2. BACKGROUND

Stringent austerity measures have often been imposed as a corrective measure in LDCs, but these programs often fall short since no substantial productive mechanism is in place to revamp their weak economy. Increasingly, these countries have recognized the need for technology to improve their debilitated conditions. While the development of indigenous technology may be encouraged, technology transfer is still seen as a vital process to improve these poor conditions [7]. Technology transfer is, therefore a frequently sought alternative by LDCs to improve their socio-economic conditions.

During this chapter the author will try to answer four questions (What, Why, Which, and Who) as presented in Figure 2.1. Chapter 3 tries to answer the question on "How".

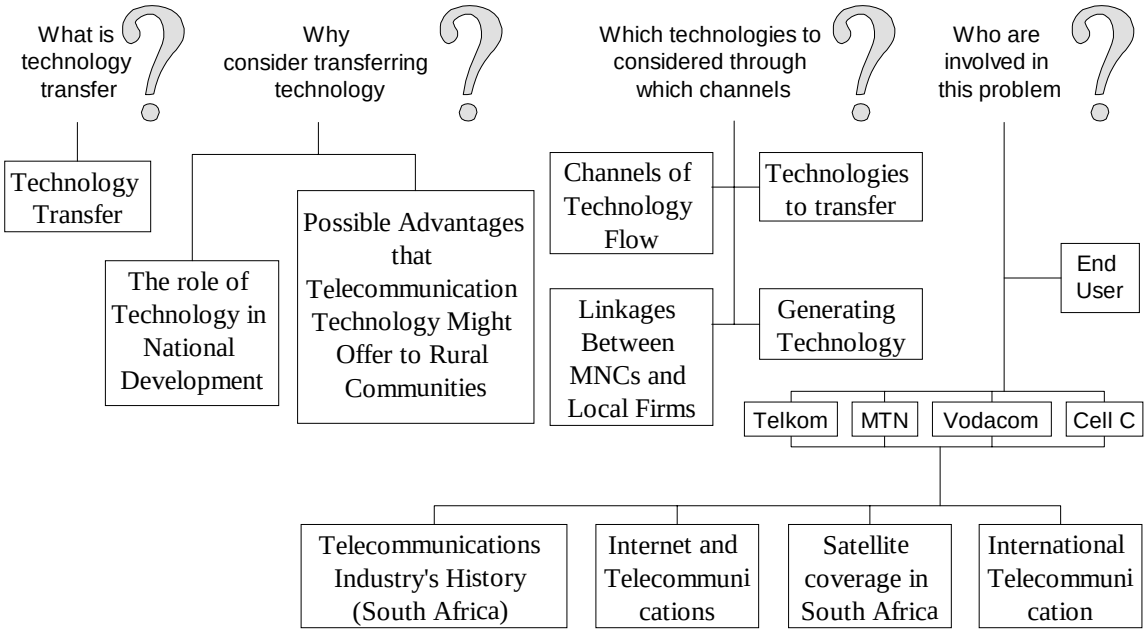

Figure 2.1. A background on technology transfer to LDCs

A background on technology transfer is given by answering these four questions namely:

1. What is technology transfer?

2. Why would anyone consider transferring technology at all? It is costly, it can make the receiving country increasingly dependent upon the supplying country (if one does not have own capability), and it's a confession that the receiver country has no competitive advantage. The only way one can answer this question is through having a look at the role of technology (in general) in national development and by looking at possible advantages, telecommunication technology might offer the rural communities

3. Which technologies should be considered for rural telecommunications and through which channels could they be transferred? The answer to this question can be found by first evaluating possible technologies suited for rural telecommunications. Then one should examine channels of technology flow and linkages between MNCs and

local firms to understand the transfer mediums used. It is also useful to understand why the generation of domestic technologies is important while thinking about this issue.

4. Who are involved in this problem of telecommunication technology transfer in South Africa? Part of the answer involves the end user, which was included but will only be discussed later during the model analysis in Chapter 6. The question furthermore involves the South African telecommunication industry (both fixed-line and mobile) and it will be overviewed on the basis of:

    - History of South Africa's Telecommunications Industry
    - Internet and Telecommunications
    - Satellite coverage in South Africa
    - International Telecommunication

2.1. Technology Transfer

Definition of Technology Transfer [7]***:*** The acquisition, development and utilization of technological knowledge by a firm/industry/country other than the one in which this knowledge originated. Technology transfer involves the acquisition of "inventive activity" by secondary users. Technology involves a hardware and software component. Hardware refers to the physical systems such as production systems, whilst software refers to the knowledge base that is essential in the smooth running of the hardware. Knowledge can be transferred through training and education, which could include training on how to effectively manage the technological processes and changes. A more complete definition for technology is given in Appendix A.

Transfer of technology often encounters serious problems, which makes it difficult to realize the goals of socio-economic development. Subsequent unproductive conflicts between the transferor and the transferee can further hinder the technology transfer process [7]. These difficulties, if not resolved before the implementation of the technology, may further delay the process of socio development in the LDC. Thus, a technology that is presumably unsuitable for the LDC's socio-economic growth, given its goals, strengths and weaknesses, may nevertheless be transferred.

The lack of linkages between the LDC's development strategies and their policies are a major reason for the transfer of inappropriate technology [7]. LDC's planners often view technology as constant and rarely consider it as a planning variable. Thus, technology, an important strategic variable for socio-economic development, is rarely integrated into the national development planning process.

The issue is not whether or not to transfer technology, but rather how to transfer appropriate technology. Appropriate technology is discussed in detail in Chapter 3. In short, appropriate technology refers to [7]:

- A technology that will make effective use of the LDC's limited resources and capabilities
- A technology that is sensitive towards the LDC's environment
- A technology that is capable of helping the LDC to further develop their resources

LDCs have many problems with information and information management. The focus of information technology in developing countries has to be on many targets such as population, information to the villages, farmers, researchers, and decision makers [6]. A part of the development problem is the question: "How is it possible to provide greater access to scientific and other development information of the LDC's population [6]. Socio-economic, cultural, educational, technical, and environmental conditions differ from country to country. Three assumptions concerning technology transfer that could be made for LDCs are [6]:

1. Resources in poor countries are not sufficient enough to implement independent information systems, services, and networks.

2. The necessary donor sources must target the creation of services containing indigenous sources of information.

3. The creation and production of independent and unconnected information services may lead to duplication and overlap. Co-operation will reduce waste and make the use of indigenous information optimal.

It is very important to appropriately tailor information technologies to local conditions if its adoption is to be effective [6]. The increased complexity of technology is such that no individual firm or country can hope to satisfy all its needs. Japan and Asia's experience [8] showed that industrial development in the latter half of the twentieth century and beyond has as one of its key requirements the upgrading of technology in production and infrastructures.

2.2. The Role of Technology in National Development

Policy makers and planners must consider technology as an important variable in national development. Technology is a variable that needs to be modified to satisfy changing societal needs [7]. The concentration of planners should not only be focussed on the advantages but also on how to possibly control and manage the negative impacts of technology. Figure 2.2 illustrates the advantages that technology may have to offer the LDC. The fact that these advantages are not guaranteed with technology needs to be stressed because only an appropriate technology, when effectively transferred and managed, will have these advantages.

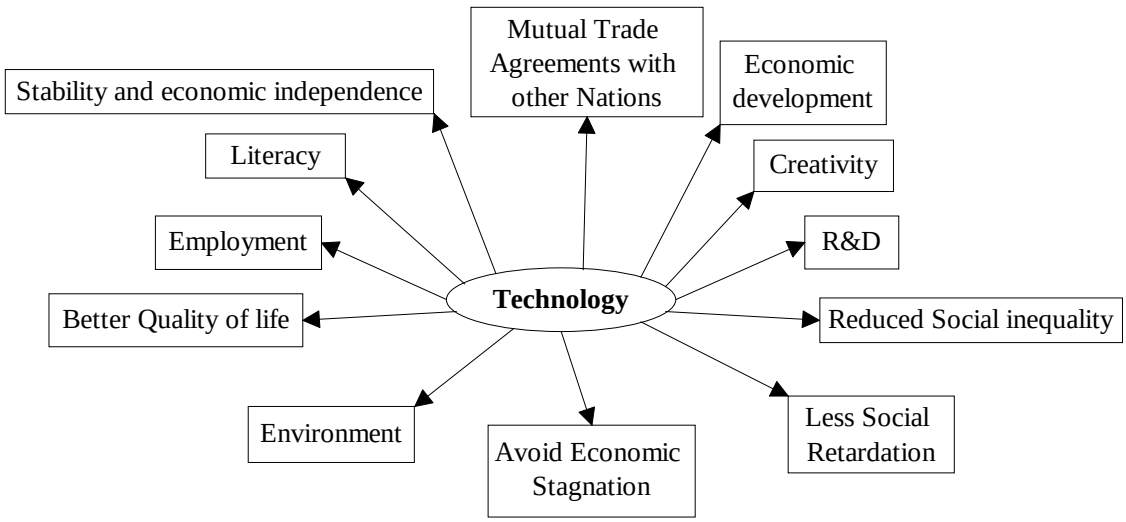

Figure 2.2. Advantages that technology has to offer in National Development

2.2.1. Employment

Appropriate technology transfer leads to employment opportunities for the population of the receiving country. The technology has to be able to utilize the available workforce and not subject the nation to the use of expatriates. Before technology can be successfully transferred, the required labour force must be adequately trained.

Technology is seen as a means of improving the deliberating economy of the LDCs. One way this aim can be achieved is through the creation of jobs. Generally, assembly line operations are more likely to use direct labour than highly automated systems [7]. Automated systems also require the use of integrated computer systems. Even though productivity has been shown to be significantly higher using such advanced systems, their demand for more advanced personnel, (computer programmers and system analysts), make them impractical for the LDC lacking people with such skills. This may include the training of skilled manpower and management needed for the smooth and effective utilization of the technology. The present focus should be on the use of present capabilities of the country rather than dependence on the transferor for a productive workforce.

The development of related and supporting industries leads to the creation of new jobs and may also lead to the development of new skills that may be necessary to satisfy changing industrial needs. Competitiveness and innovation also encourage the development of new products and services, leading to further increased employment.

2.2.2. Improved Quality of Life

In the LDCs, quality of life will imply developing preventive measures against some of the diseases that incapacitate their labour force, provision of social services, especially for children and the elderly, and enacting environmental protection laws [7]. Policy makers have roles to play to ensure that they are not dragged into a technology race that disregards the quality of life. It is imperative that technology will lead to the creation of jobs. The labour force absorbed as a result of this may contribute positively to society.

In the extended family systems that exist in most of the LDCs, such increased [7] self-esteem often translates into family pride, role models, and eventually continuity in the development of a skilled labour force by means of emulation and imitation.

2.2.3. Environmental Pollution

Environmentalists complain about the destruction of the ozone layer, acid rain, destruction of forestry, poor air quality, and the contamination of drinking water. One has to come to terms with industrial wastes. Recently, some of the industrialized countries have attempted to dump nuclear waste in LDCs [7]. In some countries, development has often meant the exclusive destruction of the habitat of other species, an act that eventually leads to their extinction.

2.2.4. Economic Stagnation

A country may acquire an inappropriate technology that may end up eroding its competitive advantage in other sectors such as agriculture and tourism. Agreements that virtually guarantee absolute monopoly to some of the investors limit foreign investments, increase inflation and unemployment, and reduce corporate tax revenues.

2.2.5. Social Inequality

Inappropriate technology refers to technology, which is socially irresponsible and insensitive to the needs, capabilities, aspirations, and expectations of the receiver. As aesthetic quality of these products continue to improve, we develop increasing needs and tend to demand more and more. Wealth becomes a necessary instrument with which to satisfy this unending urge. Social crimes in society are often associated with economic inequalities [7] or mal-distribution of incomes.

2.2.6. Research and Development (R&D)

R&D is necessary in order for the transferred technology to survive. Differences between developed countries and LDCs are shaped by the environment and people's career experiences. As a result, the way people conceptualise, analyse, and solve problems differs. These psychological attributes play a major role in determining the right types of products and services to provide to the people of all cultures, and understanding these attributes requires the participation of indigenous people in technological decisions.

The participation of supporting and related businesses in R&D not only leads to innovation and change but also generates synergistic benefits. The major manufacturers benefit from the redistribution of their resources to other R&D activities. Moreover, the cost of R&D is reduced as the manufacturer utilizes the efforts of other companies without necessarily being directly involved.

2.2.7. Enhanced Creativity

Innovativeness and creativity can be developed through the assimilation of new technology. Technologies are at times mutually dependant on each other. People become more innovative as they seek to relate existing technology to local conditions and other

technological and social problems. It is through innovative activities such as these that new technologies and new industries can be further developed [7].

2.2.8. Economic development

Many economies benefits derive the successful transfer of technology. More employment opportunities, increased GNP as a result of improved productivity, direct foreign investments, and increased gold reserves are all signs of economic development. LDCs should be able to develop, modify, and enhance the transferred technology if they intend to achieve long-term economic growth [7]. From the perspective of the LDCs, it is absolutely necessary that economic development be achieved if they are to be able to sustain their growing population and continue to provide social services for them.

2.2.9. Mutual Trade Agreements With Other Nations

Although many continue to serve as a major supplier of raw material to the world, the LDC's products are often devalued since buyers, rather than sellers, determine prices. Mutual trade agreements can assist the LDCs in reducing debts by exchanging technology for some of their raw materials. A fair price mechanism will help ensure that the transferred technology doesn't create an additional financial burden to the receiver of technology. Mutual trade agreements should also allow the LDC to export products of that technology to external markets. The availability of technology may help them limit the export of their replenishable and non-reusable raw materials.

2.2.10. Stability and Economic Independence

Stability cannot be achieved without economic prosperity and some economic independence. It is well understood that neither of these can be achieved without technology. Thus, stability is indirectly linked to technology [7].

2.2.11. Literacy

There is a need to be able to read technical manuals and instructions, to understand signals and symbols, to communicate with fellow workers and management, and even to understand quality control measures in the LDCs. Governments are also likely to emphasis education as the only means of sustaining technological progress [7]. Activities such as R&D, technological innovation, and management of technology are only possible and achievable if there is trained manpower able to relate the local conditions to the technology.

2.3. Possible Advantages that Telecommunication Might Offer Rural Communities

To many people, living in rural areas, telecommunication will stay a distant luxury, which they know nothing about and that is only allotted for the rich and fortunate living in the big civilized cities. It is not always the case that traditional communities don't afford telecom services, they often don't understand most of the terminology used and cannot grasp the advantages that it might have to offer them. A simple and easy to implement solution that comes to mind might be to launch an awareness campaign and inform people of all the advantages. This is unfortunately a much worse problem than is often believed and is rooted high up in the governmental authority. The government must first understand the

advantages that the telecommunication sector has to offer them before they will participate in any awareness campaign to have this message filtered through to the rural communities. It is thus important to focus on advantages that telecommunications can have to offer the LDC's governments and rural communities.

General Advantages of Telecommunications in Development

Modern telecommunications systems have the potential to lower cultural barriers, overcome economic inequalities and provide education opportunities [6]. Information processing and telecommunications are vital technologies for sustainable development [10]. These are the foundation for LDCs to participate in the global business arena. Through information processing and telecommunications, companies furthermore gain access to essential domestic as well as worldwide databases of information on available and alternative sources of technologies. This will increase the frequency and quality of technology transfer decisions.

Telecommunications are part of the infrastructure, which is essential for economic and commercial operation of a healthy economy. Without a solid backbone for telecommunication infrastructure, the efficiency of the LDC's private sector would decrease even further compared to the more industrialized nations of the North [6]. These major trading economies view information- and communication technologies as significant tools to improve domestic and international competitiveness.

Figure 2.3 illustrate the advantages, which affect the rural area people directly.

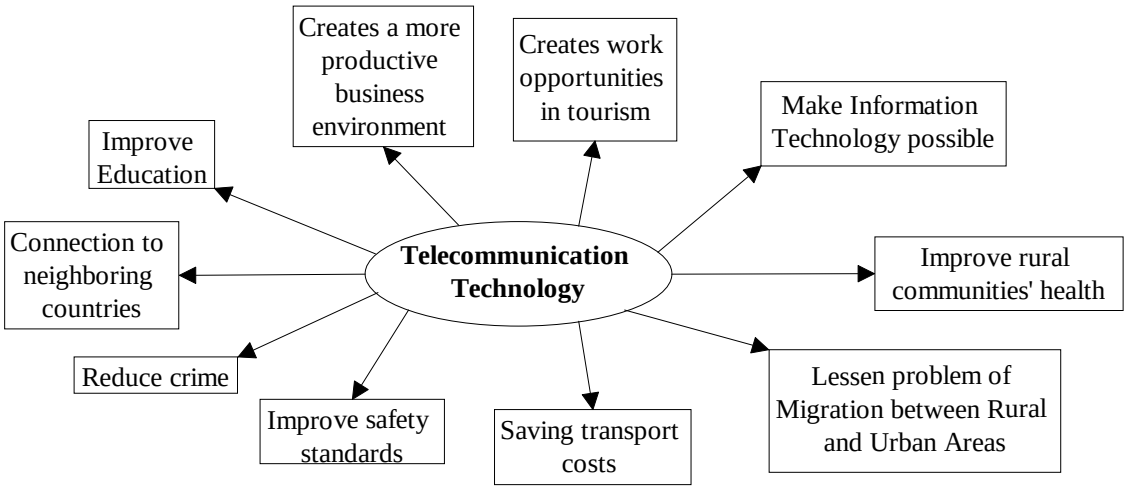

Figure 2.3. Advantages that telecommunication technology has to offer to rural communities

2.3.1. Telecommunication Creates a More Productive Business Environment

Studies in Kenya [6] have shown that efficiency of business is greater when access to telecommunication services is more reliable. The improvement affect aspects like: inventory levels, vehicle usage, managerial and labour time, lower distribution costs and higher sales prices. Lack of good telecommunication has caused constraints of service

industries in Sub-Saharan Africa including banking, accounting, advertising, and other areas, which relay heavily on efficient data collection, storage or dissemination.

2.3.2. Telecommunication Creates Work Opportunities In Tourism

Tourism (the most important growth industry in LDCs) relies heavily on a good telecommunication infrastructure. It brings 40 000 visitors [6] a year with much hard currency to Zimbabwe alone. Young entrepreneurs can also transform their primitive situation into a business opportunity but also need a means to telecommunication to advertise the new venture.

2.3.3. Telecommunication Makes Information Technology Possible

Information Technology and Development

Technology transfer is an ongoing process that is continually dependent on information flow on the performance of existing technology [6]. This is why some time has to be devoted on the influences that information technology can have on development.

Definition of Information Technology (IT) [6]***:*** Information technology is various technologies, which are used in the creation, acquisition, storage, dissemination, retrieval, manipulation, and transmission of information. IT includes computers, various telecommunication devises, media, broadcasting, press, micro-graphics, audio, visuals, and ext.

In the circumstances of a particular development context three groups of persons will need information. They are [6]:

1. People that are part of the development process, and in the process of development.

2. People involved with the operational side of development. Developers need information on what takes place in other development fields. Their particular activities cannot occur in isolation from progress in other fields such as education or community development.

3. People who participate in the management of development projects need strategic and managerial information, which will facilitate decision-making.

Information technology utilization in Africa has not reached its full potential. The problems are: under-utilization of equipment, lack of indigenous maintenance capability, and the fact that equipment is mainly foreign.

Trained staff and informed people are at the core of the infrastructure required for development. In LDCs, part of the developing process should be to organize data in ways meaningful to the local environment [6]. The availability of valuable indigenous information is a necessity for development. LDCs in Sub-Sahara Africa should therefore facilitate the training and emergence of effective and skilled producers and users of information. General characteristics, which should be present when the development role of information resources is optimal, are [6]:

- Ease of use. Information systems must have user-friendly interfaces and be able to adapt to specific user patterns and to different literacy levels.

- Accessibility to relevant information. The systems should intentionally withhold non-relevant information but not deny access or omit information of value.

- High quality of information. Information and information-systems should be reliable, accurate, current, and valid.

- Adaptability. Systems should communicate the content and meaning of information in ways easy to understand and easy to use.

- Time and cost effective.

2.3.4. Telecommunication's Might Improve Rural Communities' Health

A very pressingly important issue of concern is that a high proportion of doctors head overseas each year after their year of Community service (CS) in South Africa in which they got trained on the job. Rudasa (the Rural Doctors' Association of Southern Africa) said: "CS had improved the situation in some provinces, but the scheme had two serious shortcomings [11]:

1. A lack of senior doctors to supervise CS doctors, and

2. The fact that only a quarter of CS doctors actually went to rural hospitals".

The Eastern Cape which desperately needs more staff, for example, have no CS doctors for 2001 [11]. The provinces should make special efforts to recruit South African-qualified doctors back from Canada and the United Kingdom, to work in rural hospitals. A big part of the CS doctors' unwillingness comes from the poor safety standards and infrastructure in the rural areas. This is a field in which the telecommunications sector can play a role.

2.3.5. Telecommunication Helps to Lessen The Problem of Migration Between Rural and Urban Areas

Many people lack the skill to be accommodated in urban industries. As quickly as the rural population flooded the cities, urban slums were created. The government was unable to meet the increasing demand in social services, and consequently there were food shortages and skyrocketing inflation [7]. The crime rate increased as a result of the failing attempt to survive the greater pressures of urban cities. White-collar crime such as bribery and corruption rose to an all time high.

Today even the LDCs have a small modern sector with an urban bias, consisting of mainly manufacturing and services industries, foreign commerce, transport, and a few modern agricultural farms. On the other hand, the dominant sector of the economy, which includes vast traditional agricultural and allied activities, handicrafts, cottage industries, and local commerce, is backward not only in term of technology but also in terms of the general outlook. The modern sector can assist the traditional sector in two ways and the net outcome depends on the relative strengths of the two effects [8]. These are:

- ***"Spread effects"***
  Operating through both the supply of new ideas and the pull of demand.

- ***"Backwash effect"***
  Operating through the flow of capital and skilled labour.

The modern sector in the Eastern LDCs, cluster mainly around the urban cities. People living in these areas are culturally distant from the rest of the population and, therefore, become ineffective as vehicles of innovative ideas. So the characteristic commercial attitude cannot penetrate the indigenous sector, which is left more or less unaffected. It becomes a kind of static coexistence [8] and not a process of dynamic interaction.

The modern sector might also have a destructive [8] effect as a result. Cottage industries have been destroyed in the face of stiff competition from the modern sector. A further negative effect is that the expansion of the factory industries has not been fast enough to absorb the entire labour force. The traditional sector has become sick (unproductive and dependant on the formal sector) as a result of being faced with the problem of underemployment and disguised unemployment. A part of the surplus labour force keep migrating into towns and cities, and the modern sector's rate of capital accumulation is not rapid enough.

Migration on a large scale from rural area to big cities is generally acknowledged to be one of the more difficult problems facing LDCs [12]. Singapore's Prime Minister Lee Quan Yu said [10] (during the African Leadership Meeting held in Singapore in 1993) that family projects and local industry should be encouraged to create economic opportunities, and that people should be kept from emigrating to large cities. If the population flow were slowed down, the cities would be better able to absorb and generate employment for new immigrants and to cope with internal development problems [12]. Investment in rural infrastructure, including roads, water supply, and telephone links, has been suggested as one way to slow rural to urban migration because these improvements can reduce some of the basic disadvantages of living in a rural location. Rapid information in time of medical need or natural disasters (through telecommunication) could improve conditions in rural areas of LDCs and may in fact create additional employment opportunities [12].

On the other hand it might be argued that a rural telephone program could encourage migration [12] since the migrants could more easily keep in touch with their home village and family and would not have to endure long periods of "family information blackouts".

Migration however, depends greatly on the flow of information about job opportunities, living standards, and so forth. Without alternative communication sources rural migrants tend to follow the migration patterns of kin and friends [12] rather than risk the uncertainty of going to other places, which, in fact, may have potentially greater opportunities. If rural communities are better able to call or to receive telephone calls or call-relayed messages from friends, relatives, and acquaintances throughout a region or in other regions, better information could be received. This could ultimately bring about "a higher proportion of successful (permanent and well-paid) migrations [12], a redirection of migration towards secondary and more distant urban centres, and an increase in the overall efficiency of migration in the region.

Migration from rural area to big cities causes an army of urban unemployed, which brings about socio-political tension. There is an inevitable clash between the modern sector and the traditional sector with conflicting social and economic interests. It is however possible to reduce this negative effect, which the two sectors have on each other. This is done through adaptation of foreign technology [8] (not neglecting modernization of indigenous technology), and growth of intermediate towns.

- **Adaptation of Technology**
  In economies with surplus labour, in the process of modernization of the traditional sector there is considerable room for the development of intermediate technology, which may turn out to be the most appropriate technology [8] under the current socio-economic conditions.

- **Intermediate Towns.**
  There should be a hierarchical structure of urban development in LDCs. At the centre of a number of villages there should be intermediate towns [8] or cities. Again, for a number of intermediate towns or cities there should be a large city. These intermediate towns or cities could act as a bridge between the villages and the metropolis.

2.3.6. Telecommunication's Saves Transport Costs In Rural Areas

Telecommunications can reduce costs of transport in LDCs. A perfect example of this fact is an experience of two rural factories situated in Bangladesh [12] where radiophones made huge cost savings possible.

In early 1980 a radiotelephone was installed at both the Nabaran Jute Mill (NJM) and at the Ghorasal Fertilizer Factory (GFF) outside Dhaka. The initial data and expenditure savings estimates are presented in Table 2.1. [12]. A more complete calculation would however include savings in vehicle capital, other operation and maintenance costs, and other direct and indirect expenditures. The use of the telephones will reduce the number of trips to Dhaka for both companies in which a driver and two managers are occupied.

Benefits for both companies NJM & GFF			
Radiotelephone cost	190,000.00	Taka	
Installation	10,000.00	Taka	
Maintenance beginning after one year of operation	20,000.00	Taka/year	
Calls per week	96	Calls/week	
Assumed number of working weeks	48	Weeks/year	
Calls per year	4,608	Calls/year	
Call charge	0.75	Taka/call	
Telephone operations cost	3,456.00	Taka/call	
Costs occurred during first year	203,456.00	Taka/call	
Costs occurred during second & succeeding years	23,456.00	Taka/call	
Costs for companies			
Item	**NJM**	**GFF**	**Units**
Appropriate distance from Dhaka	20	40	Miles
Average number of round trips to Dhaka per week:			
Before installation of telephone	18	11	Trips/week
After installation of telephone	2	1.50	Trips/week
Assumed number of working weeks	48	48	Weeks/year
Average road-trip gasoline cost	350.00	650.00	Taka/trip
Average trip-trip time	4	7	Hours/trip
Average number of staff making trip (including driver)	3	3	People
Average wage of management staff making trip	1,000.00	1,200.00	Taka/month
Average number of working hours	42	42	Hours/week
Gasoline expenditure savings	268,800.00	296,400.00	Taka/year
Reduced wage expenditure for two management staff	36,571.43	45,600.00	Taka/year
Total expenditure difference	305,371.43	342,000.00	Taka/year
Cost benefit ratios	**NJM**	**GFF**	
Savings exceeds cost during year 1 by	150.09%	168.10%	
Savings exceeds cost during year 2, 3, 4... by	1301.89%	1458.05%	

Table 2.1. Factory Expenditure Savings Data from Bangladesh 1981 [12]

Respectively, in the first year direct communication expenditure exceeded costs by about 1.5 times at NJM and 1.68 times at GFF [12]. During the second and each succeeding year direct savings exceeded costs by about 13 times at NJM and 14.5 times at GFF.

2.3.7. Telecommunication Can Improve Safety Standards

Mobile telephony hold the opportunity to provide the user with a network that will enable him/her to get a hold of emergency services while outside big cities. Cellphone technology can also be applied to help find stolen vehicles. Another way that the service provider can improve safety is to offer the user a toll free emergency number that is linked to rescue-

units country wide or even worldwide. The fixed line provider can also participate in this manner.

2.3.8. Telecommunication Can Reduce Crime

A significant proportion of crime in LDCs is often within the telecommunication companies in the form of theft and corruption. Better management and control together with prosecution of criminals is the only answer to this problem. When a person commits a crime internal to a company in most LDCs, he stands a chance of losing his job but the case is rarely taken up in court and criminal charges aren't filed against that person. This causes a workforce containing bad elements, which might influence the majority and worsen the problem. Another way in which mobile telecommunication companies may help prevent crime is by blacklisting cellphones.

2.3.9. Connect to Neighbouring Countries Through Telecommunications

Through telecommunication, interaction is made easier between countries and the surrounding countries should be seen as an unexploited market segment that might bring further job opportunities.

2.3.10. Education Through the Telecommunication Industry

Education must probably be the most important area in which telecommunication can play a crucial role in LDCs. They can get involved through a number of ways for example:

- Bursary- and scholarship programs
- Practical training and exposure to new technology
- Training, skills transfer, and human resource development
- Donations to schools in the form of funds or hardware and the necessary training to utilize these technologies to a maximum
- Promote physical development programs in sports, health, and fitness.

By loans, gifts, and bilateral development contracts, opportunities have been generated to the LDCs whom cant afford high technology microcomputer systems. They obtained the equipment and some people were trained to use it, but after their training these people moved to better jobs in the organization, and the skills are seldom passed on to other employees [13]. As a result, equipment that might accelerate the development of these LDCs when used in the correct way stood unused and became non-profitable.

Telecommunications Makes Remote Education Possible

The infrastructure for adequate training and education is dramatically lacking in many African countries. It is in this area that modern telecommunication and information technologies can have one of their greatest impacts on the development of South Africa [6]. The basic process of instruction is demonstrated in Figure 2.4.

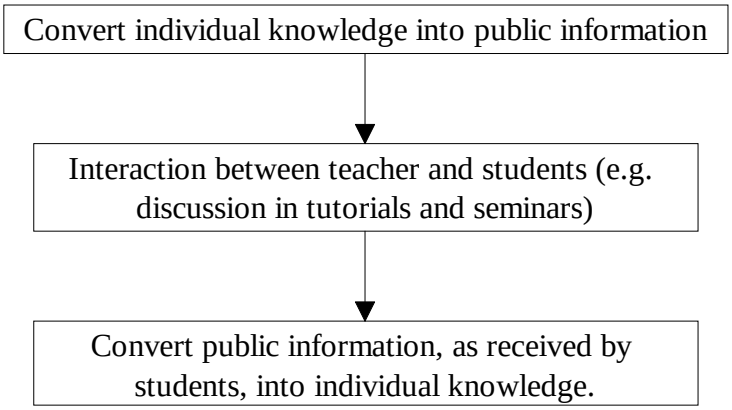

Figure 2.4. Basic process of instruction

Opportunities exist to use development (in ATM technology) to build a new environment for long-distance education, which takes advantage of multimedia documents to enhance the learning process. Two prominent considerations led to the selection of ATM technology. There is a need for multiple video streams along with high-resolution images (10^s of Megabytes each). ATM high-speed networks however supply bandwidth from 155Mbps to 2.4Gbps and have the capacity to distribute images in real time [6]. ATM has become the standard for future broadband integrated services digital network (B-ISDN) applications.

'Tele-presence' of students in the classroom is crucial to make their active involvement possible and allow instructors to gauge their success in transmitting information and knowledge. It must be possible to view the material at different times. It must be reusable. This necessitates the capture of class sessions and of the material displayed to allow playback at a later time. Distance education must be accessible to users, both students and instructors [6]. This is true in terms of physical access and ease of use, as well as minimal amount of training by using the available technology.

2.4. Technologies to transfer

A combination of technologies based on: computers, microelectronics, telecommunications and space technology [6] allow for the mechanical collection, collation, storage, retrieving and dissemination of information. These technologies are widely in use in more industrialized countries. Not all however carry immediate value for the less developed world.

Rural Telecommunications

Digital personal radio-communication systems and mobile cellular systems can facilitate and accelerate access to world networks. Low orbit satellite systems can also translate into a sensible price reduction of remote area telecommunications. The following technologies however are currently available for rural telecommunications [6]:

- Analogue and digital radio-telecommunication systems
- Mobile or fixed cellular radio-communication systems

- Satellite communication systems including micro stations, mobile satellite communication systems, national satellites, etc.

- Small mobile ground stations such as those provided by INMARSAT.

Although LDCs are not using high technology to develop, they try to benefit from a combination of information technology and telecommunication [13]. It includes aspects such as information gathering, processing, handling, storage, retrieval, and communication by machines.

Features supporting computerization in urban and regional LDC planning are [13]:

1. Fast increase in population figures.

2. Problematic housing conditions for the urban poor masses.

3. Lag between the increase of population and housing, and the realization of technical infrastructure and facilities.

4. Unbalanced land use developments in urbanized areas.

2.5. Channels of Technology Flow

Technology flows easily across boundaries of countries, industries, departments or individuals, provided that the right channels of flow exist. Three types [7] of channels can allow effective technology flow. These are:

2.5.1. General Channels

General channels refer to education, training, books, journals and other published materials, conferences, study missions, and exchange of visits [7]. Technology flows unintentionally when information is made available with limited restrictions in the public domain. Users are then free to apply the technology for their purpose.

2.5.2. Reverse Engineering Channels

Reverse engineering is another channel that allows technology to be transferred without the contribution from the source. The host, or the traditional receiver is capable of developing the capability to duplicate it in some fashion. This is feasible provided that the host has the technology to reverse engineer [7] and that there is no legal violation of intellectual or property rights. These channels are usually the most difficult ones to establish in developing countries because of the absence of knowledge that was not able to flow through the general channels.

2.5.3. Planned Channels

Technology transfer is done intentionally with the consent of the technology owner. Several types then permit access to, and use of, technology know-how. These are:

2.5.3.1. Foreign Direct Investment (FDI)

A MNC or the transferor establishes a wholly owned secondary business in the LDC. The technology remains between the boundaries of the MNC to be controlled. Through FDI the investor gains access to a labour force, natural resources, and markets, while the host country receives technology know-how, employment opportunities for its people, training of the workforce, investment capital that adds to the development of the infrastructure, and a tax advantage since most employees will be contributing to the local economy [10].

Spillovers of MNC Technology

The most significant channel for the distribution of modern, advanced technology are external effects or "Spillovers" [14] from foreign direct investment (FDI), rather than formal technology arrangements.

When firms establish affiliates abroad and become multinational, they are distinguished from the already established firms in the host country for two reasons [14]:

1. They bring with them some amount of the patented technology that constitutes their firm-specific advantage and allows them to compete successfully with local firms who have superior knowledge of local markets, consumer preferences, and business practices.

2. The MNC affiliate further disturbs the existing equilibrium in the market and forces local firms to take action to protect their market share and profit, which leads to productivity increases.

The simplest example of a Spillover is perhaps the case where a local firm improves its productivity by copying some technology used by MNC affiliates operation in the local market. Spillover also occur if the entry of the affiliate leads to more severe competition in the host economy, so that local firms are forced to use existing technology and resources more effectively. Another form of spillover takes place if the competition forces local forms to search for new, more efficient technologies. These effects may take place either in the foreign affiliate's own industry, or in other industries, among the affiliate's suppliers and customers.

MNCs have three alternative ways to exploit its technological advantages internationally. They could produce for export in the home country, sell technology to foreigners, or can establish an affiliate abroad and control foreign production directly. A technology that is exploited through FDI will probably not be licensed to the local competitors in the host country. This implies that the local firms' only chances to gain access to the technology is through reverse engineering or hiring the former MNC employees whom already have the special necessary skills.

"Spillovers" is not the answer to all development problems and could also become a drawback if not managed correctly. The entry of MNCs into monopolistic industries is likely to raise the level of competition and force existing firms to become more efficient. Foreign entry may, of course, also lead to the downfall of firms within the industry when the least efficient companies are forced out of business. This raises the fear that MNC affiliates may out-compete all local firms and establish monopolies, which are even worse

than the domestic ones they replaced [14]. The policy-maker has a definite role to play in avoiding this scenario from occurring.

2.5.3.2. Licensing

Two types of licensing can be identified [7] namely:

Multiple Licensing: The transferor licenses its technology to more than one licensee in the LDC.

Exclusive Licensing: The technology is licensed to a single licensee in the LDC.

2.5.3.3. Joint Venture

The transferor shares ownership of its venture in the LDC with a local partner and also licenses its technology to the local partner. They combine their interests by sharing resources, technology know-how and knowledge on local conditions to complement one another [10]. International joint ventures are often used by recipients to acquire technology and by sources of technology to gain access to local markets and distribution skills.

2.5.3.4. Turnkey Project

A country buys a complete project and the project is designed, implemented, and delivered to operate. It sometimes includes training and continual operation support. Engaging in a turnkey project is equivalent to buying a complete plant, which most innovative firms wouldn't sell if they plan on exploiting the market themselves.

2.5.3.5. Technical Consortium and Joint R&D Project

Two parties collaborate on a large venture because the resources of one are inadequate to affect the direction of technological change. This typically takes place between two countries because of the size of the investment which are involved [10]. On a smaller scale, Co production can also be viewed as a type of a planned channel. Here, the transferor produces part of the product components in the LDC.

Some argue that locating abroad may decrease the growth in the developed country's exports, thereby widening their trade deficit. To the country business executives counter that these factories abroad do not cost jobs in the developed country and that the potential markets abroad may be lost if production is not carried out locally.

2.6. Linkages Between MNCs and Local Firms

Some of the spillovers from FDI operate via linkages between the MNC's foreign affiliate and its local suppliers or customers. Backward linkages arise from MNC affiliates' relationships with suppliers, while forward linkages stem from contact with local customers [14].

2.6.1. Backward Linkages

MNCs may contribute to raise the productivity and efficiency in other firms as they:

- Help suppliers (domestic as well as foreign) to set up production facilities.
- Provide technical assistance or information to raise the quality of the suppliers' products or to facilitate innovation.
- Provide or assist in purchasing of raw materials and intermediaries.
- Provide training and help in management and organization.
- Assist suppliers to diversify by finding additional customers.

2.6.2. Forward Linkages

There is much less evidence of forward linkages than backward linkages. Forward linkages occur when firms contribute significantly to the development of local distributors and sales organizations [14]. The growing technical complexity in many industries causes that only MNCs can afford the necessarily R&D to develop and manufacture modern products, and causes that industrial applications might require expertise from the manufacturers. This would contribute to increasing the role of MNC-customer interactions.

Some of the characteristics of the host country, which may influence the extent of linkages, are market size, local content regulations, and the size of the technological capability of local firms. Linkages are likely to increase over time, as skill level of the local entrepreneurs grows, new suppliers are identified, and local content increases [14]. This constitutes circumstantial evidence for spillovers.

The transfer of technology from MNC parents to affiliates is not only embodied in machinery, equipment, and patent rights, but also realized through the training [14] of the affiliates' local employees.

2.7. Generating Technology

Any technology policy must have as one of its prime objectives the task of moving to the generation of technology, even if this is in restrictive areas of activity. In technologically dependant developing economies it may also be the only way to obtain which is appropriate to local conditions. Ignoring countries rich in high-value raw materials, the countries with the highest per capita incomes are those with the greatest relative strength in generation of technology [8].

It may be thought that LDCs have no prospect of ever moving to the edge of world technology. This may be true at an aggregate level but there remain narrow niches for specialization in which developing countries can compete with the best, especially when technologies are appropriate to the LDC due to a specific climate or other distinctive reasons.

Experience to generate technology may not have to be tested at the highest level, but may often be relevant at the regional level [8]. Policy mechanisms for selecting specialization areas are crucial and must avoid research such as, the exploration of basic-research targets, which have potential application possibilities only at some distant point in the future. The ability to generate technology in an efficient manner usually follows on in a specific order mastering the ability to select, transfer, install, adapt and improve other people's technology [8].

2.8. Telecommunications Industry of South Africa

South Africa ranks 23rd in telecommunications development in the world [15]. The country has approximately 5.3 million installed telephones and 4.3 million installed exchange lines. This represents 39% of the total lines installed in Africa [16].

Telecommunications in South Africa, are provided mainly by three companies: Telkom (fixed line operator), Mobile Telephone Network or MTN (cellular service provider), and Vodacom (also a cellular service providers). A third cellular service provider (Cell C) will become active at the end of 2001 together with another yet to be determined fixed line operator [17]. A brief background on the companies' history will be given below. The industry will be discussed using aspects such as:

- Internet and Telecommunications
- Satellite coverage in South Africa
- International Telecommunication

Technology transfers is an international activity between MNCs and LDCs. The aspects mentioned above form an important link to international markets not only for the telecommunications industry but also for the rest of the country's activities and are therefore included in the discussion.

2.8.1. History of South Africa's Telecommunications Industry

Fixed-line Telecommunications in South Africa

2.8.1.1. Telkom

Telkom was granted an exclusivity period of five-year ending in May 2002 during which only Telkom were authorized to supply fixed line telecommunication services in South Africa.

The question of why exclusivity was granted to Telkom are often asked by value-added network operators, almost all in favour of open competition in the telecommunications sector. Andile Ngcaba, director general of the government's Department of Communications, defended the 1995 decision to give Telkom exclusivity in the Act in exchange for assurances that providing telephone services to rural villages would be one of its priorities [18]. To connect a village is a big expense and you need some kind of incentive to make it happen. Exclusivity gave the government a more certain method of getting lines to those villages.

Emmanuel Olekambainei, chairman of the International Telecommunications Union GMPCS-MOU group and a former regulator in Tanzania, said that connecting rural areas in SA is an approach that will bear fruit later. “What SA did, made good market sense. What happens when your urban areas become saturated? The money moves to un-serviced areas. But you need a basic infrastructure there first” [18].

Telkom had significantly enhanced its competitiveness during its exclusivity. Telkom announced on 19 March 2001 that it would not exercise its option to ask for a sixth year of exclusivity [19]. The Company is ahead of its cumulative four-year rollout and service targets. Telkom CEO, Sizwe Nxasana said that Telkom welcomes competition from May 2002, when its five-year period of exclusivity would end. He also added that Telkom is well positioned to remain competitive in all markets, and that they look forward to the introduction of competition in 2002.

MTN has tentative plans to partner with Transtel, Eskom, and an international partner in 2003 to bid to become the country’s second fixed line telecommunications operator [16]. Transnet, one of MTN’s major shareholders, is well positioned to be a major player in this market owing the fact that it has the second largest network in South Africa.

Mobile Telecommunications in South Africa

South Africa's cellular industry is worth approximately R16-billion [20] but the multi-billion MTN-Vodacom duopoly is soon to end. There is very little competition between the existing networks in terms of price and product offerings. Both however argue that this is merely the result of market forces and not a result of agreement between them. Cell C launched its application for an operator's license on June 14 1999 [21] and received the third South African cellular operator license on June 26 2001. Icasa (Independent Communications Authority of South Africa) awarded the licence.

2.8.1.2. Vodacom

In 1994, just before the first democratic elections, Vodacom did not exist. Today, Vodacom is valued between R50 billion and R70 billion [22] and delivers a service to some 3,6 million South Africans which is an integral part of their daily lives.

In September 1993 Vodacom was granted one of two GSM network licenses in South Africa. However, the cellular industry was almost stillborn. The government-in-waiting threatened to withdraw the cellular licenses on assuming power. Frantic negotiations, led by Vodacom’s Managing Director Alan Knott-Craig, set conditions that included minimum levels of black participation, subsidized cellphones in disadvantaged communities and a billion rand Joint Economic Development (JED) program.

The JED plan was based on the principles of boosting foreign investment, job creation, research and development, local exports, developing local value added technology, training and forging international linkages. One of the key elements of the JED plan was to add local value to imported technology. GSM, the technology standard in South Africa's cellular industry, is by its nature high-tech and sophisticated. However, Alcatel and Siemens, Vodacom's main network equipment suppliers, have succeeded in adding hundreds of millions of rands of local value, thereby minimizing the impact on South

Africa’s balance of payments. The creation of a local smart card industry is an example of promoting local manufacturing of high-tech products. Vodacom generated R3,4 million in JED credit by assisting Integrated Card Technology to set up a smart card production facility.

Vodacom's initial growth projections catered for 250 000 subscribers within ten years [22]. They exceeded three million during the year 2000.

An impressive achievement in the JED program was the contribution of Vodacom's community services, a subsidized phone service in disadvantaged communities, which would take the country a step closer to universal telephone access.

Highlights of Vodacom's JED achievements include:

- Research and development activities undertaken by Siemens. This includes the development of Sigi's (Siemens GSM Telephone Interface), the world's first pre-paid GSM community phone, and vehicle tracking, a unit that can be installed in vehicles for multiple purposes besides tracking.

- Transfer of skills from international consultants and development of specialized billing systems by local consultants, creating long-term job creation and increasing the local value of the systems.

- Local Company Atio Corporation was commissioned by Vodacom to develop a call management system for Vodacom's customer care centre. The operator service centres were developed and assembled locally and subsequently also exported by Atio to Celcom, a Malaysian cellular network.

- Alcatel has upgraded their production facility to increase the local value for each unit as a component of its rural communication equipment.

- Vodacom's investments in tertiary education.

- Affirmative action programs implemented by Vodacom and sister company Vodac.

2.8.1.3. MTN

At the start of 1999, MTN’s network covered over 650 000 km2, which accounts for almost 48% [23] of South Africa’s geographic area and providing cellular telecommunication access to more than 80% of the population.

MTN was the first cellular telecommunications company to receive the prestigious ISO 9001 registration for their Network and IS Departments and ISO 9002 for their Customer Services

Global Telecommunications Award panel adjudicated MTN one of the top three cellular operators worldwide. CellExpo also accorded MTN the award for Best Customer Service in South Africa.

The original forecast of a total national subscriber base of 250 000 after 5 years was exceeded beyond all expectations. Currently there are 5.6 million subscribers in South Africa, representing a teledensity of 12.4% [24].

While intelligent planning and management of MTN's current 083 number range has up till now enabled MTN to cope with the rapidly increasing demand for their services, this demand has made it essential for them to open up additional capacity. MTN welcomed ICASA's decision to grant them additional number ranges (the MTN 073 prefixes). The decision will enable MTN to provide the ever increasing advantages of mobile telecommunications to a market expected to exceed 10 million [24] in a few years time."

The famous MTN lightship [23] appears regularly at events, functions and displays in all major cities of the country. More than a striking billboard for MTN, the ship also provides a platform for high quality aerial photography.

2.8.1.4. Cell C

Obtaining a Cellular Operators License

A delay occurred in the license awarding process when a review had been ordered by the high court in 2000 on the grounds that there might have been irregularities during the tender process. Nextcom, a consortium owned 60% by local empowerment groups and 40% controlled by Hong Kong-based Distacom [25] won an interdict preventing Matsepe Casaburri from awarding the license without giving the unsuccessful bidders an opportunity to respond. M&G newspaper said in August 2000 that Cell C (60%-owned by diversified Saudi Arabian group Saudi Oger, and the remaining 40% is owned by black-empowerment group CellSAF [26]) was made winner because of a complex guns-for-oil deal with Saudi Arabia. The Government replied by saying the M&G story is purely fiction [28]. Robert Nkuna, spokesperson for Ivy Matsepe Casaburri, added that there is no proof to suggest the minister had intervened in favour of Cell C [29].

Mr. Talaat Laham, chairman and executive head of Cell C said that the importance of ending the court case had increased tremendously. The delay has already taken 18 months and Cell C has lost close to 500 000 clients of which only a third is probable to return [30]. According to communications minister Ivy Matsepe-Casaburri, almost 1 600 jobs and more than R1,5 billion was lost by Cell C because of the delay. MTN and Vodacom had more than 9 million customers in mid 2001, which is 5 million more than when the third cell bidders started looking at SA in early 1999. But Cell C director Zwelakhe Mankazana believes that the market will plateau at 16,5m [31].

Cell C and Nextcom decided on Friday June 15 on an out-of-court settlement after a drawn-out third cellular license saga [29]**.** Judicial review judge Hekkie Daniels endorsed this settlement, thus ending the costly and bitter legal battles that have dented the country's image among international investors. Mankazana said they elected to settle out of court because there was no way of ascertaining if there would not be further challenges which would have seen the battle drawn out even longer. The settlement was estimated to be worth between R50 and R80 million [29], which would be just about enough for Nextcom to recover its expenses.

The settlement wasn't satisfactory for everyone at Nextcom [29], which has disintegrated somewhat since the SATRA (South African Telecommunications Regulatory Authority) first chose Cell C as its preferred bidder. The decision means the Cell C would be allowed to use both the 900MHz and 1800MHz frequencies as well as the extended 900MHz ranges [32] to provide their service.

License Agreements

Cell C would use the 084 prefix. Enforced upon Cell C by its license agreement, Cell C would have to ensure that its network covers at least 80% of the geographical area of the country and 60% of the population within five years of the launch of commercial services [32], with increased commitments through national roaming with Vodacom. At least 52,000 [32] community service telephones would have to be rolled out within seven years of the launch of commercial services compared to the commitments of 22 000 by Vodacom and 7 000 by MTN [33]. Cell C would have to pay a fixed license fee of R100 million for a renewable 15-year period [32] while an annual variable service license fee of 1% of net operational income for the first five years would also be payable.

Establishing the Cell C Network

Cell C has concluded a roaming agreement with rival operator Vodacom that will give it national coverage from the network launch day. Vodacom was selected ahead of MTN as the firm "offered superior terms that matched our requirements," Cell C CEO and chairman Talaat Laham said. Cell C customers will be able to roam on the Vodacom network for the full license period of 15 years although the major cities of Gauteng, Cape Town, Durban, Bloemfontein and Port Elizabeth would be excluded after three years [32].

Cell C expects to have about 550 base stations [32] up and running by the end of 2001, which would be enough to cover major urban areas with the high capacity GSM 1800MHz network. The 1800MHz spectrum was given to Cell C while MTN and Vodacom's requests for revision of their frequency spectrum licenses were denied. ICASA stated that the 1800MHz spectrum could not at this point in time be granted to existing licensees [34].

Cell C said it had put together a "crack team" to fast-track the network launch to make real its plans to go live before Christmas, covering 40 percent of South Africa's geographical area and 80 percent of the population in the first year [33]. The company also say 2500 direct jobs and 15000 indirect jobs will be created in establishing the network [26].

Cell C consultant Dr. Paul Doany said that Cell C is aiming at 15% - 20% of the South African cellular market by 2006. This will, according to his estimations, be between 2,5 and 3 million users [30]. According to Mr. André Szczesniak, this is a very optimistic view of the future situation and he predict a market share of 10% by 2011 and about 1,4 million users.

Cell C entered into a contract with Siemens and Accenture to the value of R2,05 milliard [30] for the rollout of its infrastructure. Siemens got the contract of R1,77 milliard for the basic infrastructure and has to install it over an 18 months period. The contract also involves maintenance. The contract with Accenture is worth R224 million for information technology solutions.

Cell C chief adviser Paul Doany said half of Cell C's projected peak negative funding of $650 million would be financed through debt. According to Cell C's updated business model, it would be profitable in four to five years.

2.8.2. Internet and Telecommunications

According to the International Telecommunication Union of Africa, for every 10000 citizens there exist 36 Internet users in Africa [1], while there are 183 in Asia, 922 in Europe, and 1167 in America. Me Clare Stone (Britain's minister of international development) said that New York alone has more Internet users than the whole of Africa. She explains that this is because of the high cost associated with the service.

According to the World Bank, the cost of a call from one African country to another is fifty to a hundred times as expensive when compared to the cost of phoning from one State to another in the USA [1]. Internet might be a solution when providing a means of contact with the rest of the world at a more reasonable rate. Telkom however are accused of limiting Internet use through unrealistic price increases. Mr. Myron Zlotnick (M-Web) and Mr. Hein Pretorius (Kalahari.net) are concerned about the high price increases and their impact on Internet use in South Africa [35]. They have requested ICASA to investigate the billing system used by Telkom and have suggested that distinction be made between voice- and data-calls.

Despite this statistics, access to the Internet in Africa has tripled in the last year. Two Internet service providers, Africa Online and UUNet South Africa, have combined forces and formed UUNet Africa. The aim of this alliance will be to provide Internet services to another eight African countries namely: Kenya, Tanzania, Swaziland, Zimbabwe, Zambia, Ghana and Ivory Cost [1].

Battery powered- and wind-up-radios were responsible for providing the initial steps for information transfer into Africa. The use of the Internet would offer the opportunity to strengthen this connection even further.

2.8.2.1. Telkom

TelkomInternet [36] has signed up more than 10 000 customers since it was introduced less than a year ago, and expectations of continued growth in 2001 have prompted Telkom to expand the service to include ISDN access.

2.8.2.2. Vodacom

The next generations of cellphones will all be fully Internet compatible and it is logical for Vodacom to move into the Internet Service Provider business. Vodacom was the first network to offer a commercial cellular fax/data service and the first to offer a cellular pay-as-you-use access to the Internet with Yebo!net [22].

2.8.2.3. MTN

MTN CallQuest and CallAudit [23] were recognized at the international CellExpo Awards as the most innovative services in the telecommunications industry. These Internet-based software packages are comprehensive, on-line bill analysis tools. Suited to both individuals

and corporate personnel, they provide access to valuable information about individual and group cellular usage.

To promote the global competitiveness of South African companies, and to anticipate the fluctuating telecommunications needs of business and industry, MTN has launched Co/Nexsys. A recent joint venture between Co/Nexsys and the Internet Solution exploits the convergence of cellular and Internet technologies and prepares the way for future developments.

2.8.3. Satellite Coverage in South Africa

2.8.3.1. Telkom

Inmarsat currently operates a global satellite system, which is used by Telkom to offer communications services for customers in the air, on the ocean or located in remote areas. Services are then typically offered to users like journalists and broadcasters, healthcare teams and disaster relief workers, land transport fleet operators, airlines, airline passengers and air traffic controllers, government workers, national emergency and civil defence agencies, and heads of state.

Intelsat is the premier commercial satellite communications services provider. Its global satellite system brings video, Internet, and voice/data service to users in more than 200 countries [37]. Very Small Aperture Terminal (VSAT) networks are attractive in meeting remote location communications requirements. Intelsat provides the space segment for VSAT networks.

Transtel uses PanAmSat, which enables Telkom to relay video programming and digital communications for hundreds of customers on a worldwide basis. It also provides communications links for broadcasters, telecommunications service providers and news organizations such as the Associated Press, Bloomberg and Reuters.

Telkom is building new satellite earth stations (“Teleports” located at Crowthorne in Gauteng, Klipheuwel in the Cape and Malvern in Durban [37]) to address the need for high-speed reliable connectivity. This technology is ideal for Internet service providers and broadcast, because it allows a thin stream of data to be transmitted to make the request, and the content is then delivered over a broader spectrum.

2.8.3.2. Vodacom

Vodacom's service provider made an agreement with Globalstar Southern Africa (Pty) Ltd., which, during July 1999, completed the minimum space segment configuration required for a soft launch in South Africa between November 1999 and January 2000. This means that corporate users will be able to try out the Globalstar network during this time. Globalstar will meet the needs of cellular users who roam outside terrestrial-based cellular coverage and South African subscribers will be able to use dual-mode phones capable of switching from conventional cellular telephony to satellite telephony automatically or as required. A $2.6 billion Globalstar [22] system will comprise 52 Low Earth Orbiting (LEO) satellites and a global array of some 60-ground stations. People virtually anywhere will be able to make and receive calls using cellular-sized handheld, vehicle-mounted and fixed-site terminals.

Vodacom also signed a roaming agreement with another satellite system, Iridium. The agreement with Iridium means that Vodacom subscribers in possession of Iridium satellite handsets are able to use their Vodacom SIM (Subscriber Identification Module) cards in the handsets on a R9 billion infrastructure for just R1,60 per minute [22].

During the financial year ending 31 March 2000, Vodacom spent more than R2,3 billion [22] on increasing network capacity and coverage, enhancing the quality of its network, creating adequate capacity for almost three million subscribers.

2.8.3.3. MTN

MTN was the first cellular network in South Africa to provide global coverage for South African subscribers. MTN introduced satellite telecommunications via our roaming agreement with Iridium Africa, which operates a low-earth-orbiting satellite network. Negotiations with ICO, another prominent satellite telecommunications company, were well advanced by June 1999.

2.8.4. International Telecommunication

Better communication with African countries will strengthen South Africa's presence in the market through a connection with institutions in both the public and private sectors. Many LDCs (Less developed countries) need basic standard technologies already viewed as old and unproductive by the developed sectors of South Africa. This situation gives an ideal opportunity for South Africa to appear as the technology source in the technology transfer process.

The telecommunication companies will now be discussed on some international involvements.

2.8.4.1. Telkom

An investment of R10 million [58] was made by Telkom to establish and sponsor a Centre for Information and Communication Technology for Africa with the aim to develop a plan for the continent

2.8.4.2. Vodacom

The company already operates a GSM cellular network in Lesotho in partnership with the Lesotho Telecommunications Corporation. Vodacom partnered Tanzanian company Planetel Communication Ltd and holds 50% [22] of the consortium.

2.8.4.3. MTN

MTN is one of the largest GSM networks in the world, with operations in Africa, which also include Rwanda, Swaziland and Uganda. In addition, MTN has roaming agreements with 153 networks in 76 countries [38].

International networks engage MTN on a consultancy basis in areas such as network planning and optimisation. Some of MTN's advanced analysis tools, developed in-house

for planning, network performance and call data records, are marketed commercially worldwide and are now used by leading Blue Chip telecommunications companies.

MTN's African strategy includes the urge to grow clusters of business by focusing on developing regional hubs, namely Southern Africa, the Great Lakes Region and Central/West Africa. Their aim is to provide significant benefits in these regions through training efficiencies, knowledge transfer, skills sharing, and mutual access to a pool of advanced and innovative technology.

MTN received its first cellular operator's license in Rwanda and in Uganda. An MTN-led consortium was awarded the second national operator license. MTN is also operative in Swaziland, and they continue to conduct negotiations in a number of other African countries.

2.8.4.4. Cell C

In addition to providing services on its own network, Cell C is also licensed to provide international and domestic roaming services to its subscribers [32].