Case Study: New Telerica's GSM networks

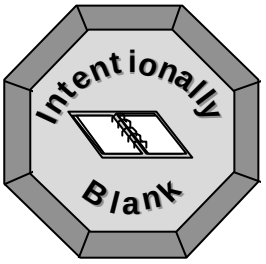
Appendix C

This appendix is designed to provide the student with an overview of a sample network: New Telerica. It shows the network set-up and growth over a number of years.

OBJECTIVES:

Upon completion of this chapter the student will be able to:

- Describe the basic development of a fictional operator's network from initial set-up to maturity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A: Case Study: New Telerica's GSM networks

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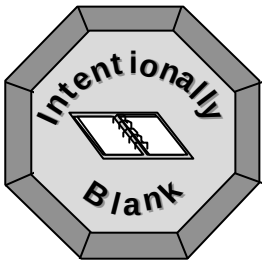
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INTRODUCTION TO NEW TELERICA

New Telerica is located on the shores of the Blue Sea. The western and southern borders are coastlines and mountains and forests cover the northern and eastern borders. New Telerica has a high GDP per person according to World Bank statistics. The currency is the Telerican Dollar (TED).

Gross Domestic Product (GDP)	92,100 TED/person
Area	507,500 km^2
Population	31,253,000
Population Density	61.6 inhabitants/km^2

Table C-1 Statistics of New Telerica

Figure C-1 New Telerica

Businesses

Industry and business development have a high priority in New Telerica.

The petroleum, petrochemical, mining and electronic industries operate at a high level of technology. Foodstuffs, textiles, clothing, plastic goods, cements, building materials and plywood are produced in somewhat less advanced facilities. These sorts of activities are still mainly concentrated in the cities, especially Secondia and Mildos, but the process is ongoing to relocate them to minor places and rural areas. The west coast of Isla de Felipe is the main center of the fishing industry and there are many small and medium fishing-related companies.

New Telerica has many large companies covering a wide range of businesses including building, food production, chemicals, medical products, electronics, computers and communications.

Transport Systems

The country is served by the following transport systems:

- **Shipping:** Port, in the south-western edge of New Telerica, is the largest port, followed by Piscor
- **Airports:** New Telerica has five main commercial airports, in Independencia, Secondia, Middleton, Port and Savorne. The airports in Independencia, Secondia and Savorne are the international airports for passenger traffic
- **Railways:** The railway system in New Telerica is operated by Ericorail and was modernized recently to enable high-speed passenger traffic and carriage of heavy goods traffic
- **Highways:** The country's highways, which are of good standard, cover a total of 19,750 km. The highway and railway carry the major part of all transport in New Telerica

Ten-Year Plan

New Telerica is a country with strong economic growth. The targets for continuing growth have been set forth in a comprehensive ten-year plan covering the period 1995 to 2005. The plan focuses on the

following areas, among others: education, industrialization, communications, agriculture and urbanization.

TELECOMMUNICATIONS IN NEW TELERICA

THE NEW TELERICAN TELECOM ADMINISTRATION (NTTA)

The Ministry of Communications governs telecommunications in New Telerica. This is divided into four departments, including one for telecommunications. The Department of Telecommunications has legal supervision of the New Telerica Telecom Administration (NTTA), even though they are, strictly speaking, two different organizations.

NTTA is a member of ITU and takes part in the work carried out by several work groups and committees of the standardization sector of ITU. All solutions and equipment introduced in the NTTA network shall comply with the recommendations of ITU.

The corporate goals for NTTA are:

- To apply, at the lowest possible cost, the facility of telecommunication services of all types to subscribers over the whole country of New Telerica
- To extend and develop the New Telerica telecommunications network with the highest possible degree of self-financing
- To operate and maintain the network as efficiently as possible

A retrospective study of the telecommunications development during the last 15-year period was performed. According to the figures of main lines and telephone sets, the development has been progressive with an average yearly increase of 9-10%.

CURRENT CELLULAR TELECOMMUNICATIONS

Six years ago the Ministry of Communications in conjunction to the Ministry of Commerce issued an operating license for a PLMN based upon GSM cellular technology. The network license was granted to Telcell, half-owned by NTTA.

Following the trends ongoing in several countries concerning liberalization of the market for telecommunication services, the license was based on an open market principle and competition at a convenient time in the future.

Since the start of the cellular network, demand for mobile services has been growing and so has the number of mobile subscribers.

One explanation for this, which is worth closer consideration, is the fact that less than 5% of the cellular subscribers are private. Business people in New Telerica very soon discovered that the mobile telephone is a powerful tool with a short pay-off time.

The number of subscribers in the cellular network today is 730,000, a penetration of 2.68%. The cellular network is also used to meet demands for sophisticated services in the rural areas, so called "fixed mobile" subscribers. About 40,000 subscribers are connected to the telecommunication network this way.

Overview of Telcell

The operating company, Telcell, was formed by NTTA (50%), Independent Insurance Company (25%) and private investment (25%). Telcell has to meet the following conditions:

- The operator is obliged to provide coverage to at least 90% of the population by the seventh year of operation. This will be done in four phases
- The operator shall retail the service to subscribers, but terminals are supplied in unrestricted competition by manufacturers. Any manufacturer may supply subscriber equipment subject to approval from Telcell
- Subscription and usage fees must be submitted to the Ministry of Communications for approval
- The design of the cellular network must not necessitate any significant changes in the existing telephone networks. As much as possible, the same facilities that exists for fixed telephone subscribers should be available to mobile subscribers

Telcell cell planning was performed by the NTTA. The goal of 90% population coverage was fulfilled after five years due to the unexpected growth of demand.

Overview of Peertel

In order to boost progress in industry, commerce and transport, it is now time to introduce a second GSM cellular network operator. Peertel was formed by Middlemedia (25%), NormData (25%), Ericorail (25%) and private investment (25%).

At the licensing contest, Peertel bound itself to the ambition of building a hierarchical digital cellular network for personal communications based on compatibility between macrocells, microcells and picocells. Peertel is expected to create high capacity and coverage in a short time and at low cost. The fulfillment of these requirements and the competition between Telcell and Peertel are expected to give lower cellular subscriber costs.

The supplier of the network elements performed Peertel cell planning. The goal of 70% population coverage was fulfilled after four years.

SETUP OF PEERTEL'S NETWORK

Market Strategy

When Peertel won the license to operate the second GSM network, they immediately set about analyzing the marketplace to determine what their market strategy would be.

The results of this analysis showed that most Telerican's did not have a favorable image of NTTA (PSTN). Among potential business users NTTA scored 55% satisfaction. Among potential residential users the figure was 30%. However, NTTA has changed its business practices and image considerably, and can no longer be discounted as a significant competitor.

Peertel's initial strategy was thus to sell itself as an aggressive market-driven operator and to establish a niche market. Their aim was to get both business and residential subscribers as a primary goal, with increasing subscriber traffic as a secondary goal. In the start-up phase, Peertel did not wish to compete directly with other network operators, as it would be very difficulty to win a price war with either Telcell and/or NTTA.

In particular Peertel saw scope for attracting residential subscribers - only 5% of Telcell's subscribers were residential.

Phase 1: From Network set-up to Network Operation

As part of their network setup, Peertel drew up interface agreements, started negotiations for transmission services, invited tenders for equipment, developed initial tariff plans, etc.

Interface Agreements

Peertel formed an agreement with NTTA to enable subscribers to both networks to make and receive calls across the networks. (NTTA has a separate deal with Telcell - in this way subscribers from Peertel can call those in Telcell.) They agreed that the charges applied for use of the other network would be 55% of the normal price of a call.

Transmission Services

Following difficult negotiations, Peertel agreed to use NTTA's network for transmission services. Basically, NTTA will provide 30 voice channels (2Mbits/s PCM link) to Peertel at a price of approximately 150,000 TED per year. This agreement is to be re-evaluated every two years.

Initial Tariff Plans

Peertel have decided that their tariff scheme must be lower than their competitor's. Peertel's initial tariffs were as follows:

Business Usage	**TED**
Connection	500
Monthly subscription	500
Call charges:	
• 8.00 - 18.00	4
• Other times	2
• Between Peertel mobiles	1
Residential Usage	
Connection	300
Monthly subscription	500
Call charges:	
• 8.00 - 18.00	6
• Other times	2
• Between Peertel mobiles	1
Free local calls (<15km) 19.00 to 24.00	

Table C-2 Tariff Plans

Phase 2: Network Roll-out

Board Decisions

Since the population is largely concentrated in the towns and along main roads, Peertel management made an early decision that initial network coverage was to be of main roads only. The intention was that this would achieve the following benefits:

- Provide coverage of business-people travelling between business centers
- Provide coverage for residents near the main roads
- Provide a strong sales argument by offering security to travelers in the case of vehicle breakdown

During the rollout phase a decision was made to offer free local calls (<15 km) after 18.00 hours for all subscribers. It was decided that the sales benefit from such an offer would outweigh the decrease in potential income.

Also at this stage, Ericorail expressed dissatisfaction with the transmission services agreement with NTTA, largely because Ericorail itself could offer some limited transmission capacity using its rail network as the basic infrastructure. To appease Ericorail a decision was made to ask planners to develop estimates and plans for alternative transmission systems (e.g. fiber optic cable from Indepedencia and Secondia), including Ericorail's network. In this it was recognized that very often the shortest feasible route between two towns was along the rail tracks.

Contingency Plans

The marketing department of Peertel provided their best estimate of expected subscriber growth. However, the inevitable uncertainty involved, called for maximum flexibility in terms of network support and expansion priorities.

In the radio access network, the initial problems of network structure were the number of installed transceivers for individual BTSs and the capacity of the attached BSCs. The transmission capacity was ample in the beginning since the star network had 30 channels (per BTS) and 1 transceiver uses only 3 of these. For flexibility the number of BTSs per link to the BSC was limited to 4 (using drop and insert). On average this allowed 2 transceivers per BTS.

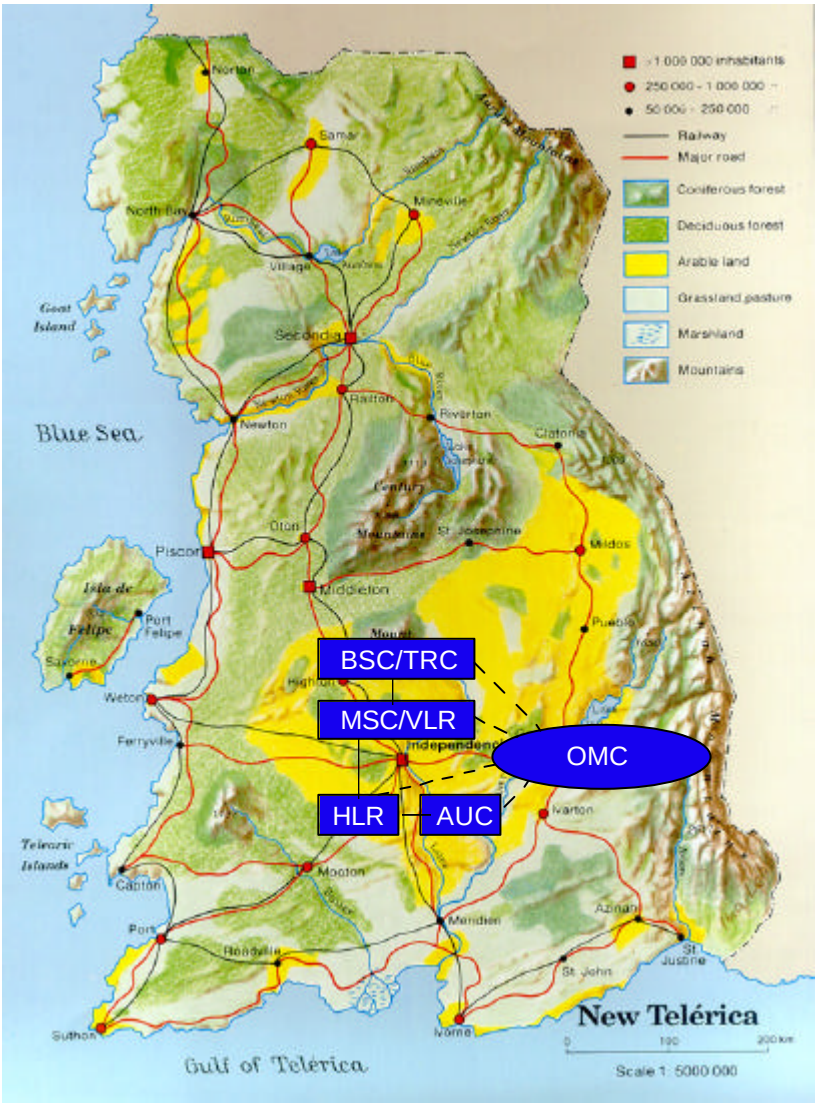


Figure C-2 Network layout

With flexibility in mind, ample physical space was planned in BTSs for expansion. In addition, planning permission was requested for additional strategic sites. This decision was made with the knowledge that, traditionally, the use of additional transmission capacity takes 9 months from initial request to actual service. These measures would enable quick expansion in the event of higher than expected cell traffic requirements.

BSC and MSC sites were located together at the center of Independencia, thus eliminating BSC-MSC transmission costs and enabling easier operation and maintenance (as both were at the same site). Peertel accepted that high traffic demands might have required remote BSCs at a later stage.

With regard to staff, Peertel recognized that its expert switching-related staff should be located in an OMC at the same location as the MSC and BSC. Its radio engineers were based in various remote locations, each supplied with the necessary transport and equipment to perform their BTS repairs[1]. Peertel also put in place the necessary training programs for its staff.

[1] Note: For simplification, it may be considered that one radio engineer has responsibility for approximately 35 BTSs. This is dependent on the geographical spread of the sites however

Planning Information

Financial data	
Depreciation period	
Buildings	20 years
Equipment	10 years
Cars	5 years
Car costs	200,000 TED
Depreciation interest	15 %
Average annual interest	12 %
Taxation	17 %
VAT	15 %
Average annual inflation	4 %
Annual premium	2 %

Table C-3 Financial data

Call Projections					
Year	**2**	**4**	**6**	**8**	**10**
Incoming Calls (%)					
Low	20	20	20	20	20
High	26	28	33	40	50
Expected	24	26	28	33	40
Outgoing Calls (%)					
Low	76	74	72	70	65
High	64	60	52	43	30
Expected	69	65	60	53	44
Mobile to Mobile Calls (%)					
Low	4	6	8	10	15
High	10	12	15	17	20
Expected	7	9	12	14	16

Table C-4 Call Projections

Roll-out phases					
		Population	Subscribers (1,000s)		
Year	Town	(1,000s)	Low	High	Expected
1	Independencia	2,312	20	57	48
	Secondia	3,237	32	90	73
	Total	**5,549**	**52**	**147**	**121**
3	Independencia	2,312	39	84	73
	Secondia	3,237	61	133	116
	Middleton	1,467	12	18	18
	Piscor	1,353	11	16	16
	Highton	443	3	5	5
	Oton	714	5	9	9
	Railton	343	3	5	5
	Suthon	692	3	4	4
	Port	620	2	4	4
	Mooton	394	1	2	2
	Ivorne	573	2	3	3
	Meridien	84	0	0	0
	Village	272	1	2	2
	North Bay	213	1	1	1
	Samar	355	1	2	2
	Mineville	437	2	3	3
	Total	**13,509**	**147**	**291**	**263**
5	Independencia	2,312	54	116	102
	Secondia	3,237	85	183	182
	Middleton	1,467	22	39	38
	Piscor	1,353	20	35	34
	Highton	443	8	11	10
	Oton	714	10	19	18
	Railton	343	8	11	10
	Suthon	692	8	14	13
	Port	620	7	14	13
	Mooton	394	4	5	7
	Ivorne	573	7	11	11
	Meridien	84	0	2	2
	Village	272	3	6	6
	North Bay	213	3	5	4
	Samar	355	4	8	7
	Mineville	437	5	9	9
	Riverton	208	2	4	3
	Clatonia	108	0	2	2
	Mildos	299	2	2	2
	Pueblo	156	0	2	2
	Gondor	180	0	2	2
	Ivarton	299	1	2	2
	St. Josephine	239	1	2	2
	Ferryville	143	0	2	2
	Weton	479	3	8	7
	Port Felipe	81	0	1	0
	Newton	201	1	1	1
	Norton	83	0	1	1
	Capton	167	1	1	1
	Roadville	107	0	1	1

	St. John	72	0	1	1
	Azinah	60	0	0	0
	St.Justine	107	0	1	1
	Total	**16,498**	**759**	**1,520**	**1,096**

Table C-5 Subscriber Projections

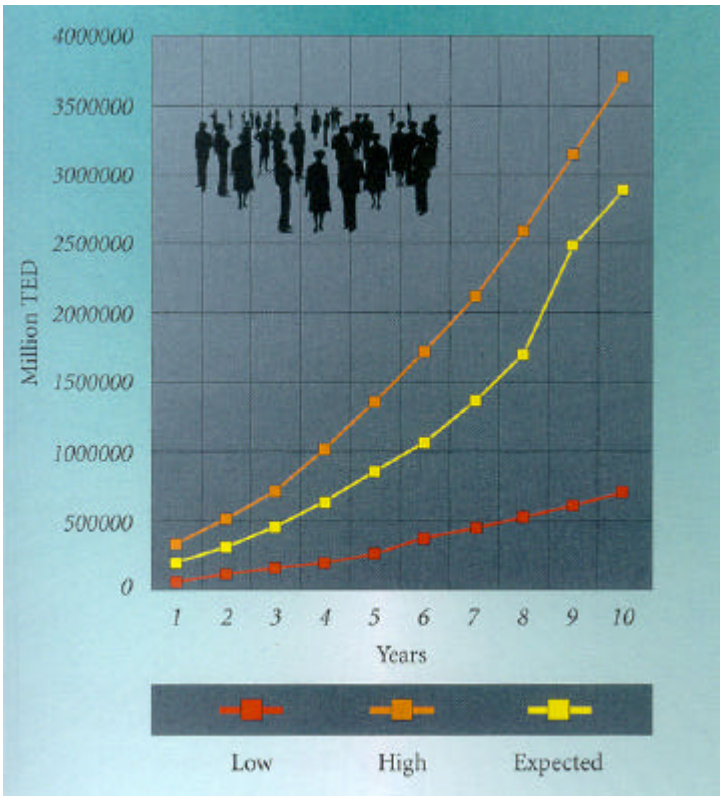


Figure C-3 Expected subscriber growth

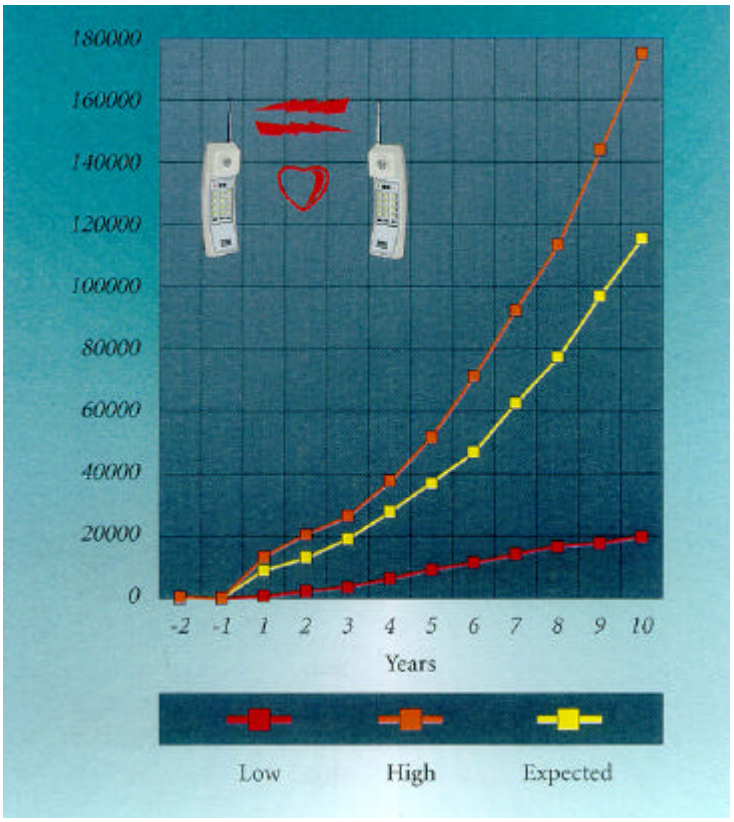


Figure C-4 Expected traffic

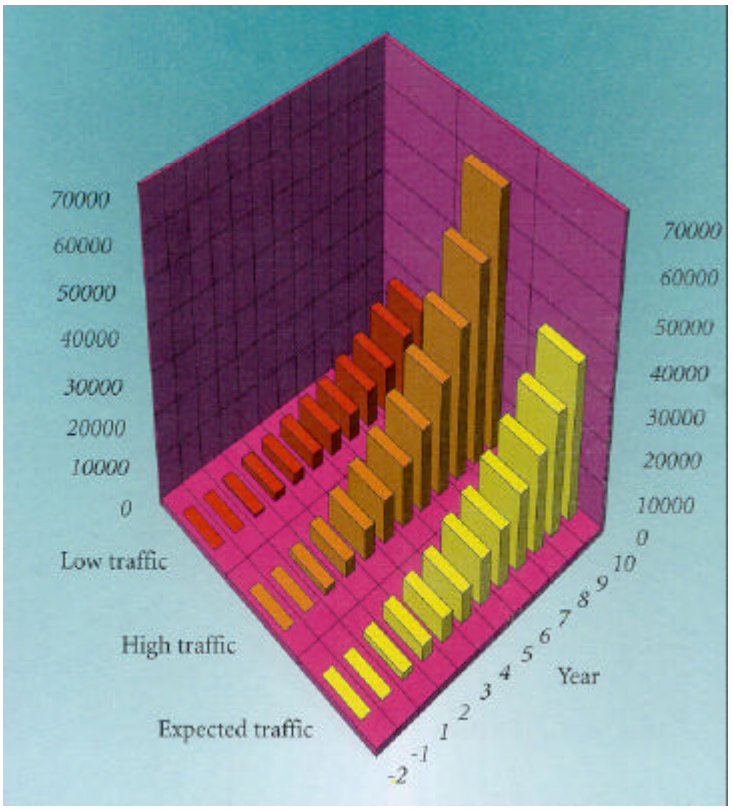


Figure C-5 Expected revenue

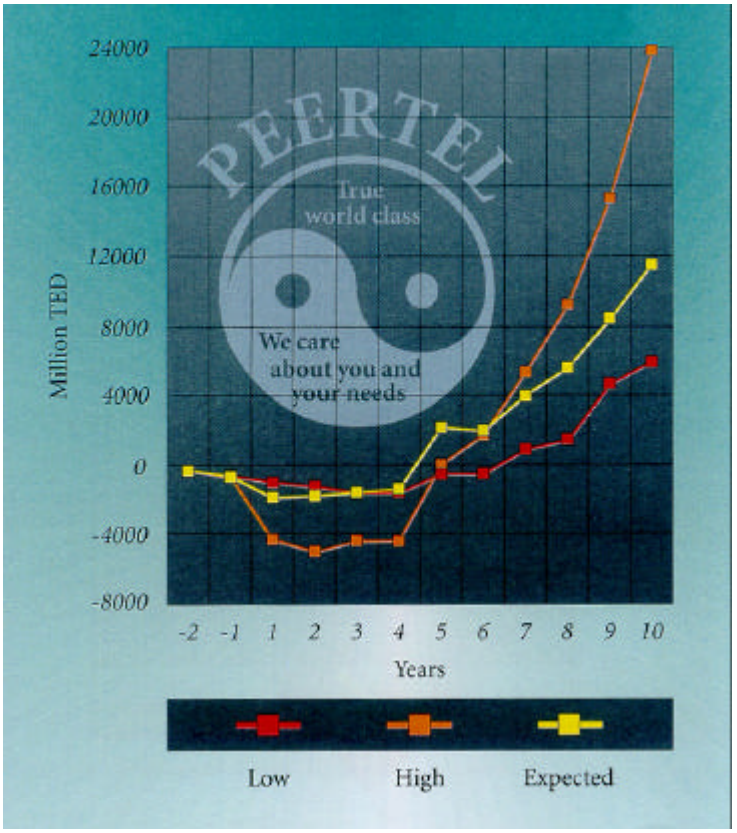


Figure C-6 Expected profit

Cell Planning Information

Peertel performed detailed cell planning for their network, as it was vital that it could successfully compete with Telcell's existing network.

A requirement of the license was that the network coverage in towns must allow for indoor coverage. This fact, among others, limited the cell sizes that they could use in some cases (e.g. concrete buildings and windows with heat-reflecting layers). Peertel calculated the average cell sizes listed in the following table.

Town and road:	**City**	**Urban**	**Suburban**
Cell Size:	**Radius (km)**	**Radius (km)**	**Radius (km)**
Independencia	0.5	2	4
Weton	1	3	5
Highton	2	3	6
Mildos	2	3	6
Clatonia	2	3	6
St. Josephine	3	5	8
Gondor	3	5	8
Ivarton	3	5	8
Pueblo	3	5	8
Middleton	1.5	3	6
Piscor	0.5	3	6
Port Felipe	1.5	3	6
Savorne	1	3	6
Riverton	2	4	8
Oton	2	3	5
Secondia	0.5	2	4
Railton	0.15	2	4
Village	3	5	8
Newton	1	3	5
Mineville	1	3	6
Samar	1	3	6
North Bay	1	3	6
Norton	3	5	8
Suton	1.5	3	6
Port	1.5	3	6
Ivorne	1.5	3	6
Moton	3	5	8
Capton	1.5	3	6
Ferryville	1.5	3	6
Roadville	2	4	6
Meridien	3	5	8
St. John	2	4	8
Azinah	3	5	8
St. Justine	2	4	6

Table C-6 Cell sizes

In addition to the above, the number of needed cells at end of year one was calculated as:

- Number of subscribers: 121,000
- Available frequencies: 48
- Cell pattern: 4/12
- GOS: 2%
- Traffic per subscriber: 25mE

Therefore:

- Frequencies per cell = 48 / 12 = 4
- Traffic channels per cell = 4 x 8 - 2 (control channels) = 30 TCH
- Traffic per cell = 30 TCH with a 2% GOS implies 21.932 Erlangs per cell (see table 6-1)
- The number of subscribers per cell = 21.932E / 25mE = 877 subscribers per cell
- If there are 121,000 subscribers then the number of cells needed is 121,000 / 877 = 138 cells.

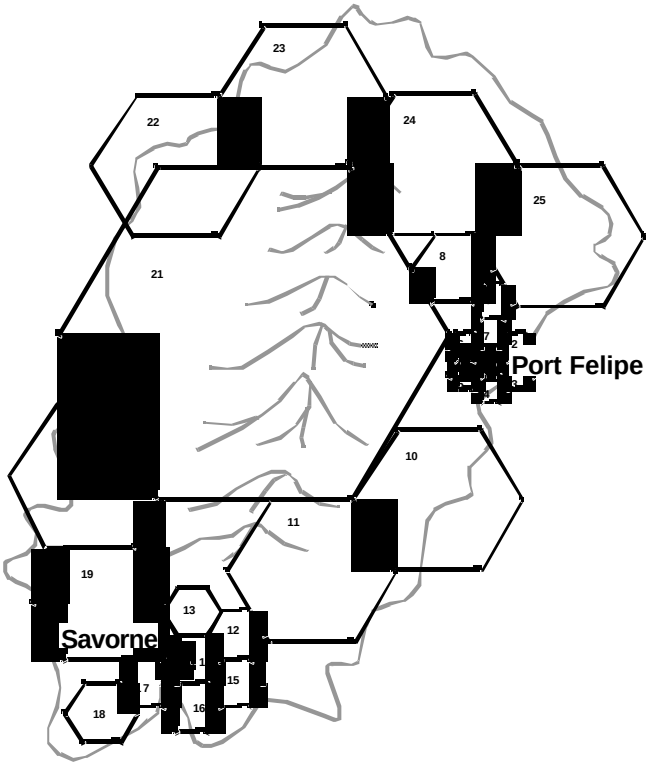
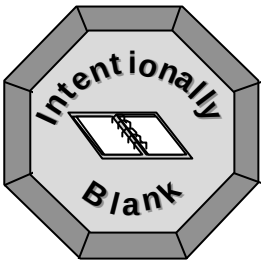


Figure C-7 Example of cellular network in Isla de Felipe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