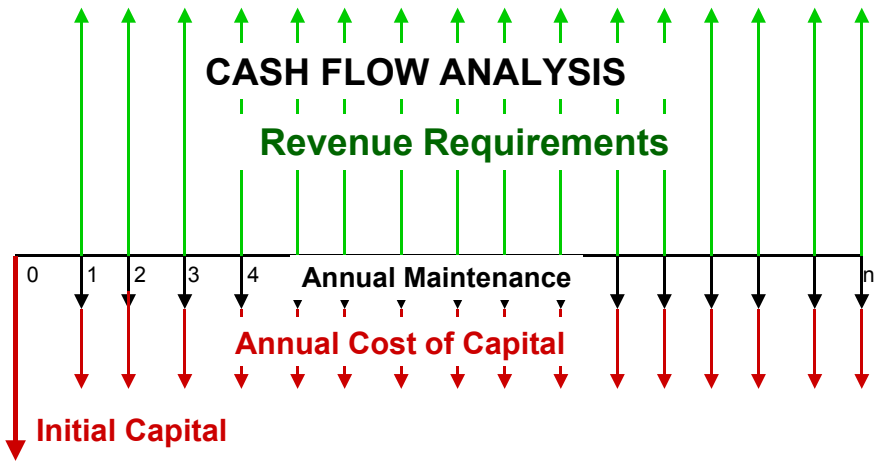
All demand is lines per 100 population, Data for Cell phones is from 1998 , Other data from Year End 2000. Source CIA WorldFact database

Methodology

The method used to infer the market price for an average access line based on market conditions expected by a telephone company wishing to invest in Cuba was based on similar costs being experienced in the United States. The specific algorithms used to derive the "Annual Revenue Requirements" (average cost per line) are shown on Figure 3.1. The specific costs used in the study are consistent with assumptions 1 to 7 listed this section.

In order to determine the capital requirements, population data for each population center were obtained from the census files. The demand profile was generated based on the ratio of telephones to population for various countries with similar demographics. The data was further refined based on population size for each sub-market. Capital replacement costs were based fixed cost- plus variable costs (listed on assumption 3). The Equivalent Uniform Annual Cost derived based on economic parameters described in detail on assumption 4. The Annual Cost of Initial Capital Investment (A) was calculated based on a 20% rate of return as detailed on figure 3.1. Maintenance costs were calculated as described in assumption 2 . The sum of these two figures is labeled "Annual Revenue Requirements New Equipment" and is detailed on the Study Details for population center. The sum of the individual revenue requirements is labeled "Totals", and is included on Table 3.2. The "Annual Revenue Requirements per Line New Equipment" is the previously mentioned figure divided by the telephone demand.

The Annual Revenue Requirements per line for existing equipment were set equal to the cost of new equipment ($427) to derive the Current Value of Equipment listed on Table 3.1. The same derivation described in the previous paragraph was used to infer the value of existing equipment.



The Initial investments is amortized over the equipment life:

$$A = P((1+i)^n/((1+i)^n - 1))$$

Where P is the Initial Investment (Present Amount)

i is the Interest Rate (ROR-Inflation Rate)

n is the number of years (Equipment Life)

A is the Annual Cost of Initial Capital Investment

Maintenance costs are estimated based on the regression formulas described in the assumptions sections.

The Annual Revenue Requirements is equal to the sum of the Annual Maintenance costs and the Equivalent Uniform Annual Costs.

Figure 3.1

Rate of Return on new equipment was based on the perpetual annuity assumption described in detail in the texts listed on assumption 4 and captioned in Figure 3.1 (above).

It should be noted that the average user cost per line is approximately 60% the average cost currently being experienced in the United States. This cost to the user per line is expected to be comparable to costs being charged in comparable countries. Although the costs were derived based on complete equipment replacement, the existing plant can continue to be used to provide service to smaller areas where sufficient return is not obtained on the marginal investment. Although the combined rate of return on investment is 20%, many of the smaller markets provide a rate of return below 20% and the 7 smallest markets are unprofitable.

Assumptions and Data Sources

1. The telephone demand was estimated based on the ratio of telephones to population in various countries with similar demographics. The source for this data was primarily the Statistical Office of the United Nations Statistical Yearbook. The data was obtained for various years. The demand for Cuba assumes that within 10 years the Cuban Economy will have developed to a level comparable to the level that would have been attained if Communism has not existed for the last 43 years. As a result

of the above it is expected that the telephone demand will be 15 percent on the population on the aggregate. The demand was further refined using the following Criteria:

La Habana Metropolitan Area	25%
Regions with population over 250,000	18%
Regions with population between 100,000 and 250,000	14%
Regions with population under 100,000	11%

2. The maintenance costs are based on current costs used in the United States. Although labor costs, which account for the majority of the maintenance costs will be lower in Cuba, it is expected that more employees will be required than in the United States. This assumption is based on the fact that productivity is much higher in the U. S due to the high level of mechanization.

3. As comparison the labor force per 10,000 main stations for the United States is 43, but 100 in Germany and 127 in Australia. In Cuba 1,200 (20 Engineers per 10,000 Main Stations) are performing tasks that would be accomplished by 300 Engineers (5 per 10,000 Main Stations) in the United States. It is evident that although the wages will be much lower, the productivity will also be lower Therefore; it is assumed that both of these impacts will offset. Maintenance cost model, captioned below and in figure 1 was assumed to be:

Description	Fixed Cost	Variable Cost
Switches with less than 10,000 lines	$ 500,000	$200 per line
Switches with over 10,000 Access Lines	$1,000,000	$155 per line

4. Capital Costs for telephone equipment are also assumed to be similar to the cost in the United States. The reason for this assumption is that most telephone equipment is purchased from very few international vendors. Some of those vendors are AT&T (US), Northern Telecom (Canada), Siemens (Germany), CIT Alcatel (France & Spain), Fujitsu (Japan), and NEC (Japan).

5. These vendors set worldwide prices based on volume. The vendors do installation of telephone equipment. The American Market has a slightly higher cost due to the cost for Operational Support Systems required to gain labor efficiencies, but the installation costs will be higher in Cuba due to the need to have the workforce force imported. The Capital Costs model, captioned in figure 1 is depicted below:

Description	Fixed costs	Variable Costs
Switches Less than 10,000 Access Lines	$ 400,000	$1,400 per line
Switches with over 10,000 Access Lines	$1,000,000	$1,000 per line

The capital costs are total costs for the equipment. The typical breakdown of costs follows:

Description	Percent
Central Office Equipment[12]	30%
Outside Plant Feeder	30%
Outside Plant Distribution	10%
Local Inter-Office Facilities	15%
Toll Network (Switch/Facilities)	15%

The typical network is priced based on the components listed above. The Central Office Network assumes Digital Switches similar to DMS-100 (or No. 5 ESS for the large switching systems, and a DMS-10 for the small switching systems.

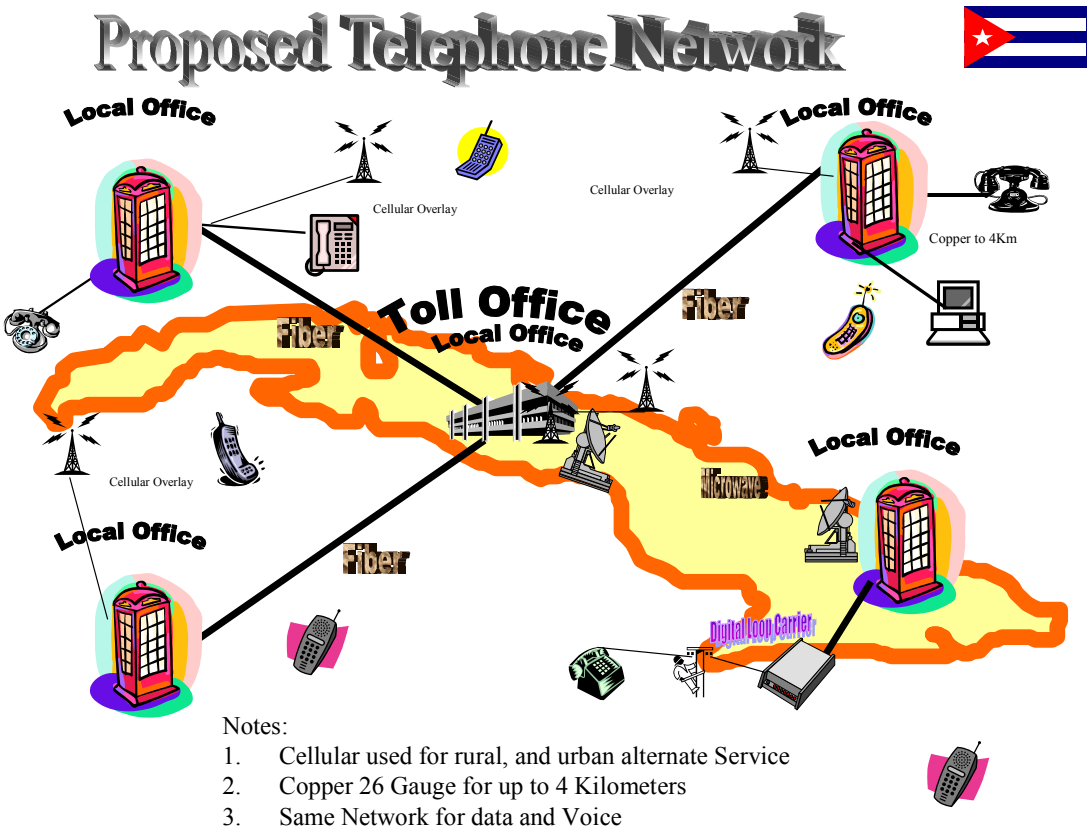
The Outside Plant Feeder Network assumes 26 gauge copper cables up to a distance of 12 kilo-feet (3.8 Kilometers), and Multiplexed single mode fiber cables equipped with digital pair gain systems similar to AT&T Subscriber Loop Carrier SLC 96 for distances greater than 12 kilo-feet.

Rural Areas were priced using a Cellular network. The Cellular Network can also be used to provide Alternate Service in Major Metropolitan Areas such as the city of Havana. It is expected that 70 percent of the demand will occur at distances less than 12 kilo-feet, and that the cable placed in proximity to the Central Office will be placed on conduit. Outside Plant Distribution Network will use 26 gauge copper cables (aerial or buried).

Central Office facilities will use a single mode fiber backbone route utilizing multiplexing equipment similar to the DDM100. The Toll Network assumes a combination of DMS-200 Toll Switches for the major toll points and DMS-100/200 switches for the smaller locations.

A sketch depicting the existing interoffice network is included in the existing situation section, and the typical network assumptions are shown below:

[12] The typical network is composed of the Switch, Outside Plant, Interoffice Facilities, and Toll Network. The Switch can range from Electromechanical analog such as the Step-by-Step or crossbar switch to Digital Electronic its function is to concentrate customer demand to reduce the number to channels and to connect customers. The Outside Plant Network consists of two components the feeder network providing an efficient interface to the switch based on distributed demand parameters. This network can be Copper designed based on transmission standards with thicker copper conductors for longer distances, or fiber using a digital multiplexed signal for transmission. The “distribution” network is a less efficient network connecting the customer to the feeder network. This network is usually provisioned in anticipation of demand with each house connected to the feeder network (the U. S. Standard is 2 pairs per living unit). Interoffice facilities interconnect switches (wire centers) and are sized based on point-to-point demand. The toll network includes both switch equipment and Facilities and are also sized on demand. In some cased local and toll networks can share the same switch or facilities.



6. Item 5 discussed the cost of a wire-line network. A cellular network uses same switching components as the wire-line network but replaces the outside plant "feeder" and "distribution" network with radio transmission systems as discussed in detail in the "Cubacel" section of this report. The cost of providing individual wires to a fixed customer is much higher than cellular costs

   Cumulative costs to serve an average cellular line has been maintained by the Federal Communications commission since the introduction of cellular systems and has been approximately constant with an average cost of $842 per line. This cost has not changed significantly because technological innovations have offset the inflationary effects. The complete analysis is contained in the appendix.

   Cellular costs unlike the wire-line counter parts do not vary significantly as a function of demand density because the cellular tower transmission range can vary from 2 to 20 kilometers based on demand density.

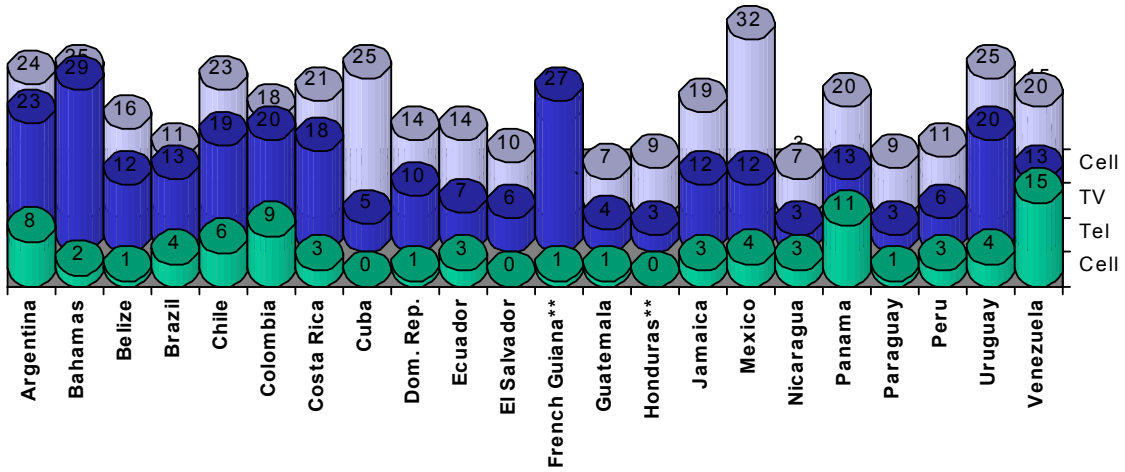
7 The Minimum Attractive Rate of Return was assumed to be 18%this is consistent with foreign investment threshold currently assumed by American Companies. It is further assumed that revenues will increase by 1 percent per year after the switch is replaced. The discount rate used in the discounted cash flow analysis is therefore 17%. This takes into consideration the revenue trend and the cost of capital.

8. The average equipment life used in the economic analysis was assumed to be 25 years for the new equipment and 5 years for the current equipment with a total replacement of equipment in 10 years. This average life results in a capital recovery factor (Annual Cost factor) of 0.173423 for new equipment, and 0.31256 for existing equipment.

9. It is assumed that one company will provide telephone service for the entire country and that the price will be based on market pricing for the aggregate market.

10. The figure below depicts telecommunications demand per 100 access lines for comparable countries additional detail is found in the appendix.

Telecommunication Demand per 100 people for Comparable Countries



11. Population distribution for 169 population centers was based on information gathered by the census files and forms the basis of the Analysis. The annual population growth was assumed to be 1%, based on historical trends

Study Details

The table labeled "Study Details" included in appendix1 summaries the detailed results of the market analysis. The assumptions used for the analysis are included in the methodology section. A summary of the results by province is included in this section

.

To conduct the study each population center was evaluated and the demographics characteristics were evaluate. It should be noted what the Havana Metropolitan Area has 15 population centers (see Ciudad Habana in Summary of Cities and Provinces) and 17 Wire Centers (Telephone Central Offices). Santiago de Cuba also has 2 wire centers within the boundaries. The profitability of telephone equipment is directly related to size and density of the serving market. Locations with a low density of telephones and smaller size are not as profitable as areas with a high density of service. The detailed list contains a ranking of profitability from 1 most profitable to 169, which is not economically viable.

It is essential to award a bid for the entire island so that companies can cover the risk of serving the lower density markets. This concept generally called “universal service” is essential to any utility where the company must serve unprofitable markets in order to serve highly profitable markets.

The Current Line Demand was estimated based on data obtained from interviews of people who worked in telephone industries on the island and form information from sources listed in Section 3.1. The Line Demand in 10 years reflects a 15% aggregate demand in the island distributed based on the parameters described in assumption 1. The 15% of market assumes is for a wire line demand profile, wireless will increment the demand from the 15%. Appendix 3 provides additional detail on the market penetration for wireless services worldwide. The current Cubacel service is also described. This service however, is not targeted to the general population. The current Cuban Cellular network is designed for foreigners who are supplementing the Cuban Government Infrastructure by providing investment capital in the island, or for the high government officials and diplomats.

The economic analysis provides an estimation of the economic value of the existing equipment. This value $210 million (U. S.) recognizes the economic value of the existing franchise. It should be noted that that investing company will be required to have a capital outlay in the range of $2,500 million to fully adequately provide service for the anticipated long term demand of 15%.

If the transition in Cuba is made during the next few years the selected company could possibly reduce the capital outlay for the Island by purchasing used equipment currently available in large supply in the United States due the recent bankruptcy of many small to mid size common carriers.

Equipment from those carriers is currently available at a price much lower than the price of new equipment in some cases as much as 70% lower. The equipment available is state of the art because it was placed during the recent period of phenomenal telecommunications growth, which ended in early 2001.

Details of the other figures included in this study follow.

The Annual Revenues for Existing Equipment Refer to the Sum of Capital and Maintenance Related costs based on the method described in Figure 3.1. All other categories are consistent with the information described in the methodology section. This table was used to determine the Annual Revenue

Requirements (Cost to serve) as well as the Value of Existing Equipment (minimum bid price for the franchise).

Figure 3.3 depicts the Annual Revenue Requirements (Cost to Serve) from a portion of the Total Market. For example, the top 10% of the market can be served at a cost of approximately $350 per line, while the cost to serve the bottom 10 percent of the market is between $550 and $700 per line. The results captioned in this graph point to the need to award a single franchise for the entire country.

If competition were allowed in the telephone industry, the smaller markets would not be served at all, due to the high cost to serve those markets. In the Telephone Industry, traditionally the more profitable markets help subsidize the less profitable areas. Figure 3.2 provides information on Rate of Return for each of the markets depicted on Figure 3.3 if we use a common price for all equipment and services in the country (an average price of $427 per access line, which is 60% of the average price, used in the United States.

The chart labeled Summary of Characteristics by Provinces depicts selected data summarized by provinces. This information can be used to provide detailed information summarized by governmental units.

STUDY DETAILS BY PROVINCES

Province Name	Population (000)	CURRENT LINE DEMAND (000)	ANNUAL MAINT. EXTG EQ ($000)	ANNUAL COST OF CAPITAL EXTG EQ ($000)	ANNUAL REV REQ EXTG EQ ($000)
Camaguey	788.7	33.7	$12,859	$1,529	$14,388
Ciego De Avila	353.2	14.4	$5,485	$652	$6,137
Cienfuegos	373.6	16.8	$6,397	$760	$7,158
Ciudad Habana	2,548.3	207.6	$79,284	$9,425	$88,709
Granma	780.5	34.7	$13,234	$1,573	$14,807
Guantanamo	526.5	24.3	$9,269	$1,102	$10,371
Holguin	1,040.0	48.2	$18,408	$2,188	$20,596
La Habana	794.6	32.3	$12,340	$1,467	$13,807
Las Tunas	439.0	17.9	$6,818	$810	$7,628
Matanzas	674.3	30.8	$11,748	$1,397	$13,144
Pinar Del Rio	689.7	29.5	$11,281	$1,341	$12,622
Sancti Spiritus	489.9	19.9	$7,608	$904	$8,513
Santiago De Cuba	1,050.0	60.1	$22,943	$2,727	$25,670
Villa Clara	890.5	36.9	$14,083	$1,674	$15,757
Nueva Gerona	60.0	2.4	$932	$111	$1,043
Total	**11,498.8**	**609.4**	**$232,689**	**$27,661**	**$260,350**

Province Name	LINE DEMAND IN 10 YEARS (000)	ANNUAL MAINT. NEW EQ ($000)	ANNUAL COST OF CAPITAL NEW EQ ($000)	ANNUAL REV REQ NEW EQ ($000)	VALUE OF CURRENT EQUIPMENT
Camaguey	127.0	$30,242	$27,002	$57,243	$11,958
Ciego De Avila	46.1	$14,138	$11,176	$25,315	$5,928
Cienfuegos	53.8	$14,709	$12,332	$27,041	$6,664
Ciudad Habana	783.7	$138,471	$138,858	$277,329	$60,013
Granma	111.3	$28,625	$25,535	$54,160	$13,430
Guantanamo	78.0	$19,381	$16,584	$35,965	$8,515
Holguin	154.8	$36,558	$32,367	$68,925	$17,360
La Habana	103.8	$30,563	$25,124	$55,687	$13,111
Las Tunas	57.3	$15,809	$13,207	$29,016	$7,049
Matanzas	98.8	$26,880	$22,296	$49,177	$12,168
Pinar Del Rio	94.9	$26,236	$22,151	$48,387	$954
Sancti Spiritus	64.0	$17,139	$14,232	$31,371	$11,740
Santiago De Cuba	192.9	$39,095	$36,302	$75,397	$7,774
Villa Clara	124.6	$30,298	$26,844	$57,142	$19,618
Nueva Gerona	7.8	$2,117	$1,972	$4,089	$14,109

SUMMARY OF CITIES AND PROVINCES

CAMAGUEY
Camaguey
Carlos Manuel De Cespedes
Cubitas
Esmeralda
Florida
Guaimaro
Jimaguayu
Najasa
Niñas
Nuevitas
Santa Cruz del Sur
Sibanicu
Vertientes

CIEGO DE AVILA
Baragua
Bolivia

Chambas

Ciego De Avila
Florencia
Majagua
Moron
Primero de Enero
Venezuela

Cienfuegos
Abreus
Auade de Pasajeros
Cienfuegos
Cruces
Cumanayagua
Lajas
Palmira
Rodas

Ciudad Habana
Arroyo Naranjo
Boyeros
Centro Habana
Cerro
Cotorro
Diez De Octubre
Guanabacoa
Habana Del Este
Habana Vieja
La Lisa
Marianao
Playa
Plaza de la Revolucion
Regla

GRANMA
Bartolome Maso
Bayamo
Buey Arriba
Campechuela
Cauto Cristo
Guisa
Jiguani
Manzanillo
Media Luna
Niquero
Pilon
Rio Cauto
Yara

GUANTANAMO
Baracoa
Caimanera

El Salvador

Guantanamo
Imias
Maisi
Nicento Perez
San Antonio Del Sur
Yeteras

HOLGUIN
Antilla
Baguanos
Banes
Cacocum
Calixto Garcia
Cieto
Frank Pais
Gibara
Holguin
Mayari
Moa
Raael Freyre
Sagua de Tanamo
Urbano Noris

LA HABANA
Alquizar
Artemisa
Batabano
Bejucal
Caimito
Guanajay
Guines
Guira de Melena
Jaruco
Madruga
Mariel
Melena Del Sur
Nueva Paz
Quivacan
San Antonio de los Banos
San Jose de Las Lajas
San Nicolas

Santa Cruz Del Norte

LAS TUNAS
Amancio
Colombia
Jababo
Jesus Menendez

Las Tunas
Majibacoa
Manati
Puerto Padre

MATANZAS
Caliente
Cardenas
Colon
Jaguey Grande
Jovellanos
Limonar
Los Arabos
Marti
Matanzas
Pedro Betancourt
Perico
Playa Larga
Union de Reyes
Varadero

NUEVA GERONA
Nueva Gerona

PINAR DEL RIO
Bahia Honda
Candelaria
Consolacion Del Sur
Guane
La Palma
Los Palcios
Mantua
Niñas De Matahambre
Pinar Del Rio
San Cristobal
San Juan
San Luis
Sandino
Viñales

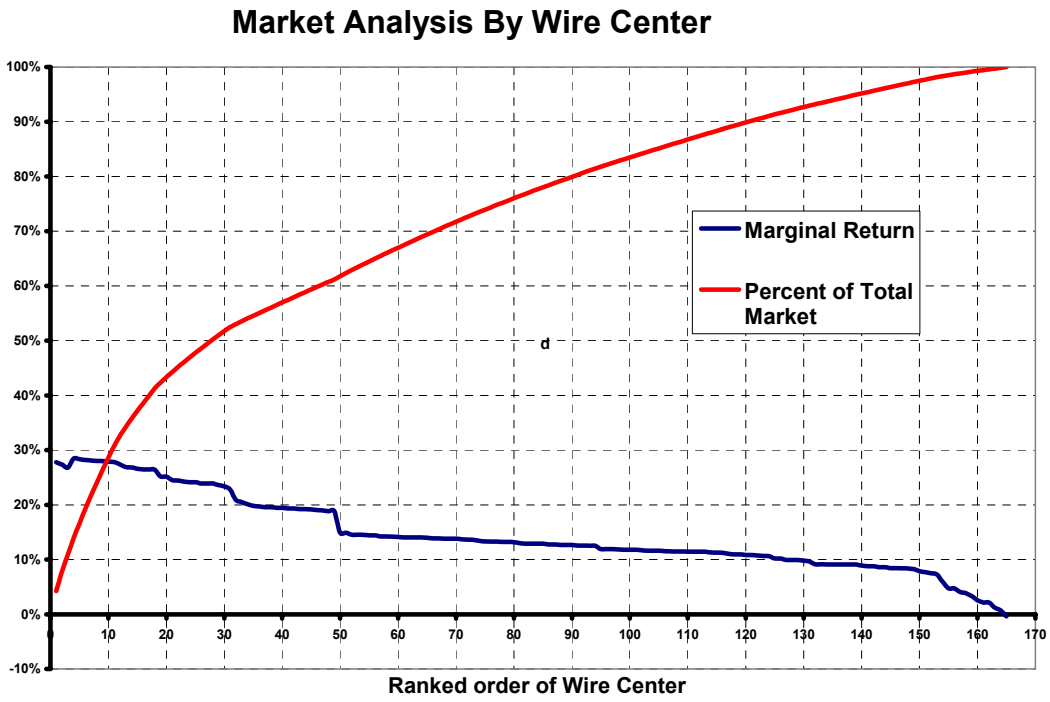
SANCTI SPIRITUS
Cabaiguan

Fomento

La Sierpe
Mella
Sancti Spiritus
Trinidad
Yaguajay
Jatibonico

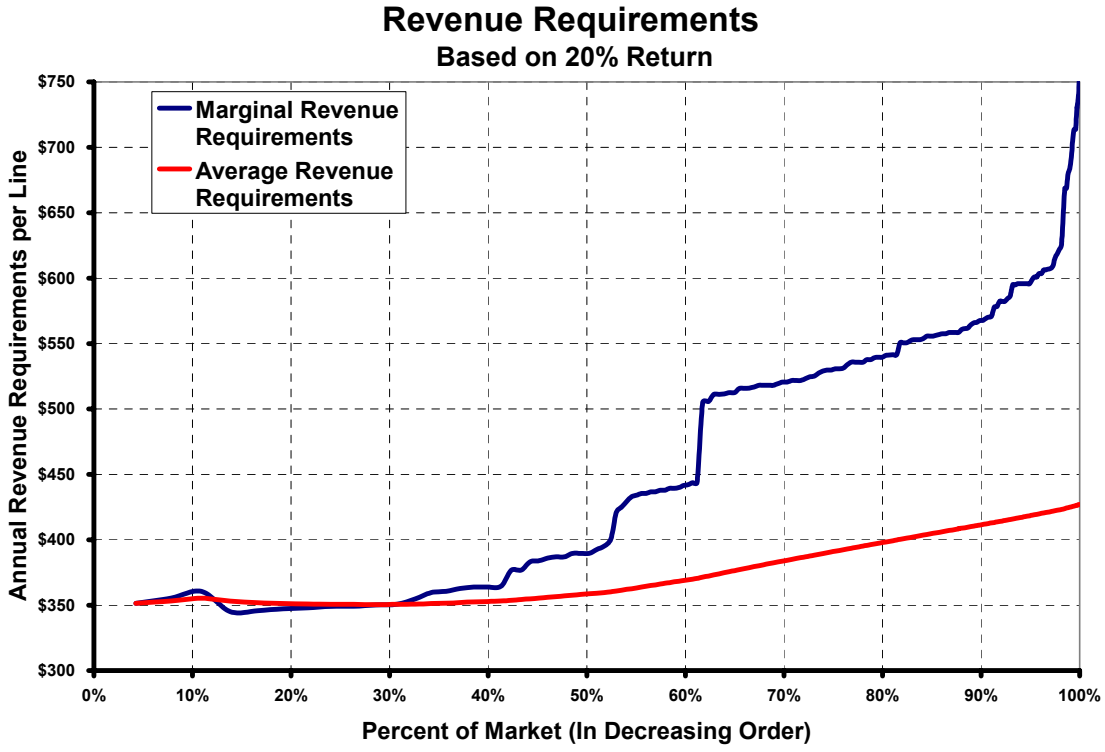
SANTIAGO de CUBA
Contramaestre
Guama
La Maya
Palma Soriano
San Luis
Santiago de Cuba
Segundo Frente
Taguasco
Tercer Frente

VILLA CLARA
Caibarien
Camajuani
Corralillo
Encrucijada
Manicaragua
Placetas
Quemado de Guines
Ranchuelo
Remedios
Sagua la Grande
Santa Clara
Santo Domingo



The figure above depicts the cost required to serve a portion of the market. The market is arranged in order of profitability. The Annual costs assume that the company will earn 20 percent Return on investment.

Figure 3.2



Sensitivity Analysis

The purpose of this section is to evaluate the impact of changes in conditions from the situation described in the study result section. Although the capital and maintenance costs could vary from the predicted range, the most volatile parameter is the demand for telephone service. The study assumed 15 access lines per 100 populations within a ten-year deployment horizon. This section will evaluate the possible impact of different demand parameters. This demand can be further enhanced by a significant wireless market demand that provides higher margins than the traditional wire line business.

The Republic of Cuba currently has 5.3 Access Lines per 100 population, it is highly unlikely that the demand for telephone service within the planning horizon will exceed 20 access lines per 100 population. Therefore, profitability and cost parameters were derived based on the variation of demand between 5.3 and 20 access lines per 100 populations.

The graph labeled "Sensitivity Analysis" depicts the return expected if the price is set based on earning 20 percent for various demand levels (assuming that the demand could vary over the range of 5.3 to 20. Table 3.1 depicts each of the points on the graph.

As an example if the average revenue per access line is $427 (based on 20% return at 15 Access Lines per Population), and the actual demand is 10 Access Lines per 100 Population the actual return would be 16.90% assuming that Maintenance Costs and Capital Deployment Costs are as expected and that sufficient equipment is purchased to meet the demand of 10 access lines per 100 population.

The graph was generated based on computing the internal rate of return (Using Lotus algorithms) for a variable demand profile using the same distribution of demand described in the assumptions. The Total demand for the Island as well as the Total Capital Costs, Maintenance Costs, and Unit Capital and Maintenance Costs are depicted on Table 3.2.

Table 3.2 also depicts various other parameters for variable demand. It should be noted that the unit provisioning costs increase as demand decreases. Therefore, profitability is significantly influenced by demand.

The Revenue Requirements (Cost to Consumer) is significantly impacted by demand. For example if the demand does not increase from 5.3 Access Lines per 100 Population (other than growth due to population growth of 2 percent per year), the market price to the consumer would be approximately 30% higher ($555 vs. $427). The Graph below depicts price variability.

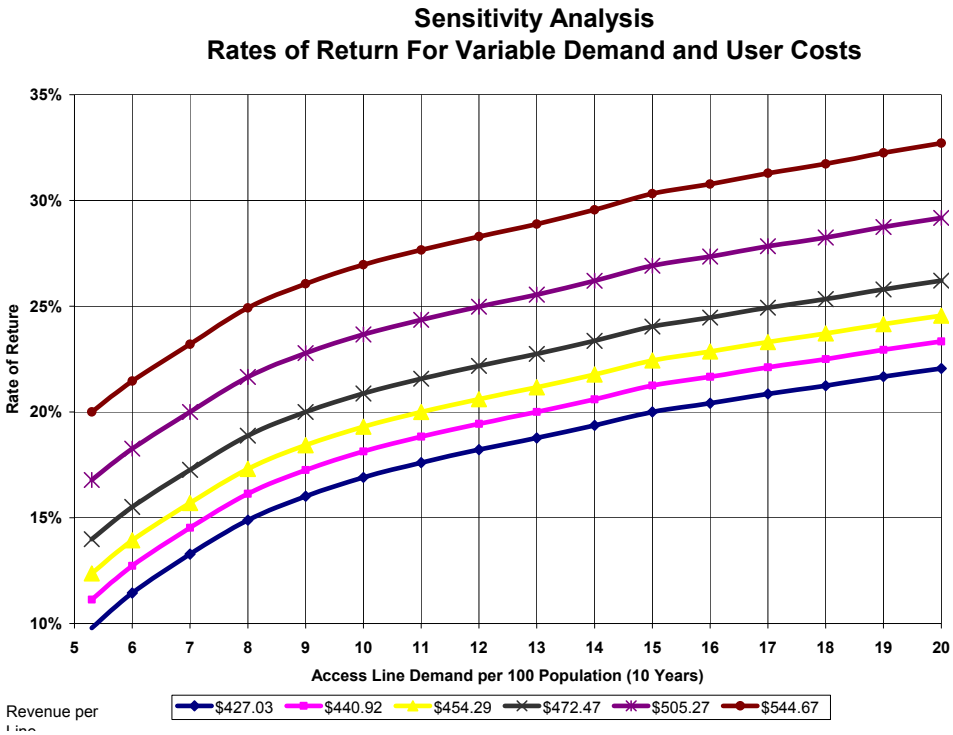


Table 3.1

Sensitivity Analysis
Summary

Access Lines per 100 Pop. in 10 Y.	Market Price Based on 20% Return	Annual Maintenance. Per Line	Average Cost Per new Line	Total Demand in 10 Years (000)
20	$404.96	$210	$1,125	2,798
19	$408.99	$212	$1,135	2,658
18	$413.54	$215	$1,146	2,519
17	$417.69	$218	$1,154	2,379
16	$422.50	$221	$1,164	2,239
15	$427.03	$224	$1,170	2,099
14	$434.14	$228	$1,189	1,959
13	$440.93	$232	$1,203	1,819
12	$447.27	$237	$1,211	1,679
11	$454.29	$243	$1,218	1,539
10	$462.27	$250	$1,224	1,399
9	$472.47	$259	$1,233	1,259

Table 3.2

Sensitivity Analysis
Summary

Access Lines per 100 Pop. In 10 Y.	Total Equipment Cost (000)	Total Annual Maintenance (000)	Total Demand in Costs (000)	Total Growth in Demand 10 Years (000)
20	$3,149,080	$587,112	2,798	2,189
19	$3,017,131	$564,026	2,658	2,049
18	$2,887,215	$540,786	2,519	1,909
17	$2,745,571	$517,375	2,379	1,769
16	$2,606,272	$493,845	2,239	1,629
15	$2,456,314	$470,263	2,099	1,489
14	$2,328,876	$446,537	1,959	1,349
13	$2,188,431	$422,496	1,819	1,210
12	$2,033,373	$398,340	1,679	1,070
11	$1,874,392	$374,126	1,539	930
10	$1,711,956	$349,905	1,399	790
9	$1,552,819	$325,673	1,259	650
8	$1,396,403	$301,365	1,119	510
7	$1,257,711	$276,756	979	370
6	$1,096,183	$251,872	840	230
5.3	$977,605	$234,370	742	132

ETECSA

Introduction

In June, 1993, Cuba decided to privatize telecommunication, and invited proposals for joint venture partners. In June, 1994 the Monterey, Mexico holding company Grupo Domos Internacional (Domos), through their subsidiary CITEL (Corporacion Interamericana de Telecomunicaciones), agreed to purchase a 49% interest in the Cuban phone system for a reported $1.5 billion.

The Empresa de Telecomunicaciones de Cuba, S. A. (ETECSA) was separated from the Ministry of Telecommunications, and established as a private joint venture. However, the Ministry regulates the phone system and set rates, so one can assume there are close ties between them and ETECSA.

Progression

Billed as the first large scale privatization in Cuba since 1959, the agreement was announced during a one-day trip to Cuba by then Mexican President Salinas. In April, 1995, Domos announced completion of the purchase, and the sale of 25% of their interest to STET International Netherlands, N.V., a wholly-owned subsidiary of the Italian State Telecommunication Company for $ 291.2 million. ETECSA was jointly managed with four Cuban Vice Presidents, three Mexican, and one Italian.

Due to the economic crisis in Mexico in 1995, Domos lost its equity. As a result, now STET controls 30% of ETECSA, the Cuban government 49%, and a coalition of banks the remainder.

The main improvements made by ETECSA are:

- Increment in the number of public telephones
- A fiber ring installed in La Habana
- Two digital electronic switches installed in La Habana
- Installation of a National Data Transmission Network (NDTW). The six main nodes are in La Habana, Pinar del Rio, Santiago de Cuba, Camaguey, Holguin, and Santa Clara.
- Secondary nodes branches to the adjacent provinces.
- The limks run at 35Mb/s, and they use Alcatel equipment capable of operating at 155Mb/s
- The NDTW uses X.25, which is old technology but Cuba has X.25 equipment and expertise.

The commercial offices of ETCSA are located at:

Calle 22 entre 3ra. and 5ta.
Miramar, Playa
La Habana

Present Structure

The present organizational structure of ETECSA is as follows:

- Executive Presidency
- First Vice-presidency
- 6 Vice-presidencies
- 19 Management branches

Responsibilities and functions are described below.

Executive Presidency and First Vice-Presidency

Responsible for the whole firm

Technical Vice-Presidency

Responsible of the strategic planning of ETECSA. It is in charge of all technological activities.

Administration and Finance Vice-Presidency

Responsible for all of the economical and the financing activities.

National Operations Vice-Presidency

Responsible for all of the activities of the national network.

International Operations Vice-Presidency

Responsible for all international calls and operations

Commercial and Marketing Vice-Presidency

Relationship of ETECSA with all customers

La Habana Vice-Presidency

La Habana has 15% of Cuba's telephones and 60% of all telephone lines. This Vice-presidency is responsible for all operations in La Habana.

Internet Services

A. Dedicated links

A link for data transmission, line, modem for the customer. Installation cost covers first month subscription. Customer must have a proper router and the license from the Ministry of Information and Communications. Services are under the domain co.cu. If another domain is desired, it must be handled through the government agency in charge, that is, CUBA-NIC.

B. Dedicated links with ratio 1 to 4

In order to have a quality service, customers must not exceed 25% of the normal average daily traffic. The established monthly rate is valid for all dedicated links under the local perimeter closer to the node. The Table below shows the bandwidth, installation cost, and monthly rate.

Bandwidth, Kbps	Installation cost, US$	Monthly rate, US $
19.2	$350	$250
28.8	$450	$350
64	$700	$600
128	$950	$850
256	$1,800	$2000
512	$3,800	$3,800
1024	$7,200	$7,200
2048	$14,000	$14,000

C. Dedicated links with ratio 1 to 1

In this case, the customer uses without restrictions, the entire bandwidth. Refer to Table below.

Bandwidth, Kbps	Installation cost, US $	Monthly rate, US $
64	$2,500	$2,000
128	$4,500	$4,000
256	$7,500	$7,000
512	$15,500	$15,000
1024	$28,500	$28,000
2048	$40,000	$40,000

D. Commuted links

All commuted accesses to InfoCom are charged according to the time of connection to the system. The installation cost covers the following cases:

- One payment for the current month
- Installation and configuration for the software for a PC IBM compatible
- Training for the usage (60 minutes)
- Email services for international internet link.
- Cost is $ 70 US

E. Commuted access to Internet (search and email)

Plans, hours	Minimum rate, US $	Additional hour, US $
II up to 15	$30	$3
III up to 40	$60	$3
IV up to 100	$100	$1
V, no time limit	$250	--

Note: In the case of unlimited time, the customer must connect from one telephone number only.

F. Commuted access to Infocom (SMTP/POP), and search on Infocom web

Plans, hours	Minimum rate, US $	Additional hour, US $
5	$15	$3
10	$20	$3
40	$40	$1

G. Rental of space in Web servers (hosting)

There are available some high speed servers. Customers can use this infrastructure to place their web sites, e-commerce, etc. Refer to Tables below.

Additional hard drives in 10Mb capacities cost is $2.50 US. There is also commuted access to Infocom for email usage, for national networks (SMTP/POP). Includes search on Web pages of Infocom.

Also, there is access to Infocom for email interchange at the national network.

E-net, ETECSA Internet Services Divisions

E-net, the new ETECSA division, Internet services provider has a connection network spread all over the country with the technology to offer:

- Internet commuted access
- National and international e-messaging
- Connections devoted to corporation networks
- Please refer to Tables below

Shared usage in UNIX servers

Categories	Small	Simple	Profe ssional	Advanced	Commercial	Corporative
Monthly rate*	$8.00	$15.00	$25.00	$40.00	$60.00	$75.00
Installation (one time)*	$50.00	$50.00	$70.00	$70.00	$100.00	$100.00
Hard drive space (Mb)	5	10	50	100	200	300
Accounts POP3	1	1	3	5	5	5
Accounts FTP	1	1	3	5	5	5
Screen names for email accounts	1	5	10	15	15	15
Extensions of MS Frontpage	---	---	----	-----	-----	----
Site statistics	yes	yes	yes	yes	yes	yes
SSL Encryption	yes	yes	yes	yes	yes	yes
ASP support	---	----	----	----	----	----
VBScript	----	------	------	------	-----	-----
JavaScript	yes	yes	yes	yes	yes	yes
Windows Media	yes	yes	yes	yes	yes	yes
Shockwave,Flash, QuickTime,VIVO	---	yes	yes	yes	yes	yes
MIME support	yes	yes	yes	yes	yes	yes
MS Access	---	---	----	----	----	----
SQL Server	----	----	----	----	----	---
Oracle	---	---	yes	yes	yes	yes
Visual InterDev,6.0	---	----	----	-----	----	----
UPS	yes	yes	yes	yes	yes	yes

* All Costs is US $

Shared usage in NT Servers

Categories	Small	Simple	Professional	Advanced	Commercial	Corporative
Monthly rate*	$8.00	$15.00	$25.00	$40.00	$60.00	$75.00
One time Installation*	$50.00	$50.00	$70.00	$70.00	$100.00	$100.00
Hard drive space(Mb)	5	10	50	100	200	300
POP3 Accounts	1	1	3	5	5	5
FTP Accounts	1	1	3	5	5	5
Email screen names accounts	1	5	10	15	15	15
MS Frontpage Extensions	yes	yes	yes	yes	yes	yes
Site Statistics	yes	yes	yes	yes	yes	yes
SSL Encryption	yes	yes	yes	yes	yes	yes
ASP Support	yes	yes	yes	yes	yes	yes
VBScript	yes	yes	yes	yes	yes	yes
JavaScript	yes	yes	yes	yes	yes	yes
Windows Media	yes	yes	yes	yes	yes	yes
Shockwave, Flash,Quicktime,VIVO	----	yes	yes	yes	yes	yes
MIME support	yes	yes	yes	yes	yes	yes
SQL Server	---	yes	yes	yes	yes	yes
Oracle	---	---	yes	yes	yes	yes
Visual InterDEv,6.0	---	yes	yes	yes	yes	yes
UPS	yes	yes	yes	yes	yes	yes
MS Access	yes	yes	yes	yes	yes	yes

Functions

ETECSA is in charge of:

- National and international basic telephone services
- Radio and TV signals conduction
- Data transmission
- Telex service
- Public phone booth services
- Added value telecommunication services
- Interactive and multimedia services development
- Internet Services (Refer to sections above)

Workers

ETECSA has increased its employees to 16, 850, out of which 35% is composed of university graduates and technicians in the telecommunication specialties.

Public phones

ETECSA has developed a public telephony coin and card network taking into account community call centers, national and international call centers, phone booths.

Summary After ETECSA

The Cuban telephone system infrastructure, in spite of the improvements mentioned above, is obsolete and deteriorating.

Privatization Potential

Several assumptions of a socio-political nature were made throughout the study to increase the attractiveness of a privatized communications enterprise in post Castro Cuba.
First, it was assumed that the new private company would not be saddled with the economic burden of offering universal service. Initially, telephone service would only be provided to towns with a population of 2,000 and higher. Individual farms will not be provided with telephone service. As wireless communications technology matures, it should become profitable to offer telephone service to the smallest towns and farms.

Second, it was assumed that telephone service would be priced at a level, which will cover the higher risk of capital investment. a (20% rate of return, compared to a risk of around 14% in the United States). In many countries in the underdeveloped world, telephone service is artificially priced low at a level, which does allow for recovering the investment in new equipment.

The result of this short-sighted policy is that, although telephone service can be afforded by more people, it is not available due to the artificially low price and potential subscribers have to wait for years to obtain a telephone line. A better solution would be to allow poor people access to telephone service by low priced public phones. These telephones would provide a minimum level of service to the lower economic strata. Satellite or cellular public phones could be used in rural areas where the cost of providing a cable infrastructure is higher than the cellular cost.

Third, because Cuba is a relatively small market, an exclusive long-term (20 years) telephone franchise should be awarded to the highest bidder. This should include all local exchange communication services

and domestic long distance as well. Also, although not specifically addressed in the study, a national cellular system could be part of the franchise. The revenues from the highly profitable long distance and cellular services could be used to subsidize to some extent local telephone service. It is assumed that competition in the highly profitable international long distance service will best serve the subscribers. However, including this service in the exclusive franchise could be negotiated. Monopoly rates should be regulated and some form of incentive regulation should be used to ensure efficiency.

Cellular Telephony

The cellular telephone concept was reported in 1979 in the Bell System Technical Journal and, in the following decade, experienced a virtual explosion in usage. The concept is to divide a geographic area into cells, or smaller units, known as micro cells. Each cell contains a fixed station near its center. This station receives messages from mobile transmitters within the cell and also transmits to mobile receivers within the cell.

The cell represents the area over which the signals have acceptable power levels. Therefore, it may not be uniformly shaped, and the fixed station may not be in the center. Both of these depend upon the geographic characteristics. The first commercial cellular service was implemented in the United States in 1983.

Fixed site cellular transmitters have an output power of 25-35 watts, whereas mobile transmitters have an output of 3 watts or less. The first cellular phones used wideband FM analog modulation. Afterwards, narrowband FM analog systems, which provide a higher capacity, were used.

The present cellular system used in the United States is the Advanced Mobile Phone System (AMPS), which was developed by AT&T and Motorola. It uses the 806 to 890 MHz frequency band. The AMPS system is used by Cubacel,in Cuba. There is now a strong push for the implementation of digital cellular systems that have larger user capacity.

AMPS, UNITED STATES

Item	A service(non wire line)	B service (wire line)
Base cell station Transmit bands, MHz	869-880,890-891.5	880-890,891.5-894
Mobile station Transmit bands (MHz)	824-835, 845-846.5	835-845,846.5-849
Maximum power, watts	3	3
Cell size, radius, Kms	2-20	2-20

CUBACEL

The beginning

On mid 1991, Luis Miguel Niño de Rivera, a Mexican businessman visited La Habana on several occasions with the purpose to introduce in Cuba cellular telephony. On September 1991 the Ministry of Communications formed a working group charged to do a feasibility study. This group made several trips to Mexico to acquire experience on the system.

As a result, on December 11, 1991 the Cuban Government signed an Administrative Concession implementing a mixed corporation, Telefonos Celulares de Cuba, S. A.-Cubacel. This is a mixed

corporation-Cuban and Mexican. On February, 1993, the first commercial operation of Cubacel started, with the Occidental Subsystem, including La Habana and Varadero.

On March, 1995 started the Oriental Subsystem, covering Santiago de Cuba. On May, 1996, the Oriental Subsystem is extended to Moa. Also, during 1996, Cubacel expanded the Occidental Subsystem by extending its coverage through the 140 Kms of the La Habana-Matanzas-Varadero expressway. Also, new radio base stations were installed through Metropolitan La Habana to reinforce and cover all metro La Habana.

On June 1997, the Central Subsystem was created, starting with Cienfuegos, and now covering all the central part of Cuba. Later on, the Oriental Subsystem was extended and presently the whole Cuba is covered by Cubacel.

B. The Corporation

Cubacel has a 20 year concession to operate the cellular telephony system in Cuba. The Cuban side of the Corporation is Empresa Estatal Cubana de Radiocomunicacion and Broadcasting, RADIOCUBA. The foreign side is the Mexican company, registered in the British Virgin Islands, International Telecommunications Investors, Inc., ITI.

Cubacel has three levels of management:

- The Board of Shareholders

It is the highest group of the Corporation. It is formed by one representative with voting power for each shareholder, several advisors for each part, and the secretary. Also, several members from both parts, as guests. The Presidency of the Board is an alternate position between both parts, each term for three years.

- The Administrative Board

It is the operational group that manages the Corporation. It is formed by the General Director, who presides it, a secretary, and the directors designated by the by the Board of Shareholders

- The Organization

Cubacel has approximately some 150 employees. The organization comprises: the General Directorate; Operations; Administration; Commercial; Finances; Information Systems.

- Services

The following services are provided by Cubacel: Cellular telephony; temporary and permanent service; voice mail; credit card validation; national and international roaming.

- Technology and operations

The standard for the system is AMPS. The frequency spectrum is from 824MHz to 856 MHz. The system operates in the B band. The switching is done using Ericsson-AXE Miniswitch. The initial capacity of each switch is up to 5000 subscribers, with an average traffic of 0.05 erlang[13]s. The switch capacity can be increased to 10,000 subscribers.

Transfer repeaters are used to cover corridors between cities and urban regions of low traffic. The voice channels are analog. The radiobases are mainly omnidirectional. Only a few are sectorized to 120^0 .

There are four centers to switch calls, CCM, two in La Habana, one in Santiago de Cuba, one in Varadero. Each with a capacity of 5,000 customers. There are 9 radiobases, in Habana Libre, Varadero, Santa Maria, Televilla, Buenavista, Cacahual, Sata Clara, Santiago de Cuba, Moa.

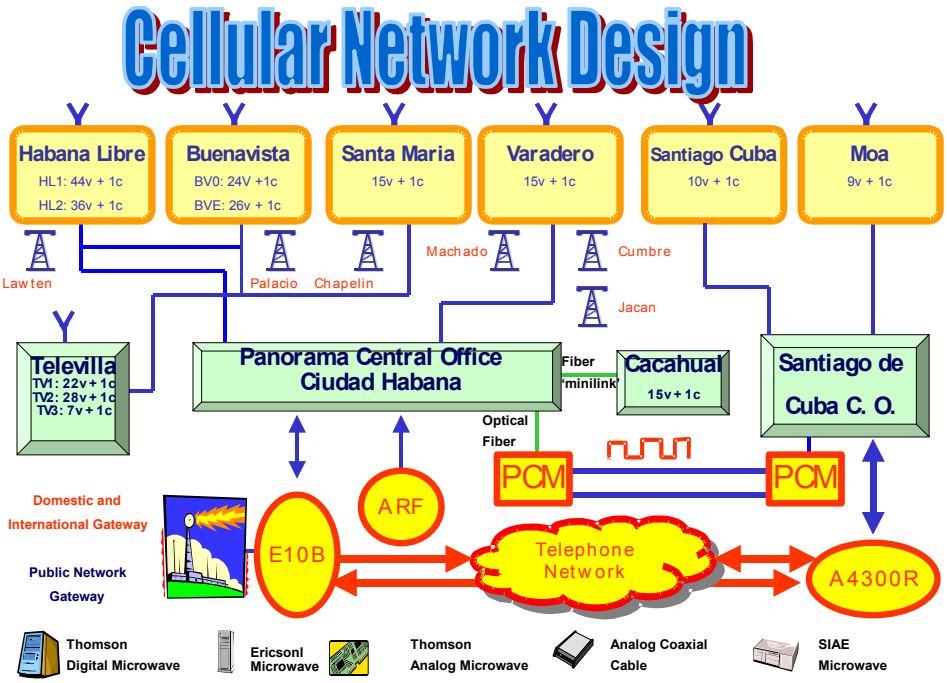
The system has 1,000 voice channels with capacity for 20,000 subscribers without saturation. There are 8 repeaters located in La Habana, Matanzas, Varadero, and Santa Clara. Refer to Table.

The Figures below shows a simplified description and areas covered by the network.

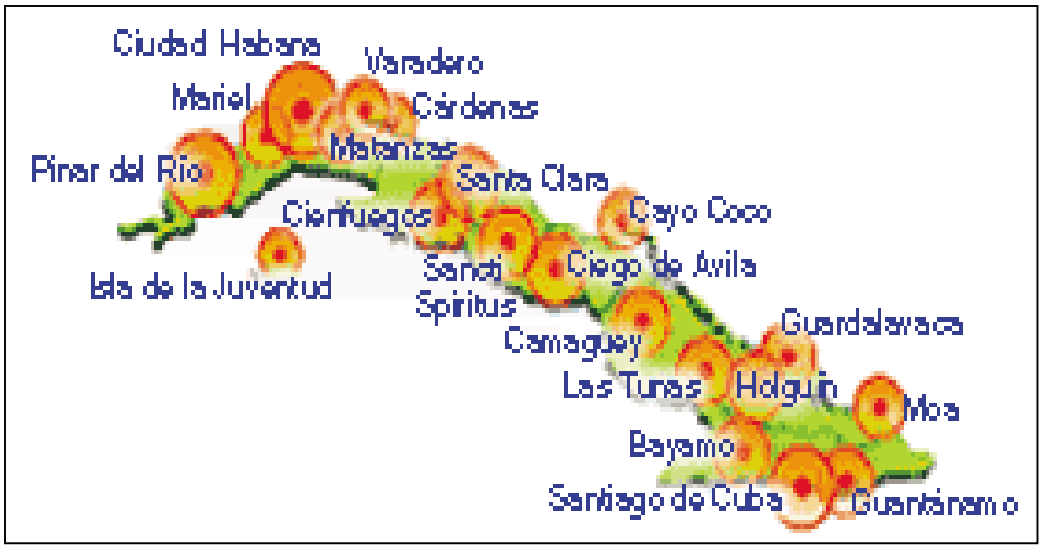
AMPS, Cubacel

Item	B Service
Switching	Ericksson-AXE Miniswitch
Transmit bands, MHz	824-856
Initial capacity/switch	5,000 subscribers
Maximum capacity/switch	10,000 subscriber
Voice channels	Analog
Number of radiobases	9
Total voice channels	1,000
Capacity	20,000 subscribers

[13] An erlang is a unit of time it refers to the percent of an hour that the telecommunications equipment is in use. .05 earlang refers to 1/20 of an hour or 2 minutes per hour. The United States uses the Centium Call Second (ccs) to measure telecommunications use. A typical residential line in in the U. S. has a 3 ccs traffic rate. Typical Business Line has a 7 ccs traffic rate. A typical Wirless line has a 1.5 ccs rate which is slightly higher than .05 erlangs. The trunk facility networks are designed based on a Poisson probability distribution, but can be approximated the recirocal of the utilization rate experessed in erlangs. Therfore a .05 rate of use results on a traffic carrying capacity of approximately 20 customers per channel. This figure is use to estimate the number of customers in the network.



PRESENT COVERAGE



RESULTS UP TO 2001

Data	1997	1998	1999	2000	2001
Average subscribers	2,900	4,388	6,233	8,479	11,097
Growth	-	50.6%	42.7%	36.0%	30.4%
Monthly bill/customer US Dollars	386.38	365.97	345.25	324.40	303.60
Total results, US Dollars (thousands)	1997	1998	1999	2000	2001
Total sales and income	13,420	19,758	26,599	33,998	41,490
Sales cost and operation	5,533	8,060	11,541	15,134	18,943
Sales cost	339	511	757	1,054	1,408
Cost of operation	5,194	7,549	10,784	14,079	17,535
Profit in sale	90	136	166	201	229
Gross profit in operation	8,317	11,698	15,059	18,864	22,547
Total expenses	1,342	2,484	3,595	4,584	5,978
Administrative expenses	403	573	770	982	1,395
General expenses	403	573	770	982	1,395
Sales expenses	537	1,336	2,054	2,619	3,188
Total depreciation and amortization	1,587	1,727	2,123	2,582	3,084
Depreciation expenses	1,448	1,588	1,984	2,442	2,944
Amortization expenses	139	139	139	140	140
Profit in operation	5,388	7,487	9,341	11,699	13,485
Interest income	134	191	257	327	399
Interest expenses	0	227	448	617	705
Profitability	39.9%	37.7%	34.4%	33.6%	31.8%
Total Revenue	5,522	7,451	9,151	11,409	13,179

CASH FLOW

Cash flow (thousands US dollars)	1997	1998	1999	2000	2001
Total net profit	5,522	7,451	9,151	11,409	13,179
Total depreciation and amortization	1,587	1,727	2,123	2,582	3,084
Depreciation expenses	1,448	1,588	1,984	2,442	2,944
Amortization expenses	139	139	139	140	140
Working capital requirements	304	492	570	617	624
Flow of operations	6,805	8,685	10,704	13,374	15,636
Long term debt	0	1,600	1,600	1,800	1,800
Long term debt payments	0	233	533	880	1,253
Investment	1,400	3,964	4,583	5,021	5,244
Net cash flow	5,405	6,088	7,388	9,273	10,741

C. Services

I. Mobile and fixed services

- Wireless telephony that allow communication at all times and from anywhere, if the subscriber is within the area of cellular coverage. Calls can be local, national, and international
- The cellular phone can be used temporarily or permanent. The activation is immediate once solicited by the customer. Permanent are those subscribers with a contract length over 6 months. Temporary are those subscribers with contracts for less than 6 months.
- It allows data transmission and, if necessary, the installation of several extensions.

II. Voice message

- This is the voice messages service, where if a call comes in, and the telephone is off, or out of the area of service, busy, or simply do not answer, the call is transferred to a voice message system where the subscriber can listen to it at a later time

III. Roaming

- National roaming makes possible for the user to have national coverage in any place on the island where cellular service is available. The system is manual.
- International roaming allows the activation of the subscriber in other cellular network outside Cuba.

IV. Miscellaneous services (* services)

- Time information
- Rent and auto repair
- Taxi services
- Hotel reservation
- Tourist information

V. Credit card validation

- It works in conjunction with CIMEX, where the stores for cellular phone sales and service also validate credit cards.

VI. Additional services

- Call wait
- Conference calls (3 persons)
- Transfer of calls

AGREEMENTS

Cubacel has agreements with the following companies:

- Telcel and Portatel, Mexico
- T.C.P. Argentina and Telecom Personal, Argentina
- Telefonica Moviles, Spain. Through this company, services are extended to Europe, Asia, and Africa.
- Bell Mobility, Telus Mobility, NewTEL, and MT&T, Canada.
- Cell Express Rentacel, Panama
- Telefonica Moviles del Peru. Through this company services are extended to Venezuela, Chile, and El Salvador

- North-West, GSM, Russia
- Telecom Italia Mobile, Italy

D. Rates (US Dollars)

Service	Activation	Basic rate	Cost minute	Equipment rent
Basic	120	40	0.30-0.40	7.0/day
Resalers	120	40	0.60	7.0/day
Embassies	120	30	0.30	7.0/day
Restaurants		30	0.40	7.0/day
Permanent, fixed	120	40	0.30	2.0/day
Credit card validationm		40	0.15	
Special * services			0.40	40.0/month
Temporary, mobile		3/day	0.90	7.0/day
Temporary, fixed			0.40	2.0/day

Market

NUMBER OF ACTIVATIONS TOTAL, 2001

Commercial firms	9,822
Embassies and functionaries	240
International Organizations	15
Foreign press	40
Tour operators	45
Corporations	150
Hotels	300
Residents	410
Others	80

ADMINISTRATIVE BOARD

The Administrative Board of Cubacel was formed (until end of 2001) by:

- **Ingeniero Rafael Galindo Mier, General Director, 1994.**

BS in Electrical Engineering, CUJAE; MS in Electrical Engineering, University of Toronto. Principal Researcher of the Academy of Sciences of Cuba. From 1964 worked as a telecommunications engineer in the ICR. From 1974 to 1989 was Director of the Science and Technology Department of the Ministry of Communications, and a representative of this Ministry in the Communications Commission of CAME. From 1989 to 1990 he was appointed as Director of Development for the Ministry of Communications. Since 1990 has been working in several capacities in relation with cellular telephony in Cuba, until his nomination as General Director in 1994, position that at the end of 2001 he still had.

- **Ingeniero Waldo Reboredo Arroyo, Technical Director, 1994**

BS in Electrical Engineering, CUJAE, 1973. Joined in 1974 the Ministry of Communications. Assistant Professor at Universidad de La Habana, from 1976 to 1980 From 1976 to 1992 worked in several capacities for the Ministry of Communications, including Director of the Telecommunications for Cayo Coco. Appointed as Technical Director in 1994.

- **Lic. Silvia Garcia Costa, Finance Director, 1992.**

Since 1963 worked for the Ministry of Communications, in accounting and finance. On 1974 was appointed as Director of Accounting and Auditor for the Ministry of Communications. On 1992 she was appointed to the position of Director of Finance.

- **Ingeniera Loretta Nuñez Ardavin, Business Director, 1994**

BS in Electrical Engineering, CUJAE,1992. MS, ITAM, Mexico, 1994. Joined Cubacel in 1992 as Sales and Customer Relations Director. On 1993 was appointed as Director of Roaming, and appointed later on, 1994, as Business Director.

SUBSCRIBER GROWTH IN LATIN AMERICA

TOTAL WIRELESS SUBSCRIBERS BY COUNTRY

Country	1995	2000	2005-Estimates
Argentina	405,395	6,670,212	14,530,214
Brazil	1,460,000	23,410,363	48,808,478
Chile	205,023	3,461,240	7,819,021
Colombia	271,990	2,256,801	7,648,769
Ecuador	51,000	470,180	1,258,198
Mexico	690,201	14,175,100	34,004,744
Peru	69,872	1,259,540	3,791,320
Venezuela	356,500	5,150,962	10,862,008
Central America	78,149	2,075,933	5,741,410
Total Latin America	3,653,400	60,631,256	138,106,637

POTENTIAL MARKET COMPARISON FOR A POST CASTRO CUBA

Cellular telephony has a brilliant future in a democratic and free market economy Cuba. The Table above shows the growth of this industry in Latin America. Projections for the market, after a transition in Cuba, estimates, after the first three years of the transition a total of 3.5 million subscribers for both temporary and fixed customers.

The present value of Cubacel, at the end of 2001, is $ 32,220,247 US dollars.

ACKNOLEDGEMENT

We want to recognize the contributions made by Oscar Lopez, BSEE, to the computer formatting of the report, as well as some of the economical analysis.

APPENDIX

Telecommunications Demand Profile for Various Countries
Based on various Sources
Including Reported figures for most Carriers
Serving Latin America
All demand and population data (000)

								Per 100 pop.(02)			
Country	Population (000)	Telephone. (000)	Cellular (000) I	Television (000)	Data From Year	BellSouth 4Q01 Latin Am.	Estimate Cell 2002	Tel	Cell	Tel + Cell	TV
Argentina	32,713	7,500	1,800	8,000	1997	1,587	2,635	23	8	31	24
Australia	17,661	9,200	5,290	10,150	1998		7,041	52	40	92	57
Bahamas	264	77	2	67	1993		5	29	2	31	25
Belize	249	30	2	41	1995		4	12	1	13	16
Brazil	150,367	19,000	4,000	16,500	1998	2,723	5,324	13	4	16	11
Chile	13,599	2,603	197	3,150	1995	860	860	19	6	25	23
Colombia	27,838	5,433	1,800	5,000	1998	1,126	2,396	20	9	28	18
Costa Rica	2,489	451	47	525	1996		75	18	3	21	21
Cuba	**10,744**	**553**	**2**	**2,700**	**1995**		**4**	**5**	**0**	**5**	**25**
Dom. Rep.	5,546	569	33	770	1995		58	10	1	11	14
Ecuador	10,741	748	50	1,550	1995	353	353	7	3	10	14
El Salvador	6,123	380	14	600	1995		24	6	0	7	10
France	57,527	35,000	11,078	34,800	1998		14,745	61	26	86	60
French Guiana**	173	47	1	30	1995		2	27	1	28	17
Germany	79,365	46,500	15,318	51,400	1999		18,535	59	23	82	65
Guatemala	9,197	342	30	640	1995	75	75	4	1	5	7
Honduras**	6,250	190	1	570	1995		2	3	0	3	9
Jamaica	2,392	292	45	460	1995		80	12	3	16	19
Mexico	81,250	9,600	2,300	25,600	1998		3,061	12	4	16	32
Nicaragua	4,813	140	4	320	1995	156	156	3	3	6	7
Panama	2,563	325		510	1995	283	283	13	11	24	20
Paraguay	5,586	167	16	515	1995		28	3	1	3	9
Peru	27,013	1,509	504	3,060	1998	405	810	6	3	9	11
Portugal	9,846	3,724	887	3,310	1999		1,073	38	11	49	34
Spain	39,141	17,336	8,394	13,100	1999		10,157	44	26	70	33
Surinam	439	58	4	63	1995		7	13	2	15	14
United St	276,333	178,000	55,312	219,000	1997		90,000	71	34	101	88
Uruguay	3,094	622	40	782	1995	137	137	20	4	25	25
Venezuela	20,249	2,600	2,000	4,100	1998	3,112	3,112	13	15	28	20

- Estimate is based on 10% growth rate as reported in BellSouth Annual Report. This is the current growth rate for cell phones. This rate was much higher in the past. It is not know if Honduras and Belize currently have Cellular service.
- The U. S. In the United States Cingular (BellSouth/SouthWest Bell) reports a rate of 10.9 per 100 population in the markets they serve (approximately 200 million population), and Verizion the largest U.S. Carrier reports 27.5 million customers in their serving area. Verizon also serves approximately 11 customers per 100 population. AT&T Wireless has over 16 million customers in the U.S. and serves about 8 customers per 100 population in the market area. Sprint has 15 million subscribers and cover a population area of over 90% of the U. S market. . Most U. S. Markets have 3 to 5 wireless carriers. Some of the reported data include the U. S. Virgin Islands and Puerto Rico. The four major carriers serve approximately 80 million subscribers in the U. S. Other minor carriers such as Qwest Communications, serve approximately 10 million. Some of the numbers might be inflated because of cross ownership of systems result in double counting some consumer demand but it is save to assume that the U.S. market has between 80 to 90 million subscribers and has an annual growth rate of over 10%.

Demand, Cost, Revenue and Rate of Return
Study Details for 169 Population Centers
(Cities or Subdivisions)
Appendix 1 Page 1 of 3

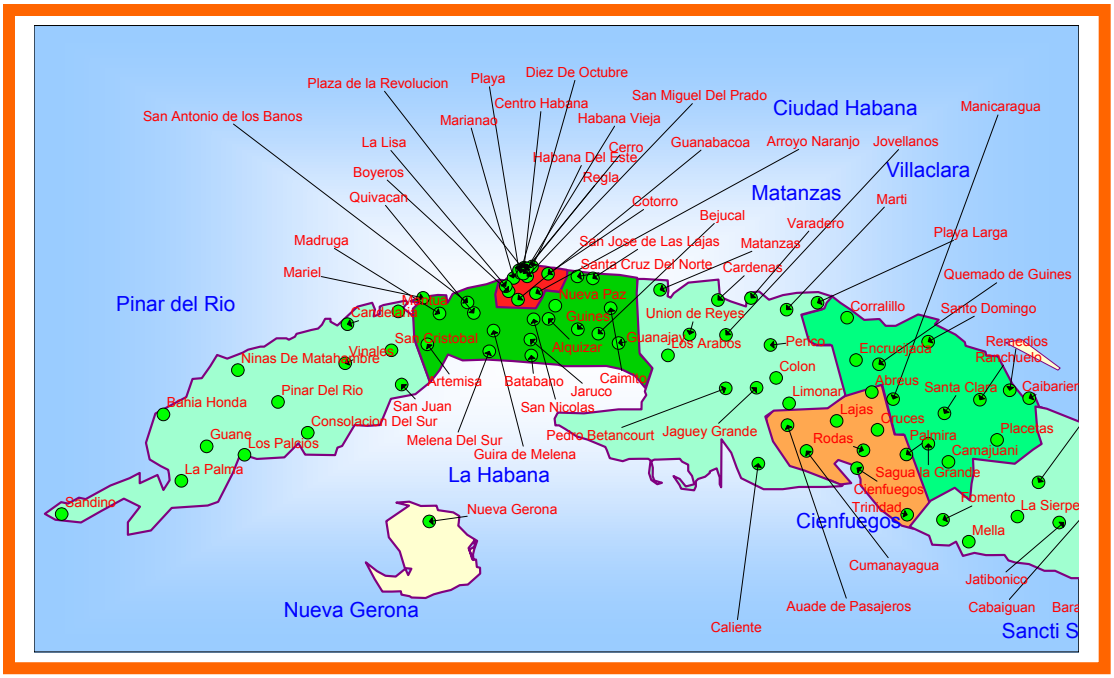
Rk [14]	City	Popu-lation (000)	Current Demand (000)	Ultimate Demand (000)	Rev. Req. Extg Eq. ($000) Annual	Rev. Req. New Eq. ($000) Annual	Existing Equip. ($000) Capital	New Equipment ($000) Capital	Per line Existing Equip Ann. Rev	Revenue per line New Equip.	Rate of Return New Equip.
	TOTALS	**11,498**	**609**	**2,099**	**280,350**	**896,245**	**210,992**	**2,458,312**	**$ 427**	**$ 427**	**20.0%**
135	Abreus	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%
147	Alquizar	28.9	1.18	3.8	931	2,291	511	5,684	$ 792	$ 607	8.4%
89	Amancio	49.0	1.99	6.4	1,148	3,453	798	9,360	$ 576	$ 540	12.6%
165	Antilla	15	0.61	2.0	780	1,487	314	3,143	$ 1,279	$ 759	-0.3%
5	Arroyo Naranjo	221.0	17.33	67.3	4,658	23,293	4,583	68,349	$ 269	$ 346	28.3%
38	Artemisa	83.9	3.41	11.0	1,526	4,772	1,294	11,958	$ 447	$ 436	19.6%
125	Auade de Pasajeros	35.1	1.43	4.6	998	2,649	600	6,818	$ 699	$ 578	10.2%
54	Baguanos	69.0	2.81	9.0	1,365	4,610	1,082	13,017	$ 486	$ 512	14.5%
88	Bahia Honda	49.2	2.00	6.4	1,150	3,465	800	9,396	$ 575	$ 539	12.7%
30	Banes	101.0	5.48	17.6	2,075	6,950	2,017	18,588	$ 379	$ 395	23.4%
32	Baracoa	97.0	3.95	12.7	1,668	5,334	1,481	13,669	$ 423	$ 421	20.9%
132	Baragua	31.2	1.27	4.1	956	2,424	544	6,105	$ 753	$ 595	9.1%
60	Bartolome Maso	64.0	2.60	8.4	1,311	4,321	1,011	12,102	$ 503	$ 517	14.1%
128	Batabano	34.0	1.38	4.4	986	2,586	584	6,617	$ 713	$ 582	9.9%
27	Bayamo	110.0	5.97	19.2	2,205	7,465	2,188	20,156	$ 370	$ 390	23.9%
144	Bejucal	29.5	1.20	3.9	937	2,325	520	5,794	$ 781	$ 604	8.6%
159	Bolivia	19	0.77	2.5	824	1,718	370	3,874	$ 1,066	$ 692	3.3%
7	Boyeros	163.0	18.64	59.9	4,924	20,833	4,910	60,861	$ 264	$ 348	28.1%
120	Buey Arriba	38.0	1.55	5.0	1,029	2,817	641	7,348	$ 666	$ 568	10.8%
139	C. Mauel de Cespedes	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%
48	Cabaiguan	78.0	3.17	10.2	1,462	4,519	1,210	11,187	$ 461	$ 444	18.8%
78	Cacocum	54.0	2.20	7.1	1,202	3,742	869	10,274	$ 547	$ 531	13.2%
55	Caibarien	68.0	2.77	8.9	1,354	4,552	1,068	12,834	$ 490	$ 513	14.4%
162	Caimanera	10.5	0.71	2.3	807	1,631	349	3,600	$ 1,135	$ 714	2.1%
98	Caimito	43.4	1.77	5.7	1,088	3,129	718	8,336	$ 616	$ 552	11.8%
117	Caliente	39.0	1.59	5.1	1,040	2,875	655	7,531	$ 656	$ 564	11.1%
57	Calixto Garcia	65.0	2.64	8.5	1,321	4,378	1,025	12,285	$ 500	$ 516	14.2%
8	Camaguey	275.0	12.78	56.8	3,733	19,818	3,446	57,770	$ 292	$ 349	28.0%
39	Camajuani	83.0	3.38	10.8	1,516	4,734	1,281	11,840	$ 449	$ 437	19.5%
66	Campechuela	61.0	2.48	8.0	1,278	4,147	968	11,554	$ 515	$ 521	13.9%
158	Candelaria	19.7	0.80	2.6	831	1,759	380	4,002	$ 1,038	$ 684	3.9%
34	Cardenas	89.0	3.62	11.6	1,581	4,991	1,367	12,624	$ 437	$ 429	20.1%
156	Cauto Cristo	21	0.85	2.7	845	1,834	399	4,240	$ 990	$ 669	4.7%
4	Centro Habana	232.0	18.20	70.7	4,833	24,393	4,799	71,702	$ 266	$ 345	28.4%
11	Cerro	171.6	13.46	52.3	3,870	18,348	3,615	53,295	$ 288	$ 351	27.8%
94	Chambas	48.0	1.95	6.3	1,137	3,395	783	9,177	$ 583	$ 542	12.5%
40	Ciego De Avila	83.0	3.38	10.8	1,516	4,734	1,281	11,840	$ 449	$ 437	19.5%
25	Cienfuegos	115.0	6.24	20.0	2,277	7,751	2,283	21,026	$ 365	$ 387	24.2%
83	Cieto	51.0	2.07	6.7	1,170	3,569	826	9,725	$ 564	$ 536	12.9%
121	Colombia	38.0	1.55	5.0	1,029	2,817	641	7,348	$ 666	$ 568	10.8%
49	Colon	78.0	3.17	10.2	1,462	4,519	1,210	11,187	$ 461	$ 444	18.8%
44	Consolacion Del Sur	81.0	3.29	10.6	1,494	4,648	1,253	11,579	$ 454	$ 439	19.2%
23	Contramaestre	117.0	6.34	20.4	2,306	7,865	2,321	21,375	$ 363	$ 386	24.3%
138	Corralillo	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%
21	Cotorro	70.2	5.51	21.4	2,083	8,199	2,027	22,393	$ 378	$ 383	24.5%
115	Cruces	40.0	1.63	5.2	1,051	2,933	669	7,714	$ 646	$ 561	11.2%
161	Cubitas	17.5	0.71	2.3	807	1,631	349	3,600	$ 1,135	$ 714	2.1%
82	Cumanayagua	51.0	2.07	6.7	1,170	3,569	826	9,725	$ 564	$ 536	12.9%
1	Diez De Octubre	335.0	26.27	102.1	7,609	35,876	7,069	104,091	$ 290	$ 351	27.8%
61	El Salvador	63.0	2.56	8.2	1,300	4,263	997	11,919	$ 507	$ 518	14.1%

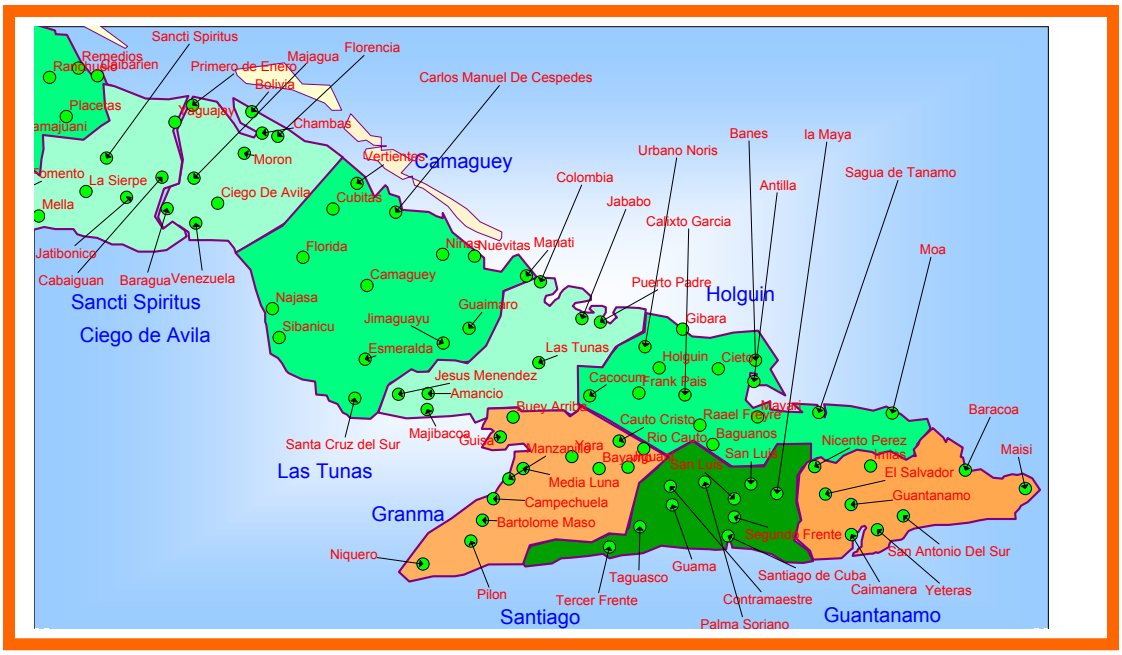
[14] Rank refers to profitability to serve the market. Numbers are 1 to 169 with 1 as the highest Rate of Return. All Population Centers in "La Habana are listed by Geographic Subdivision Ex: Diez De Octubre, Centro Habana, etc.

Rk [14]	City	Popu-lation (000)	Current Demand (000)	Ultimate Demand (000)	Rev. Req. Extg Eq. ($000) Annual	Rev. Req. New Eq. ($000) Annual	Existing Equip. ($000) Capital	New Equipment ($000) Capital	Per line Existing Equip Ann. Rev	Revenue per line New Equip.	Rate of Return New Equip.
101	Encrucijada	43.0	1.75	5.6	1,083	3,106	712	8,263	$ 619	$ 553	11.8%
124	Esmeralda	37.0	1.50	4.8	1,018	2,759	627	7,165	$ 677	$ 571	10.6%
150	Florencia	27.5	1.12	3.6	916	2,210	491	5,428	$ 819	$ 615	7.9%
35	Florida	86.0	3.50	11.2	1,549	4,862	1,324	12,232	$ 443	$ 433	19.8%
85	Fomento	51.0	2.07	6.7	1,170	3,569	826	9,725	$ 564	$ 536	12.9%
126	Frank Pais	35.0	1.42	4.6	997	2,643	598	6,800	$ 700	$ 578	10.2%
45	Gibara	80.5	3.27	10.5	1,489	4,626	1,246	11,514	$ 455	$ 440	19.2%
62	Guaimaro	63.0	2.56	8.2	1,300	4,263	997	11,919	$ 507	$ 518	14.1%
96	Guama	44.0	1.79	5.7	1,094	3,164	726	8,445	$ 611	$ 551	11.9%
14	Guanabacoa	120.0	9.41	36.6	3,122	13,184	3,394	37,570	$ 332	$ 361	26.8%
107	Guanajay	41.5	1.69	5.4	1,067	3,019	691	7,988	$ 632	$ 557	11.5%
102	Guane	42.7	1.74	5.6	1,080	3,089	708	8,208	$ 622	$ 554	11.7%
17	Guantanamo	190.0	10.30	33.1	3,228	12,040	2,826	34,087	$ 313	$ 364	26.5%
36	Guines	85.0	3.46	11.1	1,538	4,819	1,310	12,102	$ 445	$ 434	19.7%
106	Guira de Melena	41.7	1.70	5.4	1,069	3,031	694	8,025	$ 630	$ 557	11.6%
72	Guisa	58.0	2.36	7.6	1,246	3,974	926	11,005	$ 528	$ 525	13.6%
16	Habana Del Este	107.0	10.30	33.1	3,228	12,040	2,826	34,087	$ 313	$ 364	26.5%
12	Habana Vieja	145.5	11.41	44.3	3,454	15,736	3,103	45,341	$ 303	$ 355	27.4%
15	Holguin	196.0	10.63	34.1	3,294	12,383	2,907	35,132	$ 310	$ 363	26.6%
134	Imias	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%
71	Jababo	59.0	2.40	7.7	1,256	4,031	940	11,188	$ 524	$ 523	13.7%
86	Jaguey Grande	50.0	2.03	6.5	1,159	3,511	812	9,542	$ 570	$ 538	12.8%
109	Jaruco	41.3	1.68	5.4	1,065	3,008	688	7,952	$ 634	$ 558	11.5%
81	Jatibonico	52.0	2.11	6.8	1,181	3,627	840	9,908	$ 558	$ 534	13.0%
93	Jesus Menendez		1.95	6.3	1,137	3,395	783	9,177	$ 583	$ 542	12.5%
63	Jiguani	63.0	2.56	8.2	1,300	4,263	997	11,919	$ 507	$ 518	14.1%
164	Jimaguayu	16	0.65	2.1	791	1,545	328	3,326	$ 1,216	$ 739	0.7%
64	Jovellanos	63.0	2.56	8.2	1,300	4,263	997	11,919	$ 507	$ 518	14.1%
13	La Lisa	123.5	9.69	37.6	3,195	13,534	3,490	38,636	$ 330	$ 360	26.9%
24	la Maya	115.0	6.24	20.0	2,277	7,751	2,283	21,026	$ 365	$ 387	24.2%
119	La Palma	38.4	1.56	5.0	1,034	2,840	647	7,421	$ 662	$ 566	10.9%
160	La Sierpe	18	0.73	2.4	813	1,660	356	3,691	$ 1,110	$ 706	2.6%
145	Lajas	29.0	1.18	3.8	932	2,296	513	5,703	$ 790	$ 606	8.4%
42	Las Tunas	82.0	3.34	10.7	1,505	4,691	1,267	11,710	$ 451	$ 438	19.3%
154	Limonar	23.1	0.94	3.0	868	1,955	429	4,624	$ 924	$ 648	5.9%
148	Los Arabos	28.8	1.17	3.8	930	2,285	510	5,666	$ 794	$ 607	8.4%
104	Los Palcios	42.0	1.71	5.5	1,073	3,048	698	8,080	$ 628	$ 556	11.6%
108	Madruga	41.3	1.68	5.4	1,065	3,008	688	7,952	$ 634	$ 558	11.5%
105	Maisi	42.0	1.71	5.5	1,073	3,048	698	8,080	$ 628	$ 556	11.6%
143	Majagua	29.5	1.20	3.9	937	2,325	520	5,794	$ 781	$ 604	8.6%
110	Majibacoa	41.0	1.67	5.4	1,062	2,990	684	7,897	$ 637	$ 558	11.4%
113	Manati	41.0	1.67	5.4	1,062	2,990	684	7,897	$ 637	$ 558	11.4%
37	Manicaragua	84.0	3.42	11.0	1,527	4,777	1,296	11,971	$ 447	$ 435	19.6%
133	Mantua	31.2	1.27	4.1	956	2,424	544	6,105	$ 753	$ 595	9.1%
29	Manzanillo	105.0	5.69	18.3	2,133	7,179	2,093	19,285	$ 375	$ 393	23.6%
10	Marianao	177.0	13.88	53.9	3,956	18,889	3,721	54,940	$ 285	$ 350	27.9%
92	Mariel	48.2	1.96	6.3	1,140	3,407	786	9,213	$ 581	$ 541	12.5%
140	Marti	30.4	1.24	4.0	947	2,377	533	5,959	$ 766	$ 599	8.9%
22	Matanzas	121.0	6.56	21.1	2,364	8,094	2,397	22,071	$ 360	$ 384	24.4%
20	Mayari	139.0	7.54	24.2	2,623	9,123	2,738	25,206	$ 348	$ 377	25.2%
90	Media Luna	49.0	1.99	6.4	1,148	3,453	798	9,360	$ 576	$ 540	12.6%
152	Melena Del Sur	26.5	1.08	3.5	905	2,152	477	5,245	$ 840	$ 622	7.5%
137	Mella	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%
112	Moa	41.0	1.67	5.4	1,062	2,990	684	7,897	$ 637	$ 558	11.4%
74	Moron	56.0	2.28	7.3	1,224	3,858	897	10,640	$ 537	$ 527	13.4%
163	Najasa	16.5	0.67	2.2	797	1,574	335	3,417	$ 1,187	$ 730	1.2%
155	Nicento Perez	21.0	0.85	2.7	845	1,834	399	4,240	$ 990	$ 669	4.7%
114	Ninas	40.2	1.63	5.3	1,053	2,944	672	7,751	$ 644	$ 561	11.3%
97	Ninas De Matahambre	43.9	1.79	5.7	1,093	3,159	725	8,431	$ 612	$ 551	11.9%
84	Niquero	51.0	2.07	6.7	1,170	3,569	826	9,725	$ 564	$ 536	12.9%
68	Nueva Gerona	60.0	2.44	7.8	1,267	4,089	954	11,371	$ 519	$ 522	13.8%

Rk [14]	City	Popu-lation (000)	Current Demand (000)	Ultimate Demand (000)	Rev. Req. Extg Eq. ($000) Annual	Rev. Req. New Eq. ($000) Annual	Existing Equip. ($000) Capital	New Equipment ($000) Capital	Per line Existing Equip Ann. Rev	Revenue per line New Equip.	Rate of Return New Equip.
151	Nueva Paz	27.0	1.10	3.5	910	2,181	484	5,337	$ 829	$ 618	7.7%
99	Nuevitas	43.0	1.75	5.6	1,083	3,106	712	8,263	$ 619	$ 553	11.8%
19	Palma Soriano	140.0	7.59	24.4	2,638	9,180	2,757	25,380	$ 347	$ 377	25.2%
127	Palmira	34.0	1.38	4.4	986	2,586	584	6,617	$ 713	$ 582	9.9%
122	Pedro Betancourt	37.5	1.53	4.9	1,024	2,788	634	7,257	$ 671	$ 569	10.7%
131	Perico	33.0	1.34	4.3	975	2,528	570	6,434	$ 727	$ 586	9.7%
95	Pilon	44.0	1.79	5.7	1,094	3,164	726	8,445	$ 611	$ 551	11.9%
26	Pinar Del Rio	110.0	5.97	19.2	2,205	7,465	2,188	20,156	$ 370	$ 390	23.9%
33	Placetas	93.0	3.78	12.1	1,624	5,163	1,424	13,146	$ 429	$ 425	20.5%
3	Playa	239.2	18.76	72.9	6,227	26,288	6,766	74,896	$ 332	$ 361	26.8%
157	Playa Larga	12	0.81	2.6	835	1,776	385	4,057	$ 1,026	$ 680	4.1%
6	Plaza de la Revolucion	205.0	16.08	62.5	4,403	21,691	4,270	63,473	$ 274	$ 347	28.2%
142	Primero de Enero	30.0	1.22	3.9	943	2,354	527	5,885	$ 773	$ 601	8.8%
43	Puerto Padre	81.0	3.29	10.6	1,494	4,648	1,253	11,579	$ 454	$ 439	19.2%
149	Quemado de Guines	28.5	1.16	3.7	926	2,268	506	5,611	$ 799	$ 609	8.3%
130	Quivacan	33.5	1.36	4.4	981	2,557	577	6,525	$ 720	$ 584	9.8%
70	Raael Freyre	60.0	2.44	7.8	1,267	4,089	954	11,371	$ 519	$ 522	13.8%
50	Ranchuelo	76.0	3.09	9.9	1,440	5,015	1,182	14,297	$ 466	$ 505	14.9%
31	Regla	53.3	4.18	16.2	1,730	6,508	1,563	17,243	$ 414	$ 401	22.8%
67	Remedios	61.0	2.48	8.0	1,278	4,147	968	11,554	$ 515	$ 521	13.9%
77	Rio Cauto	54.5	2.22	7.1	1,208	3,771	876	10,365	$ 545	$ 530	13.3%
118	Rodas	38.5	1.57	5.0	1,035	2,846	648	7,440	$ 661	$ 566	11.0%
80	S. Antonio de los Banos	53.6	2.18	7.0	1,198	3,719	863	10,201	$ 550	$ 531	13.2%
47	Sagua de Tanamo	79.0	3.21	10.3	1,473	4,562	1,225	11,318	$ 458	$ 442	19.0%
56	Sagua la Grande	68.0	2.77	8.9	1,354	4,552	1,068	12,834	$ 490	$ 513	14.4%
111	San Antonio Del Sur	41.0	1.67	5.4	1,062	2,990	684	7,897	$ 637	$ 558	11.4%
59	San Cristobal	64.8	2.64	8.5	1,319	4,367	1,022	12,249	$ 501	$ 516	14.2%
52	San Jose de Las Lajas	69.5	2.83	9.1	1,370	4,639	1,089	13,108	$ 485	$ 511	14.5%
73	San Juan	57.6	2.34	7.5	1,241	3,950	920	10,932	$ 530	$ 525	13.6%
28	San Luis	110.0	5.97	19.2	2,205	7,465	2,188	20,156	$ 370	$ 390	23.9%
123	San Luis	37.2	1.51	4.9	1,021	2,771	630	7,202	$ 675	$ 570	10.7%
9	San Miguel Del Prado	185.0	14.51	56.4	4,084	19,689	3,877	57,378	$ 281	$ 349	28.0%
153	San Nicolas	26.0	1.06	3.4	899	2,123	470	5,154	$ 851	$ 625	7.3%
41	Sancti Spiritus	82.0	3.34	10.7	1,505	4,691	1,267	11,710	$ 451	$ 438	19.3%
103	Sandino	42.0	1.71	5.5	1,073	3,048	698	8,080	$ 628	$ 556	11.6%
18	Santa Clara	190.0	8.39	32.6	2,851	11,883	3,037	33,608	$ 340	$ 364	26.4%
116	Santa Cruz Del Norte	39.8	1.62	5.2	1,049	2,921	667	7,677	$ 648	$ 562	11.2%
53	Santa Cruz del Sur	69.5	2.83	9.1	1,370	4,639	1,089	13,108	$ 485	$ 511	14.5%
2	Santiago de Cuba	400.0	27.11	87.1	7,780	30,943	7,278	89,071	$ 287	$ 355	27.3%
58	Santo Domingo	65.0	2.64	8.5	1,321	4,378	1,025	12,285	$ 500	$ 516	14.2%
87	Segundo Frente	50.0	2.03	6.5	1,159	3,511	812	9,542	$ 570	$ 538	12.8%
129	Sibanicu	34.0	1.38	4.4	986	2,586	584	6,617	$ 713	$ 582	9.9%
79	Taguasco	54.0	2.20	7.1	1,202	3,742	869	10,274	$ 547	$ 531	13.2%
100	Tercer Frente	43.0	1.75	5.6	1,083	3,106	712	8,263	$ 619	$ 553	11.8%
46	Trinidad	79.5	3.23	10.4	1,478	4,584	1,232	11,383	$ 457	$ 441	19.0%
75	Union de Reyes	55.0	2.24	7.2	1,213	3,800	883	10,457	$ 542	$ 529	13.3%
76	Urbano Noris	54.5	2.22	7.1	1,208	3,771	876	10,365	$ 545	$ 530	13.3%
91	Varadero	14.5	1.97	6.3	1,141	3,415	788	9,238	$ 580	$ 541	12.6%
146	Venezuela	29.0	1.18	3.8	932	2,296	513	5,703	$ 790	$ 606	8.4%
69	Vertientes	60.0	2.44	7.8	1,267	4,089	954	11,371	$ 519	$ 522	13.8%
141	Vinales	30.0	1.22	3.9	943	2,354	527	5,885	$ 773	$ 601	8.8%
51	Yaguajay	75.4	3.07	9.8	1,434	4,980	1,173	14,187	$ 468	$ 506	14.9%
65	Yara	62.0	2.52	8.1	1,289	4,205	983	11,737	$ 511	$ 519	14.0%
135	Yeteras	31.0	1.26	4.0	954	2,412	541	6,068	$ 756	$ 596	9.1%

Population Centers Appendix 2





Analysis of Cellular Demand in the United States and application to the Cuban Network Design
Appendix 3

Year	Cell Sites	Direct Emp	Subscribers	Total Capital Investment ($000)	Average Inv. per subs.	Average Subs. per site	Direct Empl. Per 10,000 Subsc.	Rev. Per Line	Total monthly Revenues ($000)	Annual Growth Rate	per 100 pop
1985	599	1,697	203,600	588,751	2,892	340	83				
1986	1,194	3,556	500,000	1,140,163	2,280	419	71			146%	0.2%
1987	1,732	5,656	883,778	1,724,348	1,951	510	64			77%	0.3%
1988	2,789	9,154	1,608,697	2,589,589	1,610	577	57			82%	0.6%
1989	3,577	13,719	2,691,793	3,675,473	1,365	753	51			67%	1.0%
1990	4,768	18,973	4,368,686	5,211,765	1,193	916	43			62%	1.6%
1991	6,685	25,545	6,380,053	7,429,739	1,165	954	40			46%	2.3%
1992	8,901	30,595	8,892,535	9,276,139	1,043	999	34			39%	3.2%
1993	11,551	36,501	13,067,318	12,775,967	978	1,131	28	75.00	980,049	47%	4.7%
1994	14,740	45,606	19,283,306	16,107,921	835	1,308	24	61.50	1,185,923	48%	7.0%
1995	19,844	60,624	28,154,415	21,721,711	772	1,419	22	56.21	1,582,560	46%	10.2%
1996	24,802	73,365	38,195,466	26,707,046	699	1,540	19	51.00	1,947,969	36%	13.8%
1997	38,650	97,039	48,705,553	37,454,294	769	1,260	20	47.70	2,323,255	28%	17.6%
1998	57,674	113,111	60,831,431	50,178,812	825	1,055	19	42.80	2,603,585	25%	22.0%
1999	74,157	141,929	76,284,753	66,782,827	875	1,029	19	39.43	3,007,908	25%	27.6%
2000	95,733	159,645	97,035,925	76,652,358	790	1,014	16	41.24	4,001,762	27%	35.2%
2001	114,059	186,317	118,397,734	99,728,965	842	1,038	16	45.27	5,359,865	22%	42.9%

Notes:

1. Data from CTIA's semi annual survey as of December 2001 sponsored by the Federal Communications Commission.
2. Revenue per line has been declining as has the revenue per average investment.
3. The cost to gain an additional line (marginal cost per line) has averaged $833 per subscriber since 1995. The cummulative average is $842.
4. Average monthly mintues per subscriber was 1,689 in 2001 and 888 in 1995. Utilization has doubled and as price has declined.
5. The busy hour utilization can be estimated using 22 peak days per month and 12 peak daily hours The current use is 3.8 ccs/subscriber about the same as the wire line network.
6. The U. S. utilization is .11 erlangs (3.8/36) which is more than 2 times the utilization in the CubaCel Network or .05 peak elrlang 7. design
7. A typical Cell site in South Florida has 144 channels with a capacity of approximately 1,300 subscribers per site based on 3.8 ccs.
8. A cellular design for "La Habana" assuming current population density of over 100,000 per square mile and a 10% deman require one cell site per square mile with 672 (OC-1) channels per antenna, and one digital switch to handle the cellular demand.
9. Approximately 100 towers are required to provide an obiquitous cellular network for the island.

Appendix 4
World Wide Telecommunications Demand

	Population Million	Age Dist 15Y_65Y	Tel. Per 100 Pop	TV per 100 Pop	Internet per 100P	Cell[1998] per 100P	Cell Now	Bell South 4Q2001
Africa	571	51.5	3.1	6.6	0.5	0.6		
Asia (excluding Japan)	3,163	60.8	9.1	18.8	2.2	4.4		
Japan	125	69.8	48.5	69.5	21.7	51.3		
Australia	21	66.4	54.1	57.2	43.2	33.1		
Europe (Eastern)	234	58.6	25.9	111.0	8.0	10.4		
Europe (Western)	412	66.4	51.9	51.5	19.6	23.3		
Canada	28	67.3	67.5	78.4	48.5	15.3		
United States	278	65.3	75.2	84.9	57.4	26.8	43.0	
Rest of America	441	59.0	12.9	20.3	3.5	4.0		
Oceania	2	52.7	30.6	11.4	1.2	3.7		
World Wide Averages		60.5	17.3	28.8	7.3	8.0		
Totals in Millions	5,275		914.3	1,517.3	382.7	419.4		
Cuba (Current)	12	68.4	5.3	23.1	0.5	0.0	0.1	
Cuba (+10 Years)			15.0	23.0	10.0	10.0		
Latin America								
Argentina	33	61.0	22.9	27.5	2.8	9.2	8-10	4.2
Bolivia	6	54.2	5.1	14.0	0.5	1.8	3-5	
Brazil	150	60.1	11.3	24.3	5.8	2.9	6-10	6.0
Chile	14	63.3	19.1	23.2	4.6	6.9	9-11	5.6
Colombia	28	60.0	19.5	16.5	2.2	6.5	8-10	2.6
Costa Rica	2	58.9	18.1	21.1	6.0	5.7	6-10	
Dominican Republic	6	55.9	10.3	13.9	0.5	2.4	3-5	
Ecuador	11	57.8	8.4	14.4	0.2	1.5	5-7	2.7
Guatemala	9	51.4	7.2	14.4	0.7	7.2	7-8	0.6
Honduras	4	49.7	5.5	13.4	0.5	0.3	2-5	
Mexico	81	56.9	11.8	31.5	3.1	2.5	6-10	
Nicaragua	4	51.3	3.7	8.5	0.5	0.2	5-7	3.1
Panama	3	61.2	15.5	19.9	1.8	0.7	8-10	7.4
Paraguay	4	56.1	7.2	24.5	0.5	12.6	12-15	
Peru	22	59.0	6.9	13.9	1.8	2.3	5-7	1.6
Uruguay	3	62.6	27.5	25.3	9.7	9.7	12-15	6.5
Venezuela	20	58.5	17.3	20.2	2.0	9.9	15-18	13.9

Note for BellSouth Demand:

Bell South had a 10% growth rate in Cell phones in South America. Argentina and Chile lost lines, and the countries with low demand increased from 6% Panama to 50% for Ecuador. Bell South is the sole provider in some countries but has one competitor in most countries. In Brazil BellSouth only Serves Major Cities.

Note on data Sources:

1. The US 2001 update is based on FCC data all other information comes from Year End 1998 data from the CIA world
2. The data for Cuba is based detailed annual report for CubaCel.
2. All non cellular demand is based on year end 2000 data based on the CIA reports for year end 2001(www.CIA.gov).

Guaracabuya
Organo Oficial de la
Sociedad Económica de Amigos del País