INTERNATIONAL TELECOMMUNICATION UNION

Communications for rural and remote areas

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ITU-D Study Groups

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Report on Question 4/2

PUBLICATIONS OF ITU-D STUDY GROUPS

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Study Group 1

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Report on Question 2/1	Telecommunication policies and their repercussions at the level of institutional, regulatory and operational aspects of services
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REPORT ON QUESTION 4/2

Communications for rural and remote areas

PART A

Preamble, process and linkages

1 Statement of the Question

1.1 Statement of problem

Rural and remote areas of most developing countries have less population density and suffer from an almost complete lack of telecommunication infrastructures. Telecommunication and information technologies are very powerful means for providing education and training. They are also a means to accelerate the growth of the rural economy which subsequently helps in alleviating poverty and in improving living conditions in rural areas.

Reliable telecommunication facilities in rural areas will:

a) help in increasing access to relevant information for marketing and distribution of agricultural products and other goods manufactured in rural areas;

b) promote the growth of local industries and the relocation of industries from congested urban to rural areas;

c) assist in achieving accelerated and integrated development of rural areas by playing a catalytic role for the development of several other sectors and other constituents of basic infrastructure.

Access to basic telecommunication services in rural areas is essential to sustain life and services, not only as a means of public communications but also as comprehensive communication facilities for relaying information on medical treatment, disaster relief, administrative and other matters.

Development of appropriate technologies, policies and regulations can lead to self-sufficiency and profitability of rural telecommunications.

1.2 Question

On the basis of studies already carried out by the BDT, international, regional and national organizations consolidate the material available and formulate Recommendations on the following:

a) low-cost appropriate technology options for rural telecommunications;

b) planning and implementation of national rural telecommunications development plans;

c) promotion of the application of telecommunication facilities for developing various sectors of rural infrastructure and rural economy;

d) appropriate regulatory structures in a liberalized telecommunication regime as recommended by Study Group 1 as a means of encouraging the extension of telecommunication services to remote and rural areas;

e) options available for financing rural and remote projects including co-financing, foreign investment, etc.

1.3 Expected results

Preliminary Report and Recommendations available by mid-1996.

1.4 Liaison

Close liaison with Study Group 1 is necessary on regulatory and financial methods. The Report and Recommendations should be prepared in close collaboration with the ITU-R and ITU-T as well as other concerned international and regional organizations [3].

2 Scope of this Report

The rural and remote areas of most developing countries typically suffer from a partial or complete lack of telecommunication services. It is now well understood and widely accepted that there is a clear and substantial positive co-relation between the availability of telecommunication services and the economic and social development of the rural territory. It is also becoming widely accepted that the provision of telecommunication services in rural territory is often profitable, when the calculations include the potentially large amounts of long distance revenue which results from the long distance calls, both outward and inward, both national and international, that are now made possible.

Worldwide, there is extensive knowledge, experience and expertise on this subject that is available. To the extent possible, and for most of its work, the Group of Experts who are addressing Question 4/2 made use of the knowledge, experience and expertise that exist and are available, and the results of studies and analyses that had already been carried out. Additional study work was carried out only when it was necessary to complete or complement or verify information and studies and conclusions that were already available.

This Question addressed all the factors that are necessary to implement effective and economic rural telecommunication Programmes, going well beyond the technology options and the network planning aspects. The Group of Experts considering Question 4/2 focused their attention on all of the following aspects of telecommunication services for rural and remote areas.

a) Appropriate, economic technology options for rural and remote telecommunications.

b) Planning and implementing national rural telecommunication development.

c) Promoting the application of telecommunications for developing rural infrastructure and the rural economy.

d) Regulatory structures to encourage the extension of telecommunication services to remote and rural areas.

e) Financing options for rural and remote telecommunications programmes/projects.

This Report provides a comprehensive guideline to developing countries in addressing the telecommunication needs of rural and remote areas, and describes the urgent need for these services. It explains why telecommunications are important and economically attractive, provides information on what has to be accomplished to bring telecommunication services to rural and remote areas, and, through the Recommendations, how this can most effectively be carried out.

The Report also identifies relationships with the other Study Group Questions and with the Programmes of the Buenos Aires Action Plan which are most important in providing telecommunication services to rural and remote areas.

3 Relationship of this Report with, and linkages to, the Questions of ITU-D Study Group 1

Question 1/1: Role of telecommunications in economic, social and cultural development

i) The Question and the audience

The audience for this Question is politicians and decision-makers who have responsibility for economic, social and cultural development in the developing countries of the world. The Report which is prepared in response to this Question will provide an overview of the important role played by telecommunications in a country's economic, social and cultural development. Available knowledge will be consolidated, and experience accumulated by various countries will be shared, in order to quantify the economic benefits which result from including the telecommunication sector in national or regional development plans.

ii) Telecommunications and economic, social and cultural development

This will include the definition and scope of telecommunications, including telecommunication services and also broadcasting. It will consider information policy, and the increasing economic dependence of all sectors of the emerging information economy on wealth-creating and information-related activities. The economic impact will be considered, and in particular the economic multiplier associated with telecommunications investment. The Report will provide a framework for understanding how telecommunications and development impact on flows of capital and labour. A methodology will be considered for evaluating the importance of telecommunications for socio-economic and cultural development.

iii) Role of telecommunications

Good telecommunications impact positively on all aspects of economic, cultural and social development. In agriculture, fisheries, and forestry, markets for produce and production can be matched with supply, weather and environmental information can be made available, and "best practice" techniques can be shared. Manufacturing benefits from more efficient markets, both for input resources and for goods produced. On the service side, tourism is enabled, bringing visitors to newly feasible locations, and remote financial transactions become possible. Public service and governance improve because of information flow and transaction possibilities. Health care can be improved through Telemedicine applications. Access to educational opportunities and available information is made possible.

iv) Relationship with communications for rural and remote areas

In all of the examples and areas indicated above, the advantage of bringing telecommunications to rural and remote areas is greater than in more densely populated areas because the alternative means of passing information and messages is more costly and time consuming. When telecommunications are not available in rural and remote areas, the only way to send messages and information is by a personal visit or via a messenger. This typically involves a trip which is often difficult and time consuming, and sometimes dangerous. Alternatively, the message or the information could be withheld, and the advantage and benefit which it would have provided is lost. In rural and remote areas, the "opportunity cost" of the alternatives to telecommunications is much higher than in more densely populated areas.

Since the opportunity cost is higher, rural residents are more likely to withhold the information or the message. With the introduction of telecommunications in rural and remote areas, and over a period of time as the residents learn how best to take advantage of the new capability, the relative advantage of being able to communicate electronically, rather than via visit or messenger or not at all, will have a similar but greater positive impact on economic, social and cultural development.

Question 2/1: Telecommunication policies and their repercussions at the level of institutional, regulatory and operational aspects of services

It has generally been thought that investment in telecommunication infrastructure for the rural areas of developing countries is unprofitable. There is increasingly convincing evidence that this view is often not correct. It is increasingly clear that promoting telecommunication development in areas with low and medium population densities is the key factor in enabling the smooth and integrated development, economically, socially and culturally, of the rural areas where the majority of the population of the developing world lives.

As noted in the World Telecommunication Development Report – 1995 (see [5], "Figure 4.1: Raking it in", page 50), two of the most profitable Recognized Operating Agencies (ROAs) in the world are Telmex (Mexico) and the Telephone Organization of Thailand (TOT – Thailand). Both these organizations have implemented major, comprehensive and successful Rural Telecommunication Programmes. While this does not prove that rural telecommunication services are inherently profitable, it certainly establishes that it is possible for an ROA to be profitable while implementing a major Rural Telecommunication Programme.

Telecommunication policies and the regulatory and legal arrangements which implement them establish the framework and context of the industry at the national level. Nothing influences the industry more pervasively, and nothing has a greater influence on the degree of success which the telecommunications industry brings to the benefit of the country as a whole. This was clearly recognized in Buenos Aires, as documented in Resolution No. 4 on Telecommunication Policies and Strategies, adopted by WTDC-94 (see [3], pp. 63 to 66).

Nevertheless, it seems clear that some degree of encouragement for rural telecommunication services will often be required, in the form of some sort of "Universal Access" and/or "Universal Service Obligation". The obligation should preferably be minimal, consistent with ensuring the financial integrity and sustainability of the rural telecommunication service. For example, this might be accomplished through establishing conditions, in the ROA's licence or concession, which mandates accelerated rural service provision.

Question 4/2, "Communications for rural and remote areas", specifically seeks the guidance of the conclusions and Recommendations of Study Group 1, and Question 2/1, as follows:

Topic d) – Appropriate regulatory structures in a liberalized telecommunication regime as recommended by Study Group 1 as a means of encouraging the extension of telecommunication services to remote and rural areas

The results of the deliberations of Question 2/1 will be of great importance in all aspects of telecommunications in developing countries. These results will be of particular importance in addressing telecommunications in the rural and remote areas where the majority of the population of these countries live.

Question 3/1: Impact of the introduction and utilization of new technologies on the commercial and regulatory environment of telecommunications

i) Review of the Question

Resource prerequisites to introducing new technologies and services are the availability of both the financial and the human resources required to upgrade and sustain the infrastructure. Equally important, national strategic policies and development plans should recognize and reflect these intentions.

ii) Factors which influence the willingness and the decisions to introduce and use new technologies and services

Market demands may create pressure for new technologies and services, the pressure being greater:

a) where neighbouring regimes offer increased capability;

b) where the potential opportunity which the technology offers is clearly understood (recognizing that the opportunity may on occasion be misunderstood);

c) where there is a relatively greater potential for major gain compared to the existing service portfolio and infrastructure.

The ability to use and to rely on modern information technology tools and capability is increasingly important to the efficiency and the productivity of a country's economic sector, in an increasingly competitive and demanding world, which is increasingly interconnected.

iii) Commercial impact of the introduction and utilization of new technologies and services

New technologies can provide new and valuable capabilities. It is very desirable that the introduction of new technologies and services will evolve and augment the existing infrastructure and service portfolio in an orderly, integrated, economic way. Depending on the state of the existing infrastructure, it may be possible to "jump steps" in modernizing the infrastructure and the service portfolio, thereby saving time and money. Also, new technology may now enable the provision of service applications which are valuable for both economic and social development, for example Telemedicine, distance education, access to information databases and transaction capabilities.

iv) Impact on regulation by the introduction and utilization of new technologies and services

The fundamental need is to keep the policy and regulatory framework appropriately reflective of the technology and service evolution. This may include new or revised licensing, tariffing and regulatory arrangements. Experience has shown that it is difficult to re-regulate a technology or service when it is already in place.

v) Factors to be considered when addressing the introduction and utilization of new technologies and services

The most important factors are the revenue/cost relationship of the new technology capabilities and the new services, and the cross-impact that these will have on the existing services. Is universal availability of the new services required or mandated, and what are the cost and introduction implications of this? Over time, it may well be that some of the

existing services will "die on the vine". Can provision be made to then withdraw these services in an orderly and economic way, or will the regulations require that they be continued, although the continuation is now uneconomic? And if so, how will the cost of this be compensated?

vi) The impact of new technologies and services on communications for rural and remote areas

New technologies, both upon their initial availability and through evolution in service, have much to offer to the rural and remote areas. From a physical perspective, the key factors in their application are geography and topography. On the human side, the factors are the density and the distribution of the population, and the density and the distribution of economic resources. New technologies introduce a certain dichotomy, typically offering new and better communication capability at lower cost, but also introducing the commercial danger of "cream skimming" the high margin services and high revenue customers away from the traditional ROA, which introduces the economic danger of possible multiple overlay networks.

Efforts must be made to achieve the least-cost, best-service solution, consisting of an evolving single integrated network infrastructure which has the flexibility and capability to meet all customers' needs.

Question 4/1: Policies and ways for financing telecommunication infrastructures in developing countries

Part 1: General policies and ways of financing. Items 1, 2, 3 and 4

In considering financing policies, ways and techniques, "self financing" arrangements are clearly the preferred initial focus. This requires that both investment decisions and ongoing operations must be based on commercial business principles. Careful and detailed engineering economic analyses of network extension alternatives must be carried out to ensure that life cycle cost is minimized.

When telecommunication services are extended to previously unserved territory, care must be taken to provide adequate capacity to attract all the potential revenue that is available. Ongoing operations must be efficient in order to ensure that the service is sustainable. Commercial operations must be effective also, to ensure for example that calls are accurately billed and that the bills are collected. When all of the above is implemented effectively, a positive Business Case for the service throughout the entire rural territory will generally be achieved, or at least closely approached. There will of course be variations within the rural territory, with some areas being more profitable, and other areas less profitable or not profitable.

Conditions for obtaining external financing typically consider all of the above areas. When the ROA takes all possible steps to ensure that investments are made responsibly, that every effort is made to maximize revenue and minimize operational costs, and when the service operates with a high degree of availability and reliability, external financing which complements the internal resources is typically available on reasonable terms.

It is not necessary that the ROA be "privatized", and there may be very good national policy reasons why privatization would be inappropriate, but it must certainly be "corporatized", operating as a commercial entity. This will ensure that business economics take their necessary, crucial, and usually dominant role in the organization's decision-making processes and operations, and in the criteria by which the organization is judged.

Factors which provide a favourable climate for international investment include an appropriate regulatory function with adequate successful experience, which supports a favourable structure of the telecommunications industry. Also very helpful in encouraging international investment are appropriately supportive national policies, and legal codes addressing the areas of tariffs, investments and financial transactions.

An area where attention needs to be focused is in education and training for ROA financial personnel from the developing countries in the areas of international finance, infrastructure investment, financial negotiations, and also in everyday financial management.

Part 2: The specific problems of tariffs and accounting rates. Items 5a, 5b and 6

It is generally agreed that tariffs should in principle be cost based, and inherent in this concept is the expectation that the costs would be "as low as practical", in an ongoing and sustainable way, resulting from an efficient and effective ROA organization that is well managed and controls both its network extension programmes and its ongoing operations effectively, providing services that are reliable and are relied on by its customers.

One area in which many developing countries need support is cost analysis and cost accounting. There is often no, or unreliable, cost-based data on which to base the tariff structure. In some cases, the necessary statistical information is not available in the network systems and components of these countries' networks. Information and knowledge in this area of expertise is available, and arrangements should be made to provide it to those who need it. This shortcoming cannot be solved instantly, but it can readily be solved over time.

Appropriate revenue settlement arrangements are essential, internally between different ROA organizations or entities within the country, and also, of course, for international calling. For the latter, international settlement procedures are well established, although there continue to be concerns where there is significant dissymmetry between the charges applicable in each direction of a specific relationship. Appropriate interconnection arrangements must be provided for.

Within the country, the revenue settlement arrangements between ROA entities are the key factor in rural territory service revenue. There is increasingly convincing evidence that a "Positive Business Case" for rural telecommunications is possible, practical and desirable. The provision of Universal Access through "Public Call Offices" (PCOs) which are located near the centre of the community will ensure heavy usage patterns per line in service. Since the PCOs are located in the population centres of the communities, experience indicates that many of the calls, both originating and terminating, are "long distance", and bear a "long distance" tariff. Some of the calls, both originating and terminating, are national, some are international. Since none of this calling would have been possible if telecommunications access to the rural territory had not been established, it is proper to attribute all of the resulting "long distance" revenue, originating and terminating, national and international, to the advent of rural telecommunications. The appropriate sharing of this new revenue among the ROAs that carry the traffic is a revenue settlement issue, which must be addressed under appropriate regulatory direction and supervision.

As regards international accounting rates and international settlement procedures, this falls within the responsibility of Study Group 3 of the ITU Telecommunication Standardization Sector. The approved Recommendations of the D-series are relevant.

4 The other Questions of ITU-D Study Group 2

Question 3/2: Planning, management operation, and maintenance of telecommunication networks

By definition and by their nature, rural and remote areas involve longer distances and sparser population density than urban areas. Since the alternatives to the use of telecommunication services are relatively more costly, those who live in rural and remote areas are more dependent on these services, and rely more heavily on their continued, reliable availability, than do those who live in an urban area. Typically, and because of the topography and the demographics of the rural and remote territory that is being served, a wider variety of technology solutions are employed in providing these services. At the same time, the maintenance staffing levels are constrained, so that there is less opportunity for specialization, and each maintenance person is responsible for a greater variety of systems spread over a much larger territory.

Under these circumstances, which are normal in rural and remote areas, effective and efficient network operations planning, management of operations, and maintenance are essential to the sustainable delivery of high quality, reliable telecommunication services. Since distances are greater, trouble clearance times are typically longer. For this reason, it is important that service-affecting troubles be minimized, through monitoring network performance, and identifying and correcting imminent or potential trouble conditions before they become service affecting. It is also very important that the first maintenance person on the scene be trained and equipped to clear the trouble promptly, and restore service.

Network operations planning includes both a systems component and a human resources component. In the operations systems area, the preferred arrangements are based on the Telecommunication Management Network (TMN) principles, which are embodied in the evolving M.3000-series Recommendations, under development by the ITU-T Study Group 4. TMN principles support the operator's network management needs to plan, construct, commission, operate, maintain and manage the many dissimilar systems and components that comprise the network infrastructure. At present, each type of telecommunication equipment is managed by its own proprietary operations system. TMN intends to overcome this situation, by providing a common network operations and management fabric that provides common, transparent management functions for all equipment types and functions within the network infrastructure.

The concept of the TMN embraces not only the management of the PSTN, but also:

- public and private networks, including ISDN;
- analogue and digital transmission systems (copper, coax and fibre cable systems, microwave links, satellites);
- circuit and packet switched data networks;
- signalling systems and real-time databases;
- the Intelligent Network, and the IN services.

On the human resources side, operational planning involves the development and introduction of standard "Methods Of Procedure", which provide direction and guidance to the operations and maintenance personnel. These will include arrangements for ongoing service monitoring, and for trouble reporting and trouble management. There must be an organization structure that assigns responsibility and accountability clearly. Operations management has the responsibility of ensuring that responsibilities are carried out and maintenance operations are properly performed, on a continuous and ongoing basis.

The maintenance staff must be well trained in the performance of their duties. They must be properly equipped with test sets and tools, and have an adequate supply of spare components, for all the network systems in their care. Field support arrangements must be in place, to provide assistance with problems beyond the capability of the field forces. Good, effective field support also fills a training and development role, providing timely in-service coaching to the maintenance staff.

These operations and maintenance arrangements are especially important in maintaining good quality telecommunication services in the rural and remote areas, with their longer distances, sparse population, and greater reliance on the quality and reliability of telecommunications.

Question 5/2: Human resources development and management

A major challenge and opportunity for effective telecom human resources development and management is in the rural and remote areas, which by their nature involve longer distances and sparser population density than urban areas. The maintenance staffing levels which serve the rural areas are typically constrained, so that there is less opportunity for specialization. Typically, and because of the topography and the demographics of the rural and remote territory that is being served, a wider variety of technology solutions are employed in providing these services. As a result, in the rural areas it is usual that each maintenance person is responsible for a greater variety of systems spread over a much larger territory. Because of the distances involved, outages will generally be longer, and it is particularly important that the service be restored promptly by the first maintenance person at the scene. It is very desirable that service-monitoring techniques be used, so that potential trouble situations can be identified and corrected before service is affected.

Because of both the distances involved and the typically wide variety of systems which the rural maintenance person is expected to handle, computer-based training and distance learning techniques are particularly appropriate. Also, there is an opportunity for innovation in field information techniques, e.g. technology-based alternatives to paper-based manuals, practices and procedures.

Of special importance to the maintenance staff in the rural territory is the existence of field support arrangements in place which provide real-time assistance on problems beyond the capability of the field forces. Good field support can provide a significant human resources training and development role, providing timely, on-demand in-service coaching to the maintenance staff.

The application of computer-based training and distance learning techniques in the development of the required skills and knowledge in the telecom maintenance forces also provides an excellent demonstration opportunity to promote more widespread use of these techniques. In the rural and remote areas, access to telecommunication services will typically be provided through several lines which are located at a Public Call Office (PCO) located in the centre of the village. The advent of telecommunication services brings the opportunity of providing education through distance learning techniques, potentially in a virtually unlimited variety of subject areas. The use of these techniques in training the telecom maintenance personnel will provide an excellent opportunity to demonstrate the potential advantages of distance learning, which could now be available in the village.

Question 6/2: Impact of telecommunications in health care and other social services

The benefits of bringing telecommunication services to previously unserved or underserved rural and remote areas depends on the applications which are now possible and which take advantage of the newly available capability. Applications involving health care and other social services are excellent examples of the advantages that telecommunications bring to those who live in the rural and remote areas of developing countries.

The application of telecommunications to health care, know generically as "Telemedicine", is a wide and active field. The technology and the experience base are both evolving quickly. While some Telemedicine applications involve very complex technology and typically involve medical specialists in large urban centres, the health-care opportunities for the newly served rural and remote areas are in general relatively simple and straightforward, and offer great value to those who live in the communities.

Some examples of these Telemedicine applications follow:

- A nurse in the village can consult with a doctor in a city hospital. The nurse can send the doctor a patient's file electronically.
- A doctor in the village can obtain a second opinion from a colleague elsewhere.
- A patient can be examined and diagnosed in the village, without being transported to the hospital.
- The patient can be diagnosed more quickly, and treatment can be started.
- Health-care professionals in remote communities can further their education and knowledge through in-service training and development (distance learning).
- Mentoring relationships are possible, involving junior professionals in remote communities and senior, experienced professionals in urban health centres.

In the small communities of the rural and remote areas of developing countries, Telemedicine enables health-care services that are not now available to be provided, the quality of the health care to be improved, and the care to be delivered at lower cost.

Similarly, other social services that were not previously available can be provided, and social services that were available can be delivered more efficiently and at lower cost.

Question 7/2: Telecommunication support for the protection of the environment

The availability of telecommunication services in the rural and remote areas of developing countries is a fundamental and important building block in providing for the protection of the environment, and ensuring appropriate attention to environmental issues. The long distances and sparse population which is characteristic of the rural and remote areas require communications capability in order for environmental concerns to be addressed adequately. Also, in many respects the rural and remote areas run the greatest risk of suffering environmental damage.

Telecommunications make remote sensing possible, using the technology known as "System Control And Data Acquisition" (SCADA). For example, air and water quality can be monitored, and remote control is feasible, for example of the flow of water through control dams.

Advice of environmental dangers or disasters can be provided, in both directions. The rural area can advise the appropriate authorities of an environmental disaster, thus enabling quick response, and also immediate guidance to those affected. In the reverse direction, it becomes possible for the central authorities to issue warnings to areas at risk, for example of the danger of hail, heavy wind, or tornadoes.

Less dramatic but probably more important, good weather forecasting becomes feasible, based on meteorological information collected in the rural area, and provided to the residents of the rural area. This in turn benefits the local economy, particularly agriculture, with advice, for example, on when to harvest.

Wastage is reduced, in particular of crops, through improved market knowledge and the effective matching of sellers and buyers. Not only does this make better use and reduce wastage of the current crop, but it helps to ensure that future crops are well suited to the expected market.

Telecommunications also reduce energy consumption, substituting for the need to travel in order to obtain necessary information. And travel that continues to be required becomes more efficient. For example, the truck will be sent to pick up the load only after confirmation that the load is ready to be despatched.

More generally, the advent of telecommunication services in the rural and remote areas makes it possible to inform and educate the residents of these areas on environmental subjects. Distance learning techniques make it feasible and relatively easy to improve the awareness and the education of the rural residents on environmental matters.

5 The Programmes of the Buenos Aires Action Plan (BAAP) – BAAP primary linkages

5.1 Programme 3: Guidelines for the Elaboration of a Business-Oriented Development Plan

This Programme will enable Network Planning Engineers in developing countries to plan the evolution of their National Networks based on commercially-oriented principles. This will be achieved through the Master Plan Guide which has been created, and through the training courses which are being provided.

The telecommunications network consists of a large number of systems and components which interconnect and operate together. Successful provision of telecommunication services requires that all necessary systems and components be in place, working effectively, and with capacity and capability that is appropriately matched throughout the network. As demand grows, the commercial objective is to add capacity gradually and uniformly to match the demand, so that the total capacity and capability of the network grows gracefully, and does not result in inadequate capacity in some systems and components, and excess capacity in others. Also, it is essential to monitor and manage the performance of the network, taking whatever remedial action is necessary to ensure that good quality, reliable service is sustained.

The network planners will achieve significant economies of scale by developing the network in accordance with an orderly, well thought out, comprehensive network plan. Working to such a plan will result in significant economies in equipment purchases, in constructing and commissioning the planned network systems, and in the appropriate support arrangements, such items as training, test equipment and spare components. As local experience develops, the capability of the ROA staff will "move up the learning curve", and both the planning function and the actual construction and commissioning of the new network systems will be carried out more effectively and at less cost.

In addressing communications for rural and remote areas, all of the above applies, and the potential advantages are greater because the cost of network development is inherently higher in the rural territory, since distances are greater, topography is often difficult, and the population is less dense. Despite these inherent difficulties, rural telecommunication services must be profitable, or close to profitable, if they are to be sustained. For this reason, the business orientation of the development plan is very important.

Every effort must be made to take advantage of commercial opportunities in providing telecommunications to rural and remote areas, to ensure that there is adequate capacity to support all the potential long distance calling, both national and international, both outward and inward. Other opportunities provided by communications in the rural and remote areas are the provision of improved service at lower cost in social development areas, for example in health care through Telemedicine applications, and in education through distance learning opportunities.

5.2 Programme 5: Computer-Aided Network Planning

Effective and efficient Network Planning is becoming progressively more complex, as existing technologies develop and new technologies become available, as the possible service portfolio expands and services become more complex, and as new and expanded applications make demand forecasting more difficult.

It is now widely recognized that successful Network Planning must of necessity be computer-aided. To carry out the increasingly complex calculations manually is no longer practical. Good Network Planning must consider multiple scenarios, where each of several dimensions offers several options. Having worked through the multiple scenarios to achieve an optimal strategy, it is then necessary to carry out sensitivity analyses in order to understand which input components influence the planning decisions most, and to test combinations of potential "worst case", "best case", and "most probable" possibilities.

The ITU Development Sector provides a Computer-Aided Network Planning tool, named "PLANITU", which has been in use for several years. PLANITU is being actively introduced to developing countries around the world under BAAP Programme 5. At this time, some 100 countries have either introduced PLANITU into their Network Planning function, or have requested that it be made available to them.

PLANITU provides an integrated interactive approach for finding minimum cost solutions, addressing exchange locations and boundaries, selection of switching and transmission systems, establishing traffic routing and circuit quantities, and assisting in transmission planning. Large networks, of several hundred exchanges, can be studied. PLANITU deals effectively with local networks, with rural networks, and with national and international networks. Being modular, PLANITU can be enhanced, and development work is in progress to address evolving wireless technologies.

In planning telecommunications for rural and remote areas, as compared with more dense urban territory, there are more technology options, there is more volatility in possible traffic demand volumes, and the higher costs of serving these areas means that poor network planning decisions are more costly and more difficult to rectify.

For these reasons, the availability and use of computer-aided network planning is an **essential precondition** for any country which wants to implement an effective Rural Telecommunication Programme. An appropriate computer-aided network planning tool must be available to the organization which is planning the Rural Programme, and the network planners must be trained and experienced in its use.

5.3 Programme 9: Integrated Rural Development

This is the "focus Programme" for Question 4/2. As outlined below, this Programme will blaze the trail and establish the direction which Question 4/2 will pursue, in establishing the best ways of bringing telecommunication services to rural and remote areas.

Conceptually, "Integrated Rural Development" takes advantage of the widespread synergistic effect of the introduction of telecommunication services in the rural and remote areas. It proposes the application of telecommunications to benefit the coordinated development of all sectors of the rural economy, including agriculture, fisheries, forestry, transportation, education, health care, financial and other transactions, and the quality of government and delivery of government services.

Programme 9 is developing an in-depth understanding of the needs, both of the community and of individuals, in the rural and remote areas of developing countries, and, in cooperation with appropriate partners, is implementing Pilot Projects in several countries which explore and demonstrate the advantages which can result from Integrated Rural Development.

"Universal access" to telecommunication services is provided through Public Call Offices (PCOs) or Multipurpose Community Telecentres (MCTs) located centrally in each community. The PCO or MCT provides voice telephony services, and also the other telecommunication services that are required in the community, for example facsimile, transaction capability, database access, and access to Telemedicine and distance education opportunities. The commercial viability of the rural telecommunications service is enhanced, benefiting by the economic advantage of providing several high-usage lines at a single location. This provides a focused, significant service need which results in attractive revenue for the ROA with less investment than would be required to serve multiple locations.

The Pilot Projects which are sponsored by this Programme will constitute the "social science laboratory" which tests and experiments with the most effective and successful ways of bringing telecommunication services into the rural and remote communities of developing countries, and which establishes the value of the synergy which is created by introducing telecommunications into these communities. In this way, Programme 9 will establish the best practice for the introduction of telecommunication services to rural and remote areas.

It is very important that the experience and knowledge and understanding which comes from the work of Programme 9 should be fully taken into account in the work and the findings of Question 4/2. The Conclusions and Recommendations that are developed by Question 4/2 must reflect the work of Programme 9. In the reverse direction, as the work of Programme 9 continues, it must take advantage of the Recommendations of Question 4/2.

5.4 Programme 12: Development of Telematics and Computer Networks

This Programme follows logically from BAAP Programme 9 – Integrated Rural Development, and complements and extends the initiatives of that Programme. The concept of this Programme is the expectation that, over time and as required by the needs of the community, the Public Call Office (PCO) will in most cases add functionality and capability, and will evolve to become a "Multipurpose Community Telecentre" (MCT), described and discussed in [8] and [18].

For reasons of economy and efficiency, access to telecommunication services in rural and remote areas will continue for some considerable time to be provided at a central location in the community, rather than through the provision of telephone service to individual residences. Also, the support services which will be required can more effectively and economically be provided at a single central location, the MCT.

Gradually, and as community needs dictate, an extensive portfolio of telecommunication services will be provided at the MCT, along with all the on-premises facilities and equipment, and supporting human skills, that are required for these services and applications to be fully effective. A strong feeling of "community ownership" of the MCT should be encouraged. It is expected that the MCTs will unleash extensive latent creativity and entrepreneurial resources in the rural communities.

As well as public telephone service, electronic messaging capability and facsimile, the MCT will provide personal computers, printers and modems, photocopy capability, and teleconferencing facilities. For those who wish to use it, the MCT will constitute a "work centre" which enables local residents to work remotely, and "telecommute" electronically, as is increasingly the *modus operandi* of knowledge workers in the developed countries.

This will make it possible for residents of the rural and remote areas, particularly the younger generation, to take advantage of the functionality provided by the full spectrum of telecommunication services which previously had only been available in the major cities. It is expected that this will provide significant employment opportunities in the local community, and will help to reduce or reverse urban migration.

As with Programme 9, the innovative Pilot Projects which are sponsored by this Programme will provide a "social science laboratory" for implementing MCTs, experimenting with the best ways of adding additional telecommunication services to the PCOs, and establishing and understanding the value of the resulting synergy.

Also as with Programme 9, it is essential that the experience and knowledge and understanding which comes from Programme 12 should influence the work and the findings of Question 4/2. The Conclusions and Recommendations that are developed by Question 4/2 must reflect the work of Programme 12, and as Programme 12 continues to progress, it must be guided by the Conclusions and Recommendations of Question 4/2.

6 BAAP secondary linkages

6.1 Programme 2: Human Resources Management and Development (HRM/HRD)

Effective Human Resources Management and Development (HRM/HRD) is an essential requirement in providing efficient and sustainable rural telecommunication services. A wide variety of skills and knowledge is required, including the planning, construction, and commissioning of network extensions, monitoring service and network performance and taking appropriate remedial action, operations and maintenance of the many systems and equipment types that comprise the rural network, and commercial and customer service operations, including, for example, issuing timely and accurate bills and successfully collecting the payments.

The need for an efficient and effective work force is greater in rural and remote areas for many reasons. Compared to more densely populated areas, the rural network contains a wider variety of systems and equipment types, long distances are involved which often include difficult travel conditions, and the backup and support is sparse, both in equipment and in human resources. Individual repair visits take longer and are more costly, which causes outage times to be longer. For these reasons, it is very important that faults be cleared promptly, by the first craftsman on the scene.

Under these conditions, it is imperative that the maintenance and operations staff who support communications for rural and remote areas be well trained to handle the equipment in their territory, and be well equipped both with the required test equipment and with the appropriate equipment spares. It is also important that these people have appropriate support resources on call, who are able to provide guidance and direction to the craftsman in the field when required.

Programme 2, Programme 7 and Programme 9 are valuable support resources in achieving this, both in terms of the technical content and educational process of the required training and in the method of delivery. Programme 2 is developing the process of "Technology Based Training", a tele-education capability that offers particular value for the widely dispersed maintenance staff that support the rural and remote territory.

Programme 2 also includes an initiative (Activity 2.9), in conjunction with Programme 9, to provide education and training systems to specifically meet the needs which support those who are operating and maintaining communications for rural and remote areas.

Programme 7 – Improvement of Maintenance and Programme 9 – Integrated Rural Development are the resources on technical content, and Programme 2 bears the responsibility for the educational process, especially the "Technology Based Training", which takes advantage of the tele-education or distance learning possibilities and opportunities.

6.2 Programme 6: Spectrum Management

The radio-frequency spectrum is a limited natural resource which is of strategic importance to the world in general and to individual nations specifically. While the ITU-R has developed Recommendations with the objective of ensuring effective international coordination and regulation of the radio-frequency spectrum, efficient spectrum management at the national level is recognized as a fundamental prerequisite to the development of technically sound national radiocommunication infrastructures. The increasing complexity of spectrum management makes the use of a computerized spectrum management system essential.

In providing communications for the rural and remote areas of developing countries, in most cases radio systems of one type or another will prove to be the most economic and effective technology. It follows, then, that effective radio frequency spectrum management at the national level is an essential pre-condition for the implementation of a successful Rural Telecommunications Programme.

Under Programme 6, the ITU-D has arranged to specify, develop, test, introduce and make available to developing countries a "Basic Automated Spectrum Management System" (BASMS). The ITU-D intends that work will soon be started to evolve BASMS into an "Advanced Spectrum Management System" (ASMS).

BASMS is a multi-functional computer-based system which has been designed to provide radio frequency spectrum managers with the automated support that is required in their operations.

Features of BASMS include:

- Record keeping for all radio service licenses and related technical and administrative information.
- Initial features for frequency assignment and interference calculations for fixed, mobile and broadcasting services and frequency coordination for both national and international applications.
- Recording and notifying license fee data.
- Generating frequency licenses.
- Support of the national frequency allocation table.

Training courses for the users of BASMS have been in progress since III Q. '95. With the availability of this new tool, the ITU-D is now well positioned to equip and train developing countries to meet the challenge of ensuring that frequency spectrum management keeps pace with the evolution of radiocommunication services and systems that are used in bringing communications to the rural and remote areas of their countries.

6.3 Programme 7: Improvement of Maintenance

Studies confirm that poor maintenance is a very common cause of poor service and network congestion in the telecommunications networks of many developing countries. The first step in effective network maintenance is the selection of network systems that include integral diagnostic facilities, with user friendly terminal features and remote testing capability.

To maintain network services properly requires a well trained and experienced maintenance staff that is fully equipped with the required test equipment and with appropriate spare parts and components. A maintenance support organization is required, to provide assistance and guidance when problems are encountered which are beyond the capabilities of the field staff. It is also important to continually monitor the performance quality of the services and the network, so as to promptly trigger appropriate remedial action when it is required, preferably before the reduction in service quality and/or capacity becomes apparent to the users of the network.

The need for efficient and effective network maintenance is greater in rural and remote areas than in urban centres for many reasons. Customers in rural areas depend more heavily on the availability of telecommunication services. The rural network typically contains a wide variety of systems and equipment types. Long distances are involved, often with difficult travel conditions. Individual repair visits take longer and are more costly, causing outage times to be longer. For these reasons, good maintenance is very important in order to keep the number of faults to a minimum, and to repair faults as quickly as possible.

Programme 7 aims to improve the overall performance of the maintenance organization, including monitoring the quality of service, and the handling of customers' complaints and of network fault indications. The Programme will develop maintenance guidelines and support software, and will trial pilot maintenance organizations and support centres.

Another area which Programme 7 is pursuing is the introduction of the concept of "Telecommunication Management Network" (TMN, ref. ITU-T Study Group 4, the evolving M.3000-series Recommendations) to the network maintenance organizations of developing countries, as a system tool which offers the potential to improve the overall monitoring, management and control of both the services and the network.

These initiatives will result in better qualified and equipped personnel in the maintenance staff, which are working within more effective maintenance organizations. As a result, the existing networks will be able to handle more traffic and provide a better quality of service, which will result in increased customer satisfaction and in increased revenue.

6.4 Programme 10: Broadcasting Infrastructure

Unprecedented recent socio-political changes in the developing world, combined with rapid technological progress, have created new requirements for efficient and successful sound and TV broadcasting systems. The deregulation trend allows newcomers to apply for broadcasting licenses. This requires urgent replanning of the limited frequency spectrum which is provided for broadcasting services. Typical problems include the lack of an established regulatory framework, deficiencies in planning methods and tools, and an inadequate number of properly qualified staff who have to cope with an excessive workload.

Optimization efforts and corrective action are often taken too late or not at all. Some decisions for system rehabilitation are made on an ad-hoc basis under tight time constraints, and without adequate planning. Because of lack of resources, developing countries are facing serious difficulties in developing adequate technical infrastructures for broadcasting which are able to meet the expectations of the public.

The long-term objective of Programme 10 is to develop the planning, management and operational capabilities of those broadcasting organizations and independent broadcasting service-providers from the developing countries that want to increase their self-reliance and efficiency. The focus will be on assisting the broadcasters from the developing countries to develop adequate technical infrastructures, to enable them to fulfill their important role in educating and informing the public and in supporting economic, cultural and social development.

The main activities of Programme 10 include the following:

- Elaboration of guidelines for the preparation of development master plans for broadcasting infrastructure.
- Regional seminars, to train national counterparts.
- Preparation of a planning manual for broadcasting technologies.
- Development of a computerized frequency planning tool for FM/TV broadcasting transmitter coverage areas.
- Regional seminars on new technologies in sound and TV broadcasting.
- A VHF/UHF propagation measurement campaign for tropical areas.

Rural and remote areas will benefit the most from improved broadcasting because of the long distances and the widely dispersed population in these areas. Rural broadcasting will be an important component of Programme 10, in complementary relationship with Programme 9 – Integrated Rural Development.

6.5 Programme 11: Information Services

The telecommunications network is a vibrant, living organism. The regular, periodic recording, presentation and distribution of appropriate statistical information, sometimes referred to as "Key Indicators", is virtually essential to those who are responsible for the management of the telecommunications network, enabling them to understand, control and orchestrate its health and effectiveness, and to manage its development to deliver a larger volume and variety of services and to serve more territory.

An up-to-date and comprehensive telecommunication development database is valuable in many different ways. Ministries and regulators use internationally defined indicators to monitor ROAs, analyse trends in other countries and regions, and make international comparisons. ROAs are able to benchmark performance against their counterparts in other countries, and, through the use of internal Key Indicators, are able to assess and manage the effectiveness of areas

and organizational units within their own enterprises. Regional and international organizations have a basis for formulating plans, policy advice and strategy, and for investigating the impact of telecommunications on economic and social development. Private sector vendors and other organizations can analyse market profiles to discover and highlight investment opportunities.

The long-term goal of Programme 11 is the establishment of a comprehensive database of information which includes broad coverage of the telecommunications sector, organizational profiles, responsibilities and activities; regulatory environments; multilateral and bilateral project assistance; private sector activities and financing indicators. The availability of this information will benefit the worldwide telecommunication community. This will allow the ITU Development Sector to provide a better range of services and to be more responsive to requests for information from its Member States/Sector Members and its information services customers.

PART B

Information, studies, findings and conclusions

The material which follows is based on information provided in contributions put forward to ITU-D SG 2, and other available resources.

1 Need for a comprehensive, integrated approach in addressing communications for rural and remote areas, and the resulting benefits which impact economic, social and cultural development

The World Telecommunication Development Conference, Buenos Aires, 1994, in Resolution No. 4 – Telecommunication Policies and Strategies (see [3], pp. 63 to 66), offered extensive comments and suggested appropriate policies and principles. The following are of specific importance when considering communications for rural and remote areas.

Telecommunications, and most notably a modern telecommunication infrastructure, play a major role in a country's economic and social development. A well developed and well structured telecommunication network plays the determinant role in economic, social and cultural development.

Telecommunication policies must be developed as part of an overall strategy of economic and social development. Market-based economic principles are playing a growing role in the development of the telecommunication sector.

The regulatory and operational functions should be separated, with a view to facilitating more efficient management by and of ROAs, and to better reflect customers' needs for more cost-effective services. An established and appropriate regulatory framework will ensure the long-term development of the telecommunication sector on a stable basis, while promoting technological innovation, infrastructure modernization, service diversification and quality of service improvement. Appropriate regulation is also essential in promoting the provision of universal access to basic telecommunication services in rural and remote areas.

Telecommunication development policy must encourage the harmonized development of networks and services with a view to reducing national and regional disparities and improving the interoperability of networks worldwide. Policies must ensure that ROAs give special attention to the needs of remote and rural areas. Recognizing the considerable investment needs required for the development of modern telecommunication infrastructures, particularly in rural and remote areas, it is very important to explore all alternatives for attracting investments from sources of national savings, and encouraging national and international private sector participation.

Other investigators have explored the impact of the advent of telecommunications in rural and remote areas. It has been quite clearly established that improving telecommunication infrastructure in rural and remote areas can substantially enhance the quality of life. However, telecommunications are a necessary but not sufficient component for improving the quality of life in these areas. Other infrastructure components are essential also, for example transportation, potable water, and also water for irrigation, and electrification.

Experience indicates that the development of rural infrastructure will enhance economic, social and cultural development. Economically, productivity and efficiency will be improved. In agriculture and fisheries, markets will become more efficient, as producers are able to determine their most favourable selling options. Products and production will be improved, both through better market information and intelligence, and through sharing "best practice" techniques and information. Examples of substantial economic advantage through improved market information range from the fishermen of the Korean islands to produce farmers who export their crops in Côte d'Ivoire, Kenya and Zimbabwe.

Market information also provides a major boost to manufacturing, whether of handicrafts or industrial-level manufacturing. Tourism also becomes a viable local commercial opportunity, since tourists insist on a certain degree of communications capability, and the sales and marketing requirements of the tourist trade need good communications.

The advent of communications capability in rural and remote areas provides substantial opportunity for social development. An obvious example is "distance learning", a concept already in widespread use in remote and rural areas of developed countries, and in an increasing number of developing countries. Another related opportunity is in health

care, or Telemedicine. Very often, the Telemedicine applications of telecommunications involve distance learning, for example training the health-care workers in the remote and rural communities, or educating specific target populations such as expectant women or young mothers.

The cornerstone of successful and sustainable rural telecommunication service is to ensure that delivery of the service is based on commercial business principles. The ROA's decision-making processes and operations must be based on business economics, which understand and address both costs and revenues, minimizing the former and maximizing the latter. A "Universal Access" and/or "Universal Service Obligation" for the rural and remote area may very well be necessary. Careful attention to economics and profitability will go far to lighten the burden of the obligation.

Major cost savings can be achieved by implementing a well planned and orderly Rural Telecommunication Programme. A dedicated Programme over several years will develop expertise in the personnel of both the ROA and the equipment vendors. Entrepreneurial PCO operators in the villages will find creative new opportunities to provide value to the rural residents they serve.

Applications of telecommunications that promote economic, social and cultural development will provide major improvements in the lives of rural residents. Examples include Telemedicine, distance education, electronic transactions, and database access. Since the provision of telecommunications in rural and remote areas is generally more expensive than in urban areas, care must be taken to ensure maximum advantage for the development opportunities in the communities served. It is important to provide enough capacity for all the service needs, and in this way the ROA can realize all the opportunistic revenue that arises from serving these needs.

Ideally, a Positive Business Case can be achieved for the Rural Service, and this will ensure its ongoing viability and sustainability. Minimal regulatory overview will be required, and the continuity of the Rural Service will be assured.

2 Appropriate techniques and approaches for engineering economic cost studies, financial analyses and fiscal planning

National rural telecommunication development initiatives should be organized and implemented through a carefully planned, orderly, progressive, multiyear programme, as part of the national telecommunication development master plan, to ensure that such programmes are implemented efficiently and economically.

i) The nature of planning rural telecommunication network projects/programmes

All planning of Telecommunication Networks is by its nature complex, involving the interaction of many interrelated variables. Such planning is inherently an iterative process, seeking to progressively move closer to an optimal solution. In all network planning, careful attention must be paid to the long-range planning view. Plans must be open-ended and flexible, and there is the constant danger that short-term solutions may impede long-term optimization.

The network plans that are compared must **always** be comparable in coverage, in services provided and in service quality, and in duration. The comparisons must always be equitable ("apples vs. apples"), in order to provide an appropriate basis for decision making. Obviously, a plan that ignores or excludes an essential component will tend to have a misleadingly lower cost than one that includes that component.

The network planning techniques used, and the tools that support them, are of necessity sophisticated. As a practical matter, it is now essential to perform network planning studies using a computer-based planning tool, in order to properly investigate and compare the multi-dimensional network alternatives which are now possible. Appropriate computer-based tools do exist and are available. These network planning tools are becoming progressively more "user friendly" and easier to use.

Planning Rural Networks brings unique challenges to the network planning task. In this planning, it is important to consider the socio-economic benefits to the rural area that the advent of Rural Telecommunications will bring, both qualitatively, and also quantitatively to the extent that this can be defined. It is desirable that the financial advantage of the socio-economic benefits should be considered, noted also under "Financial Analyses", below.

Service Quality objectives must be clearly established. Expected Subscriber Demand, and the related revenue expectation, is of course an important input to the planning process, and it is typically known only poorly for the currently unserved rural and remote areas. Expected usage by those who have never had telecommunication service is difficult to forecast under any circumstances. The recorded "held applicants for service" are likely to be greatly

outnumbered by the latent unexpressed, and hence "unrecorded", demand. Here again, planning iterations are essential to explore the range of possibilities, and understand the sensitivity of network planning conclusions to major variations in demand.

ii) Engineering economic cost studies

These studies are based on flows of funds of all types throughout the study period, including capital expenditures, revenue, the expense costs of maintenance, operations and overhead, and also salvage (at the end of the useful life of the equipment or system). Provision should be included for the appropriate test sets and spares, and for staff training, and for commercial expenses, for example rendering bills and collecting them, and agents' commissions. These various types of funds flows, over the study period, must be correctly accounted for in accordance with taxation and depreciation requirements, which tend to vary between countries.

If revenue is constant when comparing different solutions, then "Present Worth of Annual Charges" (PWAC) is the appropriate selection decision criterion, but, in Rural Network studies, expected revenue is likely to vary between solutions, in timing if not in overall amount, so the correct decision criterion is "Net Present Value" (NPV). Another helpful criterion is "Internal Rate Of Return" (IROR). The network planner's objective is to provide the network solution that maximizes NPV and IROR. To find this solution, he will certainly have to carry out several iterations of the proposed plan. Network planning decisions must not be based on "Installed First Cost" (IFC), although this cost must be considered, as it directly impacts the Project/Programme funding requirements.

It is also important to carry out appropriate sensitivity analyses. It will generally be found that three or four of the input factors have a substantive impact on the outcome of the study and the conclusions reached, and that the other factors are relatively unimportant. The management task, then, is to focus on these critical factors, both to ensure the best prior knowledge of their probable values, and to monitor developing experience as the plan is implemented, in order to make adjustments to the plan when and as changed conditions warrant.

Network solutions which have the flexibility to readily adjust to the unexpected variations in demand which will certainly occur are preferable. In this regard, radio-based network solutions, with flexible capacity and the possibility of equipment relocation, tend to have an advantage over hard-wired cable solutions, which include a large and unrecoverable civil works component.

The planner must also consider the national intertoll network, and the international intertoll network. If these networks are provided by a different organization, both revenue separation and interconnection arrangements are very important. These parts of the overall national network are key adjuncts of the Rural Network, since long distance revenue will be a major factor in the economic analysis. The ability of the intertoll networks to carry the long-distance calls that create this revenue is essential if the revenue is to be realized. In developed countries, "One Percent Non-completion, Busy Hour, on Intertoll" is a network performance standard which is typical and is generally met.

iii) Financial analyses

This function is the step that follows, at a higher level, the effective engineering economic cost studies of the intended Rural Network. It considers the outcome of the cost studies, and may well require the decision-making process to move to other arenas. For example, and based, perhaps, on an inability to develop a Rural Network Plan that has a positive NPV, or an acceptably low negative NPV, the fiscal analyses may trigger dialogue with the regulatory authority. Areas for consideration could include changes in tariff level and/or alternative tariff structures. Revenue settlements should also be considered. In this regard, the quantified understanding of the socio-economic benefits which will result from the proposed Rural Telecommunications Network may be the key factor in influencing the regulatory arrangements.

iv) Fiscal planning

This is the next step beyond and above Financial Analyses, and must consider not only the previously determined financial values, but also the schedule of funds flows, the methods by which funds are to be raised (e.g. debt vs. equity vs. internally generated funds), foreign currency requirements, and possibly other financing approaches. Examples of the latter would include BTO and BOT arrangements.

Two specific areas that must be carefully considered are foreign exchange risk and importation tax. Prudent fiscal management requires arrangements that protect the enterprise from risks caused by unexpected changes in foreign exchange rates. Importation tax requirements directly increase the cost of imported equipment and systems, and this

additional cost must ultimately be reflected in the price of the service. There is a very good fiscal argument to be made that the levying of importation tax by developing countries on rural telecommunications equipment is unhelpful and counterproductive.

Giving appropriate consideration to all of the above factors, the fiscal planners must ensure that the proposed Rural Telecommunications Project/Programme fits appropriately within the overall fiscal plans and expectations of the enterprise.

3 Topic a) – Low-cost appropriate technology options for rural telecommunications

3.1 Definition

A rural area may be characterized as follows:

- scarcity or absence of public services (water, electricity, etc.);
- shortage of qualified technical staff;
- geographical or topological features little suited to the installation of currently used transmission lines or systems;
- scattered population;
- scarcity or absence of health or education services;
- limited economy.

Telecommunications in rural areas should be able to offer the same services as in urban areas (telephone, data transmission, video transmission and other services) both for individuals (private subscribers) and for the community (public services, public booths, telecentres, etc.).

3.2 Definition of models

a) Preamble

The following considerations, which reflect the true situation in most developing countries, should be borne in mind before embarking on the study of Question 4/2.

They include:

Traffic flows

Communications in rural areas are mostly directed from remote locations either:

Case 1: to a locality where the international transit centre generally operates; or

Case 2: to the hierarchically higher and/or main administrative locality; or

Case 3: to the "closest" locality from the point of view of regional and/or cultural links (regional town); this is the case where administrative divisions do not coincide with the development of telecommunication infrastructures.

Localities in Cases 2 and 3, being regarded as important centres, have a minimum telecommunication infrastructure (automatic exchange). They are also linked to a locality with an international transit centre via a long-distance transmission system (trunk cable, radio-relay or satellite).

These considerations give an idea of the telecommunication structure in developing countries, particularly LDCs.

Geographical situation of rural or remote localities

Rural or remote localities almost invariably gravitate around the three types of town identified above: a locality with an international transit centre, an administrative centre, or a regional centre.

Service to remote localities

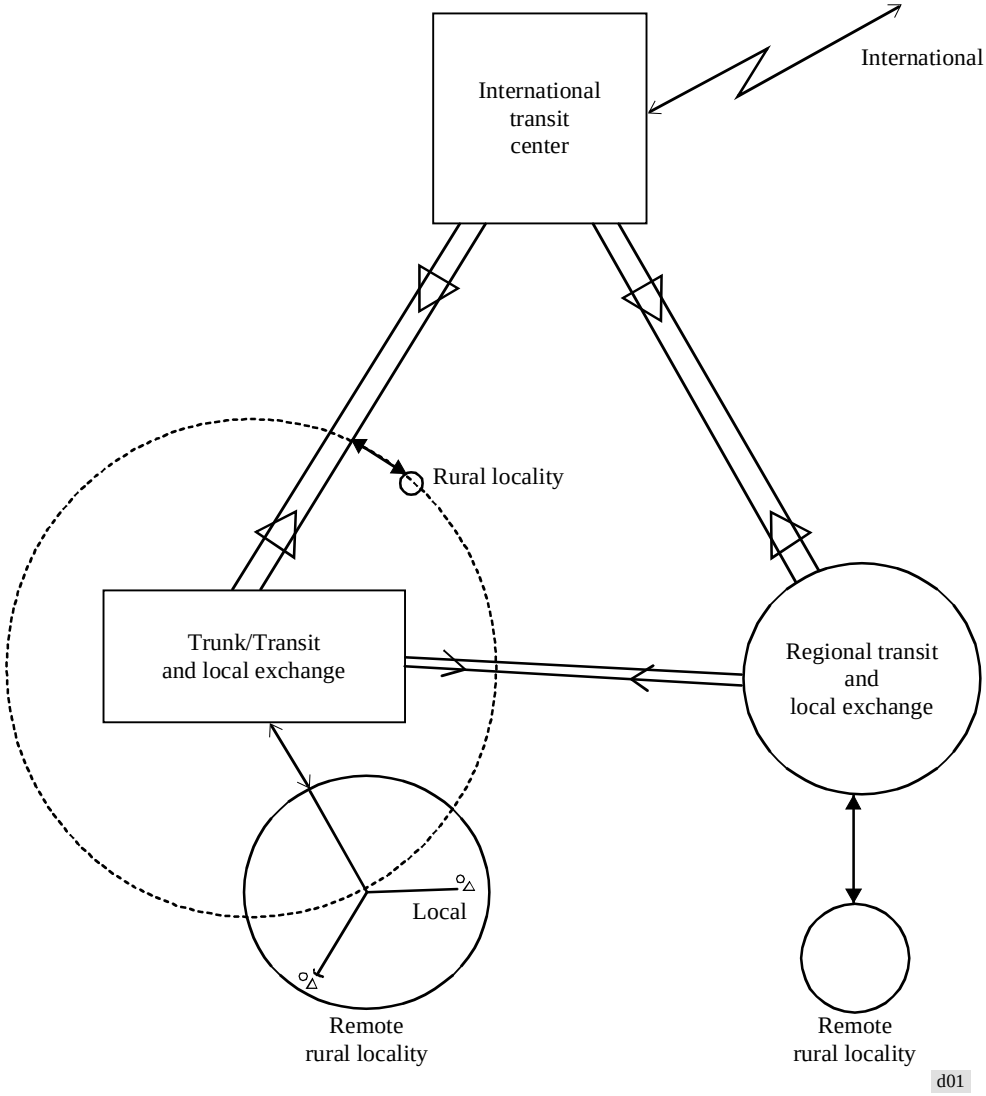
In the light of the above considerations, service to rural or remote localities will consist in:

– linking the rural locality with one of the three types of centre listed above;

– providing local subscriber connections (see illustration Figure 1).

FIGURE 1

Location of areas to be served



b) Geographic aspects

According to the definition of rural areas, the geographical or topographical features of such areas include, amongst others, expanses of water (lakes), deserts, and mountainous or snow-covered areas. Added to this is the distance between the rural locality and the higher centre to which it is attached. This very important distance factor when combined with other constraints will greatly influence the choice of technology for the rural area service.

c) Socio-economic aspects

This aspect is also a reflection of the above definition of a rural area. The scarcity or even total absence of public services (such as water and electricity), and of health and education services means that economic activity is limited, not to say embryonic.

This situation partly explains the concerns about profitability often expressed in connection with telecommunications in rural areas (forgetting the importance of telecommunications in social and economic terms, and their role in limiting rural exodus).

d) Accessibility

The notion of accessibility to bear in mind is accessibility to telecommunications services for all, i.e. allowing any individual, regardless of his or her social circumstances, to enjoy the benefit of telecommunication services.

The characteristic of rural life, particularly in LDCs, is that the vast majority of people there live in modest, not to say impoverished, circumstances. Furthermore, their communication needs are occasional and infrequent. It is therefore not necessary for each inhabitant to have an individual line. Instead, the telecentre concept is useful when planning telecommunication infrastructures in rural areas. The needs of some private subscribers and possibly companies will need to be met, however, by applying, as the case may be, what is known as the minimum tariff principle. Under this principle, private subscribers and/or businesses who wish to have individual lines at home and/or in their businesses agree, on the basis of a contract, to pay for communications at a different (higher) price from that applied for public or community services.

e) Models

Before selecting an optimal rural system, the areas where the system will be operating should be identified. It may be remembered that, according to studies and analyses carried out in various countries, rural areas may be represented by four models (A, B, C and D) as follows:

– **Model A** (high population density): an area where the population density is relatively high for a rural district and where distances between neighbouring villages are fairly short.

– **Model B** (mountainous area): an area where villages are separated by mountains or hills, or where they are situated on a mountain or a hill.

– **Model C** (ribbon type): an area where villages are strung out along a river or a road.

– **Model D** (scatter type): an area in which the population is sparse and widely scattered.

3.3 Types of models advocated

Three models are presented below, corresponding to three typical, commonly encountered scenarios, although others can be used, like those listed in 3.2e) above. We considered that the other models were combinations of the three models identified rather than new configurations.

The following three models offer the advantage of being less complex and less overlapping, and can be considered as the detailed reflection of the illustration in Figure 1.

The three models are as follows:

- **Model 1:** the so-called "**remote**" configuration, which applies for instance to new urban or suburban areas linked to existing networks.

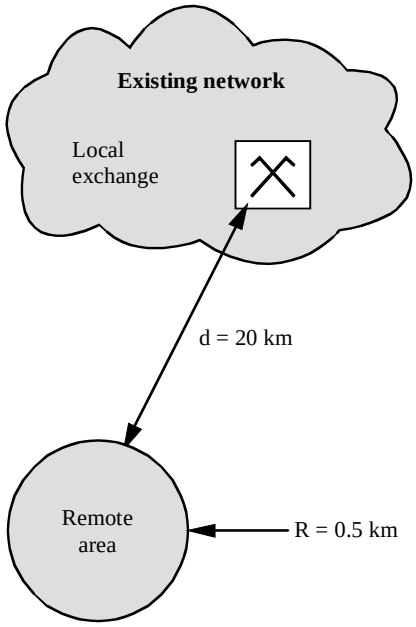
- **Model 2:** or "**star**" configuration, which is the extension of an existing zone around its centre to include new subscribers. This is typically the case in suburbs.

- **Model 3:** or "**tree**" configuration, which covers a much wider, typically rural area where a large number of villages (cells) have to be connected to the nearest regional administrative/economic centre.

Extreme configurations such as deserts, islands or a few regions with a very scattered population whose potential subscribers are hundreds of kilometres from the connecting exchange have not been considered. In such cases, it is clear that techniques such as satellites or radio-relays will be the most appropriate even though the cost may be very high.

FIGURE 2

WLL MODEL 1 – Urban/Suburban – Remote configuration

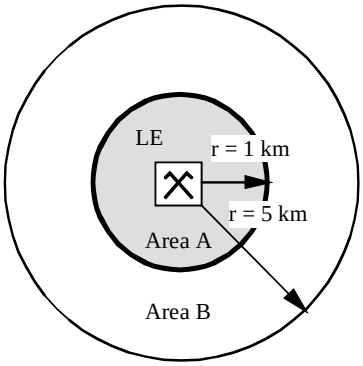


- Existing network
  - Spare capacity 2 000 lines in LE
- New area
  - Environment type: Suburban/Urban
  - Number of subscribers: 300 to 1 500
  - Subs. density: 500 to 2 000/km^2
  - Subs. type: Business
  - Traffic per subs.: 100 mE/subs.
  - Services: POTS
Fax group 3 and 4
ISDN (2B+D)
  - Grade of service: 1%
  - Deployment: Fast (2 years max.)

d02

FIGURE 3

WLL MODEL 2 – New Urban/Suburban area – Star configuration

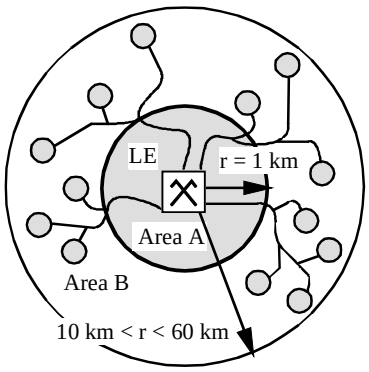


Area type:	**Center (A)**	**Suburbs (B)**
Number of subscribers	600-3 000	10 000-40 000
Subs. density	200-1 000	100-500
Subs. type	Business	Residential
Traffic per subs.	100mE	50mE
Services	POTS Fax Group 3 and 4 ISDN access	POTS Fax Group 3
Grade of service	1%	1%
Deployment	5 years	5 years

d03

FIGURE 4

WLL MODEL 3 – Small town and rural area – Tree configuration



■ **Area type:**	**A**	**B**
▸ Environment	Urban	Rural
▸ Nb of subscribers	600-3 000	20-1 500
▸ Subs. density	200-1 000	2-50 subs/cluster
▸ Concentration/ Nb of clusters		10-30
▸ Traffic per subs.	100mE	50mE-80mE
▸ Services	POTS Fax Group 3 and 4 ISDN access	POTS Fax Group 3
▸ Grade of service	1%	1%
▸ Deployment	3 years	3 years

d04

3.4 Technologies applicable to the models

Without going into great detail, it may be said that the technologies applicable to the models should meet the following requirements:

– provision of links between rural areas and connecting exchange centres;

– provision of local connections within a single rural area.

For links with connecting exchanges, the following systems may be mentioned:

- multi-pair copper or fibre optic trunk cable;
- radio-relay;
- satellite (geostationary or non-geostationary).

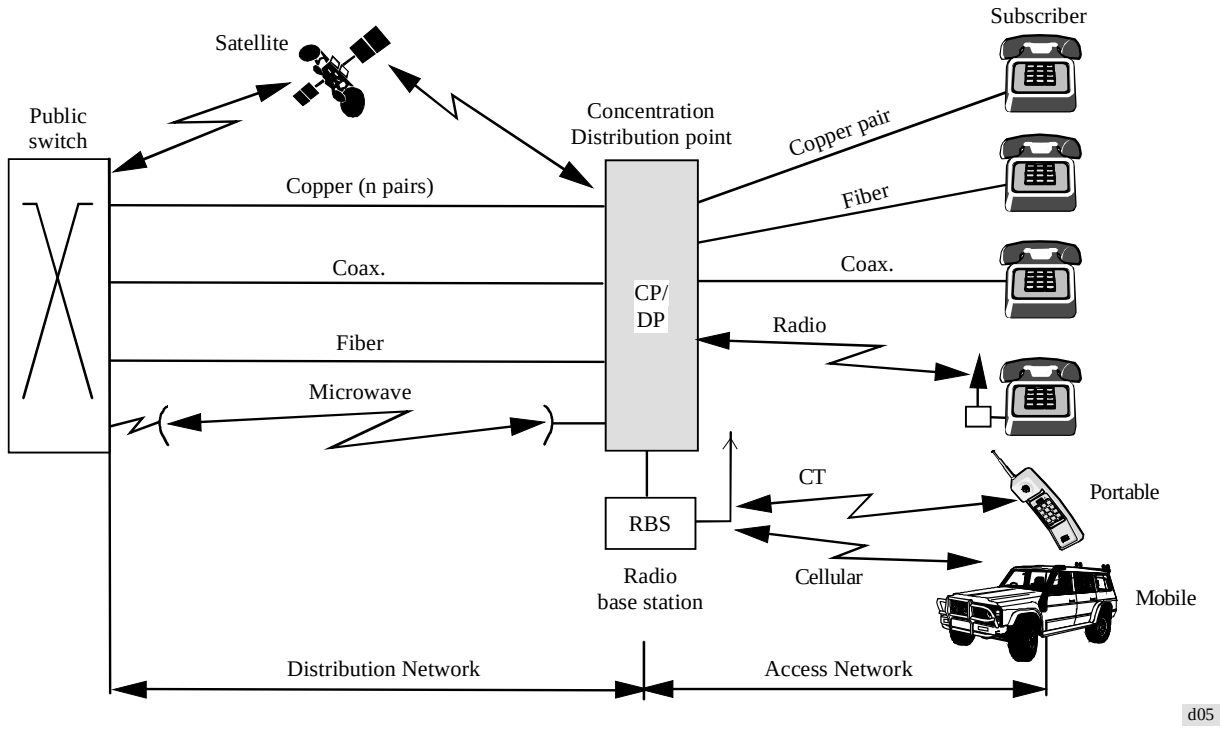
For local links (or connections):

- multi-pair cable (copper, fibre optic);
- single channel radio system;
- point-to-multipoint radio system;
- cellular.

The above is illustrated in Figure 5, where the local loop refers to the entire network between the automatic exchange and the subscriber's home. Likewise, "CP" or "DP" could represent a remote subscriber access unit, a rural automatic exchange, a terminal station or radio-relay with subscribers.

FIGURE 5

The local loop definition



3.5 Comparative analysis

a) What technology at what price?

That is the question asked by every operator, regulator, builder and user.

In practice, no technology or figure can be put forward until the following questions have been answered:

- **What services** (voice, data, vision, video)?
- **For whom** (existing or new operator, domestic or business use)?
- **What performance** (capacity, sound quality, reliability)?
- **In what configuration** (region, distance, environment)?
- **On what existing infrastructure, and subject to what equipment limitations** (switching, transmission, distribution equipment, subscriber terminals, power supply, pylons, cables, antennas, buildings, integration, start-up, training, operation, including subscriber management and invoicing)?

  What are the regulatory requirements?

There are many different parameters which make comparison very difficult.

The objective of the following (as a complement to the studies and comparative analysis already carried out for other models) is to provide comparative cost factors for both cable and radio solutions, in respect of the three typical configurations set out in paragraph 3.3. It is understood that the choice of one or more technologies will depend, among many factors, on the replies to the questions listed above.

b) Technological compatibility and coherence

Referring to the definition of local loop in paragraph 3.4, it may be recalled that both the access network and the distribution network may use either cable or wireless technology. In theory, most combinations can be used. However, other parameters such as geography, local constraints or even relative capacities, performance or the services supported

may limit the number of possibilities. Hence the interest of studying the compatibility and coherence of technologies for models such as those described in paragraph 3.3.

Compatibility

The existence or otherwise of a concentration point (CP)/distribution point (DP) in the local loop is the first compatibility factor between the different elements of the network. If the distribution point is co-located with the local automatic exchange, the subscriber loop will use only one technology and compatibility will be limited to the interface with the automatic exchange. On the other hand, if there are two subnetworks, i.e. when there is a concentration/distribution point, compatibility between the two subnetworks needs to be examined. Figure 9 illustrates the two cases.

Coherence

Although most juxtaposed technological combinations are technically possible, environmental capacity service and other factors generally limit the range of solutions. A compatibility/coherence matrix should therefore be drawn so as to restrict comparative studies to feasible solutions.

The following table illustrates this procedure for the three models under consideration.

Compatibility and technological coherence matrix for the three models

Technologies	**Access network**							
Distribution network	**Copper**	**Coaxial**	**OF**	**Cellular**	**MW**	**PMP**	**CT**	**Satellite**
Copper				x	x	x	x	
Coaxial	x			x	x	x	x	
OF	x			x	x	x	x	
Cellular							x	
MW	x	x	x	x		x	x	
PMP	x			x			x	
CT								
Satellite	x	x	x	x	x	x	x	

c) Solutions for the three models

If we now consider the results of the compatibility/coherence matrix for the three models, local constraints and services required, only a limited number of solutions appear realistic and significant for cost comparison purposes.

Technologies			
Models	**Solution**	**Distribution**	**Access**
Model 1	Sol. 1 Sol. 2 Sol. 3	Copper Radio-relay Radio-relay	Copper Cellular* Cordless
Model 2	Sol. 1 Sol. 2 Sol. 3	N/A	Copper Cellular* Cordless***
Model 3	Sol. 1 Sol. 2 Sol. 3	Fibre optic Pt-Multi-Pt Satellite**	Copper Cordless Cordless

* Cellular includes both analogue and digital.

** Satellite technology also includes hub and Vsat.

*** Cordless = wireless access.

d) Assumptions

In order to evaluate the cost of the different solutions, the following assumptions have been made:

– The cost of subscriber radio terminals (fixed, mobile or portable) has been included in the calculation when radio is used in the access network, but not the cost of operating licences.

– Subscriber loops are regarded as starting from the automatic exchange terminal.

– Analogue and digital cellular systems have been evaluated separately and all equipment has been included (MSCP and all the other necessary associated equipment). This also means that the case of an extension of an existing mobile cellular network to fixed subscribers which requires only the addition of fixed terminals has not been considered in the study.

– All ancillary equipment, such as ducts, jointing chambers and feeders, has been assumed to be lacking in both urban and suburban areas and has thus been included in the cost calculations.

– Radio coverage has been estimated on the basis of normal transmission conditions without any major obstacle and only for subscribers using external roof antennas.

e) Cost comparison

The results of the cost comparison for the various models are set out in Figures 6, 7 and 8. The following information can be extracted from the curves:

Regardless of the model or solution envisaged, all the curves have the same hyperbolic form.

This is logical, since the high initial investment cost is shared among an increasing number of subscribers. The cost per subscriber therefore decreases along a hyperbolic curve until it reaches a constant cost, which corresponds approximately to the cost of the subscriber equipment, i.e. the subscriber terminal and accessories (antennas, etc.).

In **model 1**, the urban/suburban "remote" configuration for solution 1 (copper) and solution 3 (radio-relay + cordless), the initial infrastructure can support all potential subscribers and thus the cost per subscriber decreases slowly to the minimum. In other words, in a new "remote" urban/suburban configuration, all the cable ducts can be regarded as having been laid from the outset and only the drawing of cables through the ducts has to be taken into account.

In this case, the additional cost is less than with any other wireless solution, which also explains why, starting from a much higher initial investment, including the installation of ducts, the solution 1 curve then crosses that of solution 3.

Still in the same model, the solutions 2 curves (radio-relay + analogue or digital cellular) decrease up to the limit of the maximum number of subscribers which the base radio stations can support. At that point, the peaks correspond to the new investment required for new base radio stations and related equipment, such as power and radio-relays to link them to the automatic exchange. Then the curve declines again as for the initial investment.

As expected, the final cost is higher for digital than for analogue, which in turn is more expensive than "cordless".

Model 2 is a "star" urban/suburban configuration, which can support more than 40 000 subscribers compared with 1 500 in model 1 and 4 500 in model 3.

The shapes of the curves are the same as in model 1, but the scale is significantly different.

In all the solutions (copper, cellular or cordless), major investments are required at the beginning in order to cover the first ring of the new zone from the outset. Thereafter, investment will continue progressively as new subscribers are connected.

Model 3 is a rural "tree" configuration. The rules are the same as for models 1 and 2. However, the peaks in all three solutions reflect the frequent additional investments needed each time a connection is made to a new cell or branch of the network. The shaded area in the curves shows the variation of cost per subscriber as a function of the distance from the automatic exchange.

For solutions 2 (PMP and CT) and 3 (satellite and CT), the frequency of the peaks reflects the new investments required for each new cell.

In model 3, due to the low subscriber density in zone B and their low level of concentration (many small cells), solution 2 with PMP and CT is the least expensive, while solution 3 with the satellite "hub" and Vsats" is the most expensive.

It should be noted that offers of global satellite links which can offer appropriate services at competitive prices are now coming on to the market.

FIGURE 6

The Cost Comparison
Model 1 – Urban/Suburban – "Remote"

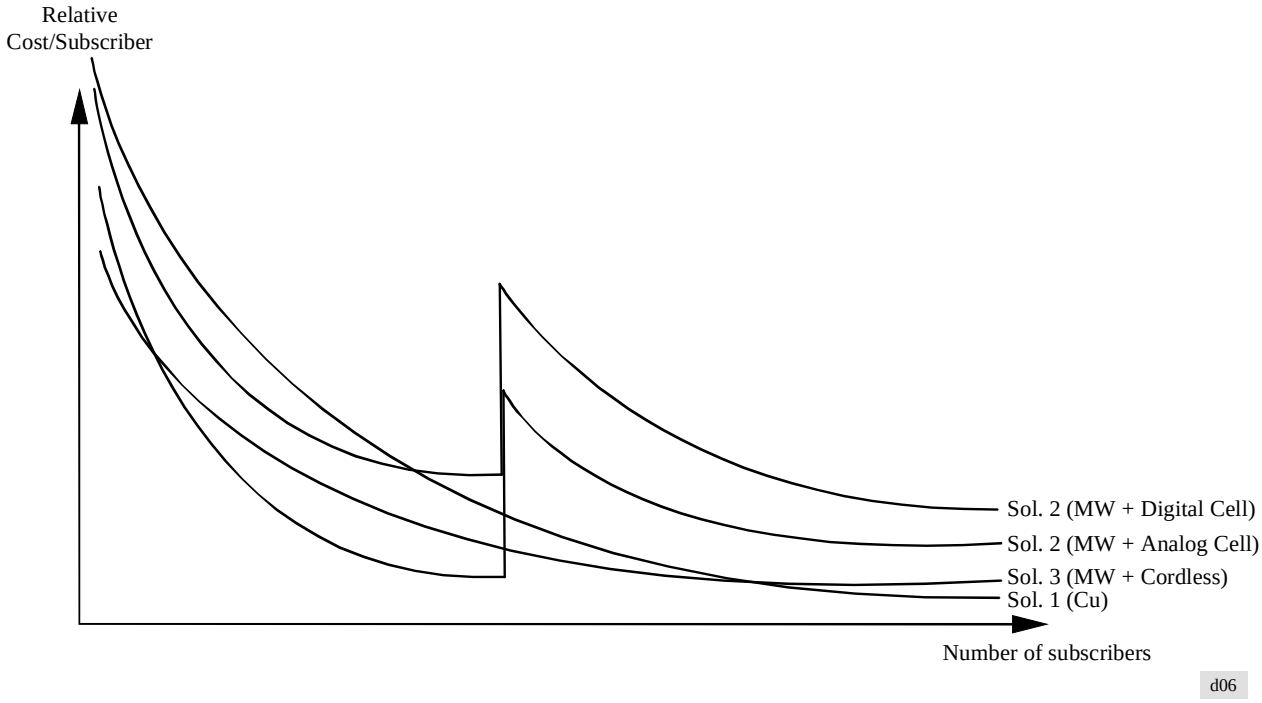


FIGURE 5-7

The Cost Comparison
Model 2 – Urban/Suburban – "Star"

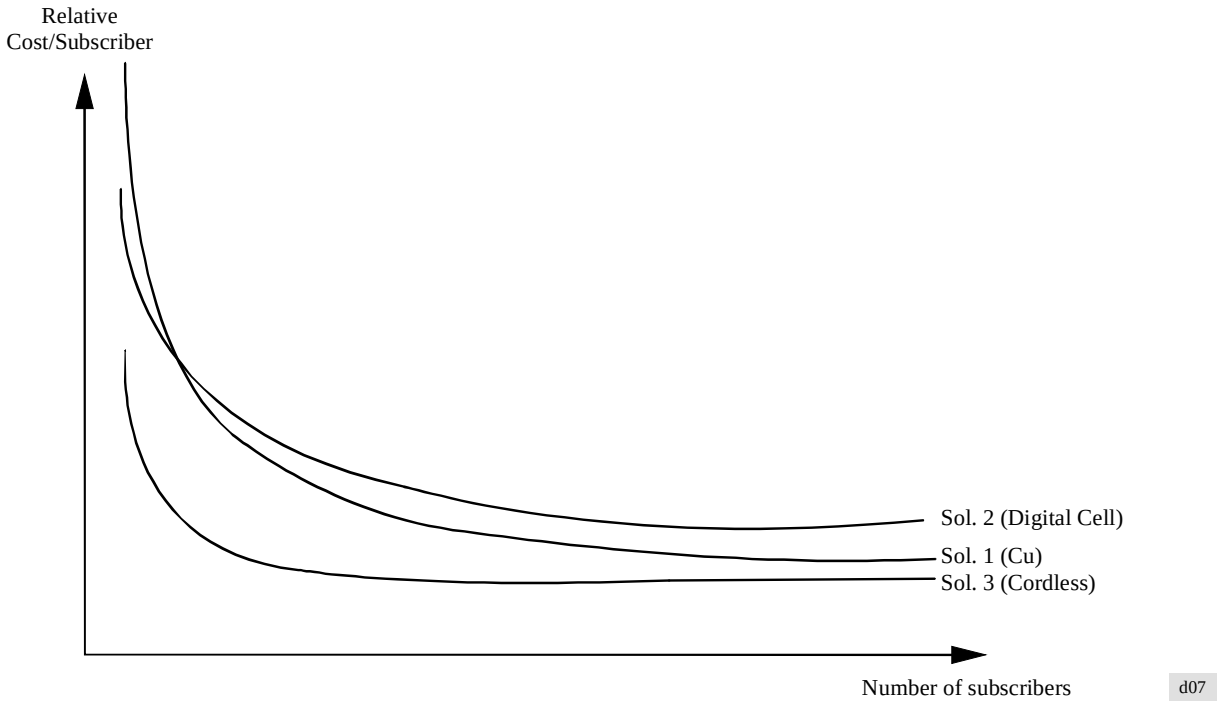


FIGURE 5-8

WLL – The Cost Comparison
Model 3 – Rural – "Tree"

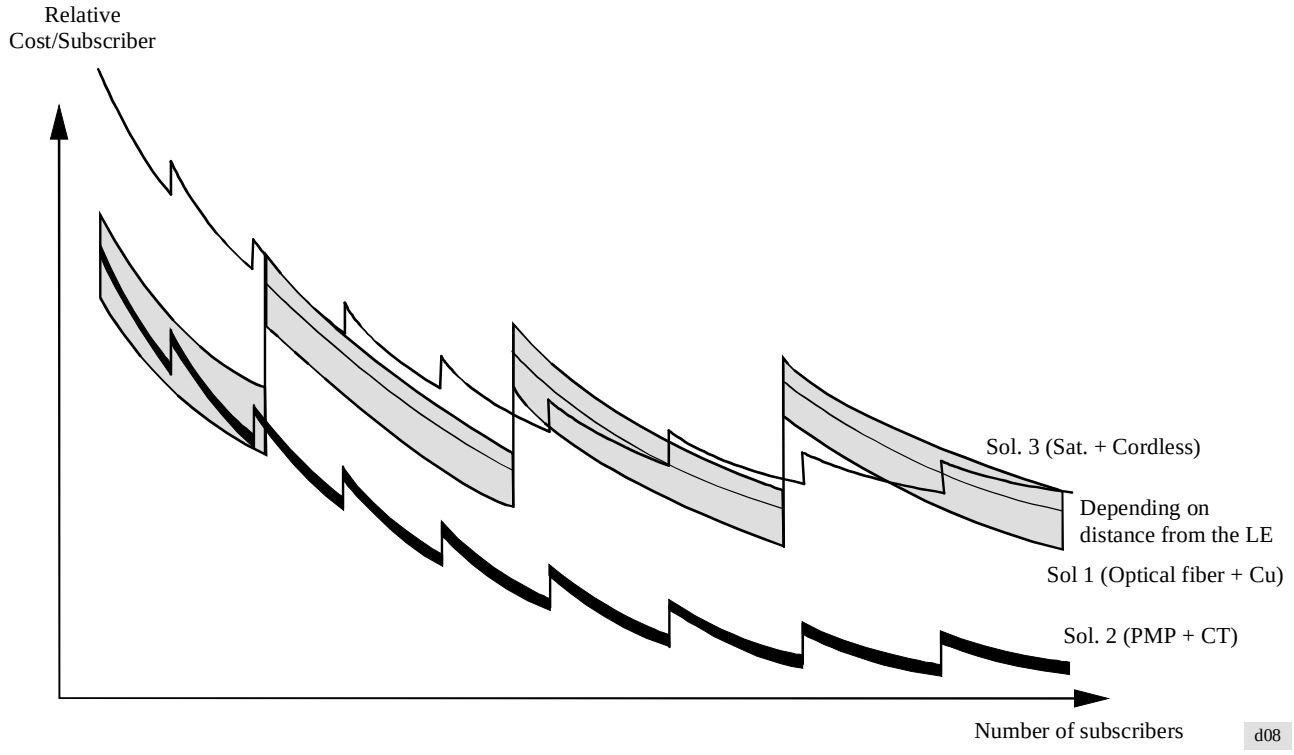
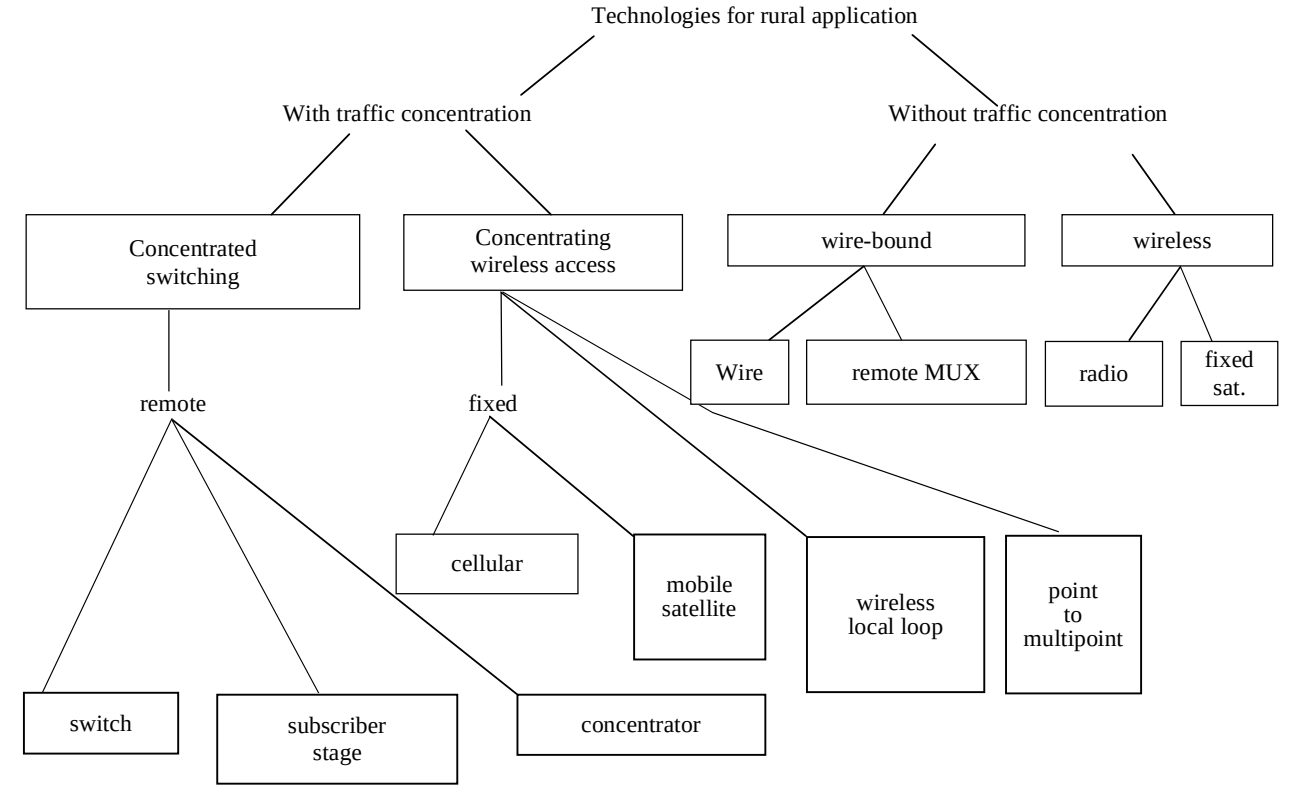
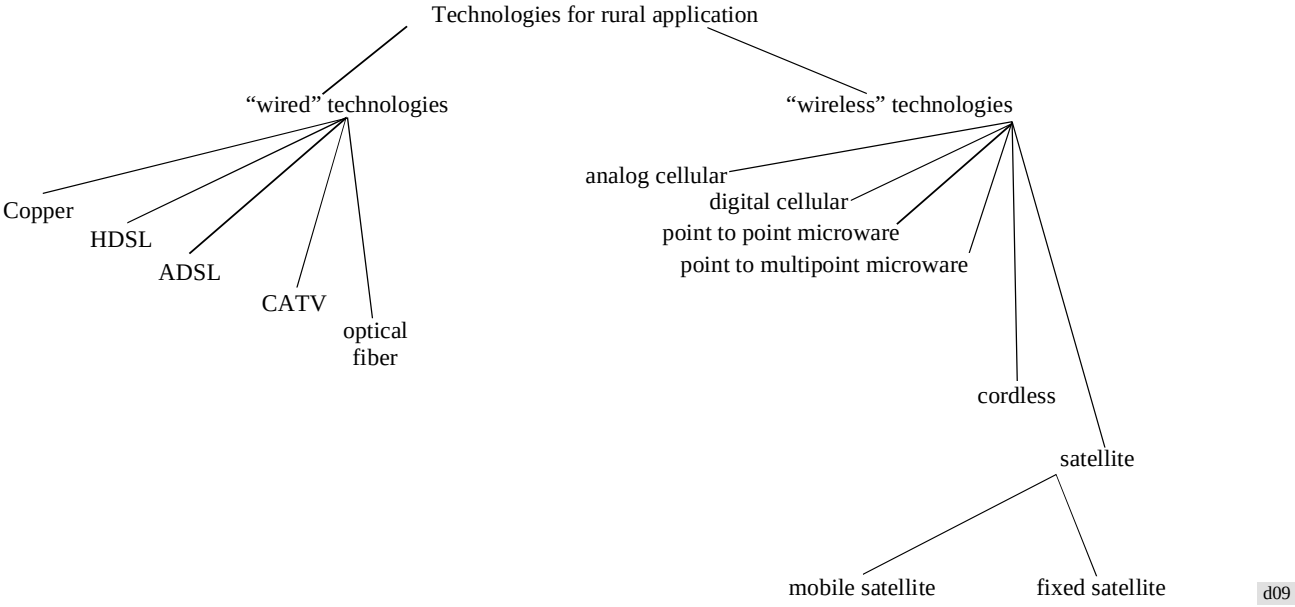


FIGURE 9

Local loop with traffic concentration



Local loop without traffic concentration



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4 Topic b) – Planning and implementation of national rural telecommunication development plans

4.1 Introduction

Despite the major changes in recent years in telecommunications development resulting from deregulation, the very high cost of infrastructure increasingly induces operators to install infrastructure and equipment designed for life spans which cause a high degree of inertia in the organization of their networks. This highlights the importance of planning, the technical, financial and commercial consequences of which will have an impact for many years.

Planning a telecommunication network for a given area and period of time may be said to consist in defining the structure of the general network (switching and transmission) and, according to the extent and topography of the area concerned, the structure of the subscriber access network.

Planning a network therefore means choosing a system which can satisfy environmental constraints, operating objectives, the required functions and customer demand, while giving the best value for money.

Depending on the target planning year selected, a distinction may be drawn between the following types of plan:

a) Master plan (long-term planning)

This is a document concerning the general development plan over a period of ten to twenty years.

A telecommunication network will not remain optimal for very long if allowed to evolve at the whim of short-term operational management criteria.

That is why it is necessary to draw up a telecommunication master plan, an essential document which will serve as a framework for a coherent policy as regards equipment, rational technical management and proper control of investment costs.

b) Medium-term plan

A medium-term plan, which covers a period of five to ten years, deals with the feasibility of projects and their specifications. It is intended to define:

– the target network for the period in question with an estimate of current and future service needs;

– the major phases of transforming the existing network into the target network.

c) Short-term plan

A short-term plan covers a period of one to three years, and applies to “emergency operations”, to particular project specifications or to project extensions. In other words, it establishes in detail the development of the network and the practical means of implementation.

d) Updating of master plans

In view of changing demand and technology, periodic updates of long- and medium-term plans are highly recommended.

4.2 Methodology

Two essential phases shall be considered:

– development strategy;

– network planning.

a) Development strategy

A development strategy consists, firstly, in defining objectives, taking into account the results of available studies on demand, human resources, technical aspects and financial resources.

Secondly, it addresses technical choices in designing the network structure. It selects demand growth parameters and helps in drawing up basic plans.

The following list of basic plans is not exhaustive:

- numbering plan;
- routing plan;
- transmission plan;
- digitization plan (transition from analogue to digital);
- synchronization plan;
- tariff and charging plan;
- signalling plan;
- coverage plan;
- frequency plan;
- etc.

With regard to development strategy in particular and in view of the growing share of rural telecommunications in the extension of national public telecommunication networks, it is becoming essential to take account of demand from subscribers in rural areas in establishing a development plan strategy. Furthermore, technological progress should now facilitate a bolder strategy of offering the same services and the same quality of service to urban and rural subscribers alike.

b) Network planning

Network planning has to be based on preliminary studies, which entail assembling the following basic data:

- **Forecast demand and traffic data**

A demand forecast gives a projection of the number of main lines (ML) in the target year (including immediate and future needs of the rural areas concerned); in addition, it should give a breakdown of main lines between business and residential categories and the type of services offered.

A more detailed breakdown of main lines might distinguish between:

– the administration's lines;
– business lines;
– residential lines;
– public booths;
– service and operating lines.

It is important to know how demand will grow in order to select equipment of the right capacity.

Likewise, traffic forecasts are needed in order to ensure satisfactory inward and outward traffic flow. When the amount of traffic is known, equipment can be dimensioned accordingly. Traffic forecasts can be refined on the basis of the breakdown of demand forecasts.

- **Engineering rules governed by the development strategy, taking into account the systems to be introduced and the recommendations of the basic plan**
- **Data concerning the existing infrastructure**

In addition to the other data, planning should incorporate the existing network and use all available techniques (switching, transmission, distribution) to design an optimal structure of the network up to a given horizon.

Data concerning the state of the existing infrastructure may serve as a basis:

– for recommending the replacement of the most obsolete equipment;
– for extending the life of equipment which is still serviceable;
– for using or reusing existing infrastructure (e.g. pylons).

It goes without saying that each of the techniques used has its own environmental requirements (buildings, power, air-conditioning, means of access) and of course its own investment costs.

- **Investment cost estimates**

Investment cost estimates are used:

– to estimate the financing required to implement the development plan;

– to ensure overall profitability of investments;

– to allow adequate and timely mobilization of funds.

To sum up, network planning involves the following tasks:

– for the general network structure:
  – design of the network operating structure;
  – incorporation of basic data (demand, engineering rules);
  – choice of exchange sites and transmission nodes;
  – study of forecast traffic and destinations;
  – switching network structure;
  – transmission network structure;
  – investment estimates;

– for the access network structure:
  – delimitation of areas (local and cross-connection);
  – evaluation of civil engineering works (ducts, jointing chambers, radio sites, etc.);
  – evaluation in terms of pair/kilometres of primary cables and/or radio-relay transmission equipment linking exchanges and base stations;
  – evaluation of outward secondary pairs and/or access radio equipment (base stations and subscriber terminals);
  – investment estimates.

These tasks will lead to corrections, re-evaluations and periodic updates throughout the life of the development plan. The complexity and repetitive nature of calculations lend themselves to the use of software tools both for planning and for updating purposes.

Depending on the type of planning, specific tools can be used, for instance for:

– general network structure (switching and transmission); and

– local subscriber access network structure (cable and/or radio).

c) Planning in rural areas

The rural network should be considered as an extension of the general public network to rural areas. Network planning in rural areas must therefore address both the structure of the general network, which carries rural area traffic, and the access structure for rural subscribers, which must be connected to the general public network exchange.

As indicated above, planning software tools are used to prepare the general network structure, including the exchange covering the rural area. However, the study of the rural subscriber access network and its connection to the exchange may lead to the use of cable and/or radio technologies, as appropriate.

This then means, depending on the technologies used for the local network, using:

– planning software tools designed for the cable sections of the local network; and/or

– specific planning tools designed for the “radio” parts of the local network, including, for example, coverage calculations, frequency requirements and frequency planning.

Thanks to the speed of calculation and flexibility of parameters, simulations can be run to assist in selecting the most appropriate technologies.

d) Complementary studies

In the light of the results of network planning, complementary studies may be undertaken to cover economic feasibility, technical programming, evaluation of human resources and the specifications of short- and medium-term projects.

The economic feasibility study helps to select the optimal and most economical solution, taking into account investment costs, income and operating costs. It also allows a readjustment of plan objectives according to budgeted financial resources and operating costs. The final result, which is subject to periodic re-evaluation, can then be used to revise development plans.

Human resource studies

The human resources needed to operate the network may be determined by an organization study.

The dates and duration of the various operations required to implement the development plan are established by technical programming.

Individual specifications

Some specifications are provided by network planning, e.g. amount of traffic per exchange, number of circuits, routing plans, required transmission capacity, etc.

However, in the case of short- or medium-term projects and calls for tender, additional specifications are needed to install systems meeting operating requirements and operators' objectives.

Conclusion

In any network planning, total demand must be taken into account, including the immediate and future needs of rural areas. Moreover, the network structure adopted must always be able to cope with traffic from future subscribers in rural or remote areas.

Network planning should ensure that the same services are offered with the same standard of quality for all subscribers, both urban and rural.

Thanks to the diversity of systems used in access network structures for rural area subscribers, solutions are becoming increasingly well adapted to local topology and to available means.

5 Topic c) – Promotion of the application of telecommunication facilities for developing various sectors of rural infrastructure and rural economy

i) The view from the ITU

"**Telecommunications and economic development**

The relation between telecommunications and economic development has been the topic of numerous studies ... virtually all agree that there is a close relationship. The strength of the relationship is evident in a graph of GDP per capita (as a surrogate for economic development) plotted against teledensity. For every extra $US 1,000 of GDP per capita, the relationship predicts an extra 2.24 main lines per 100 population. This relationship ... is shown as a straight line, but it is more accurately a non-linear relationship as it appears easier to increase teledensity for low-income countries than for high-income countries. ... it would suggest that telecommunications investment brings higher social and economic rewards in the low-income countries than in the high-income countries ... in ... benefits per extra dollar spent.**"** See [2], p. 3, Box 1.1.

This clear statement leads off the ITU's World Telecommunication Development Report – 1994 [2], prepared as an input to the First World Telecommunication Development Conference in Buenos Aires in 1994. The correlation is clear and precise, although the direction of the causal relationship is the subject of continuing debate. The Report explores this issue further.

> **"Why wealth doesn't explain everything**
>
> ... From a statistical viewpoint, the relationship is very strong (R_2 = 0.85, where 1.0 would equal perfect correlation). Nevertheless, there are clearly some other factors involved as well as money ...
>
> The chart ... examines the 'outliers' for which the prediction model does not work well. Countries with a higher teledensity than GDP per capita would predict: Greece, Malta and the Republic of Korea, for instance, have all followed government programmes of accelerated investment in telecommunications which may help

> to explain why their networks are comparatively well developed in relation to their income levels. Countries with a lower teledensity than GDP per capita would predict: In some cases, for instance Algeria, Nigeria and Saudi Arabia, this may be because their level of GDP per capita is boosted by the production of natural resources.**"** See [2], p. 76.

Also, there are substantial and buoyant revenues in international long distance markets.

> **"International traffic patterns: Social calls are rising**
>
> The five-fold growth of international telephone traffic over the last decade is often attributed to higher cross-border flows of trade and investment. ... However, as the price of international telephone calls becomes closer to that for domestic ones, there is substantial evidence that social calling, particularly among families divided by work or emigration, is becoming a strong driver of traffic growth.**"** See [2], p. 14.

ii) Individual countries' experiences and findings

In Bangladesh, where 90% of the population lives in the rural territory, and almost all rural residents are engaged in agriculture, which accounts for 50% of the country's GDP, only 10% of the telephones are in the rural territory. The county's topography leads to flooding during the monsoon season, rendering road and railway communication impossible. As a national policy, telecommunications is being extended to the rural territory, and 449 of 466 rural sub-districts now have telecommunications. The intention is to develop the rural sub-districts as centres of rural economic activities and primary growth centres, so as to discourage migration to the cities.

The scale and scope of extending telecommunications to these rural areas is beyond the resources of the Government, and so private operators have been invited to participate in this work. Results so far have been promising. Bangladesh has found that rural telecommunications can be a significant source of revenue. The example is given of average revenues of $US 190 per day, per telephone, with usage averaging 100 callers per day [9] and [20].

Lebanon cites increasing demand for telecommunications in the rural territory, heavily focused on the support of commerce and economic development. The demands include administrative needs of both public and private sectors, project-type enterprises such as offshore platforms, mines, and forestry, electronic transactions for the banking industry, and network control and management for pipelines and railway companies. In Lebanon, also, rural telecommunications is expected to be at least a partial solution to urban migration [10].

With the move to a market-oriented economy in Myanmar, the need for telecommunications has become more evident. With the economy performing below its potential, improved telecommunications will foster economic growth, boost production, and lead to improved agricultural output and greater transport efficiency. Still a government body, Myanmar Posts and Telecom has been "corporatized", operating on a business-driven commercial basis [11].

In Bhutan, 70% of the population lives in the almost totally unserved and topographically difficult rural territory, some areas as far as seven days' walk from the nearest road. The Government has set a target of establishing telecommunications to all villages by the year 2002. Bhutan is seeking the opportunity of participating in a Pilot Project under Programme 9 – Integrated Rural Development, developed under the Buenos Aires Action Plan [23] and [24].

The Government of China (ref. 31) clearly recognizes the value in economic and social development which rural telecommunications provide. China has embarked on an ambitious programme to bring modern telecommunications to the vast rural areas where three quarters of the population of the country live. Practical priorities have led to the establishment of a multi-year rural programme which has first addressed the south-eastern coastal region, and will then move west across the country.

Programme management of the rural telecommunications programme in China is based on uniform principles which address planning, standards, equipment and system selection, construction, and development applications. The programme makes use of an appropriately wide variety of modern telecommunications technology. The growth objectives in terms of teledensity are very aggressive. The Chinese Government's motivation is clearly linked to the significant economic and social development and advantage that will result.

In Yemen also, the Government recognizes that telecommunications are vital for socio-economic development and growth. Three quarters of Yemen's population live in the sparsely populated and topographically difficult rural area, mainly in very small communities. Nevertheless, the Government of Yemen is determined to bring telecommunications to the rural and remote areas.

In this initiative, Yemen has enjoyed good support from the international community, both the public sector (ITU, the World Bank, and UNDP) and also the private sector. Yemen's rural programme is moving forward well, with several specific projects in progress which are making use of modern telecommunications technology. Network planning studies are ongoing to continue the progress of the rural programme. The final sentence of the contribution from Yemen deserves to be quoted: "In conclusion, telecommunication will remain an indispensable tool in all human activities, and whenever there's a will, there's a way" [32].

iii) Other studies, research and results

There is widespread agreement as to the importance and relevance of the availability of telecommunication services in promoting and strengthening the economic, social and cultural development of rural and remote areas. There is much anecdotal evidence which supports the view that there is a strong causal linkage. However, specific factual, statistical evidence is much harder to come by. It seems that the linkage and relationship between telecommunication services and rural development is much easier to observe and describe than it is to measure.

This is in fact not surprising. The relationship is complex, and it does involve substantial elements of attitude and psychology. Laboratories do not exist where one could "add telecommunications" in carefully measured quantities, while holding all other factors constant. Also, it is now generally agreed that telecommunications are an essential enabler for the development of rural and remote areas, but that telecommunications alone are not sufficient.

The Director of the ITU's Bureau of Telecommunication Development (BDT) expressed an act of faith and issued a "call to arms" in his opening address to the WTDC-94 in Buenos Aires. To quote,

> "One of the most strategic issues of the Buenos Aires Action Plan we are proposing is Integrated Rural Development, where telecommunications will go hand-in-hand with the other sectors such as Agriculture, Education, Health, Transportation, and Tourism, etc., to develop the rural areas, to develop the village. We expect therefore the development of new businesses in the rural areas, a better living standard for the village people, a more competitive environment for industries to grow and of course a tremendous market for the future telecommunications industry as the majority of the population of developing countries lives in rural areas." See [12], p. 3.

Perhaps we professionals in the telecommunications industry focus too closely on our industry itself. It is, after all, "the flow of services emanating from the physical infrastructure that improves the quality of life of people, not the infrastructure itself." See [13], p. 3. The priorities for telecommunications are two-fold. It is essential to ensure that services are made available to meet the communications needs of those who live in rural and remote areas, services which must provide a diversity of capabilities, good quality and reliability, and be priced to be affordable.

And secondly, these now-available telecommunication services will in turn support all the social developing priorities which have emerged worldwide. To cite examples, access now becomes available to basic human needs such as primary health care, basic education, and family planning needs. Women, in particular, will benefit from these capabilities. Infrastructure services, for example transportation, will become more efficient. Government services will improve, as newly available information can flow in both directions. Economic development will be enhanced, both through improvement in the markets and through the availability and exchange of information and knowledge. Telematic services provided at Multipurpose Community Telecentres (MCTs [8] and [18]) can create "virtual offices" which enable knowledge workers to "telecommute", and will be a strong force in reducing or reversing urban migration, particularly of young people. Environmental sustainability will be enhanced.

Both the importance and the complexity of the cross-sectoral development impact between the availability of telecommunication services and the other sectors of the economy and of society are explored in detail, and an analytical framework for evaluation is suggested, in the Canada – CIDA paper of similar name [14].

Research by the Telecommunications and Informatics Division of the World Bank, and by the Telecommunications and Policy Programme of the University of San Francisco, suggests that those extensive rural and remote areas of developing countries which lack telecommunication services are fast approaching a binary alternative. Already progressively marginalized compared to their brethren in their nations' cities, where there are telecommunication services and economic dynamism, one possibility is that these areas can continue without service, the marginalization will continue, the contrast in life styles will deepen, the rural economies will become or remain stagnant, and the brightest and best young people will get up and go to the cities or beyond.

There is in fact a good alternative, which is reasonably and readily achievable. Through the provision of telecommunication services, these rural areas can be drawn comfortably and conveniently into the global marketplace. Agriculture, manufacturing in both factories and cottage workshops, fisheries and forestry will all find that their markets will become much more clearly defined and focused, and hence much more accurately and profitably served. Knowledge, training and education will all become available within the community, both in economic- and market-related subject areas and in order to provide basic literacy.

To bring telecommunication services to the still unserved rural and remote areas of the world's developing countries will need determination and vision at the national policy level, and will require very substantial resources, both in industry-specific management and technical skills, and in financial resources. However, there is increasingly convincing evidence, contrary to earlier views, that the provision of rural telecommunications can in fact be profitable. Thus rural telecommunications can become an attractive candidate to attract investment capital from the private sector.

This is good news indeed, noting that the World Bank estimates that the level of private sector investment in the telecom sector must increase, in the last half of the 1990s, by an order of magnitude compared to the decade of the 1980s. A very substantial portion of the need can be internally financed by the ROAs, again taking advantage of that positive business case. The increasingly limited public sector official funds should best be used to support sector and enterprise restructuring, and to act as a catalyst for private sector investment.

As well as economic development, the advent of telecommunications in rural and remote areas provides major advantages in social and cultural development. Specific application areas which have proven to be very successful are education and health care. Distance learning is used in developed and increasingly in developing countries for educational requirements ranging from basic literacy to technical skill training to university-level courses. The key advantage which telecommunications bring is interactivity, often asymmetric, typically with voice-only between the student and the teacher, but in some applications, particularly in seminar-tutorial settings, fully symmetric. An interesting example, although not with a specific rural focus, is the University of Monterrey, in northern Mexico, which serves its 26 campuses through videoconferencing, reaching classes as large as 1 000 students, and with growth of 8% per year, to become Latin America's largest private university (see [15], p. 5).

The application of telecommunications to health care, or Telemedicine, often makes use of distance learning capability. This could involve the training of remotely located health-care workers, either in formal training sessions and courses, or, as in Chile, with informal training and coaching through mentoring relationships, where junior professionals in remote locations dialogue regularly one-on-one with a senior experienced doctor at a "big city" hospital. It could also involve the health-related education of lay people, for example educational programmes for expectant women or for new mothers. The other area of application of telemedicine is to provide linkage over distance in the patient-doctor relationship. Digitized medical information, for example X-rays that have been scanned digitally, and other medical test results, can readily be sent over a standard telephone connection, the speed of transmission improving as the proportion of digital transmission media increases.

Distance learning is extensively used in New Brunswick, one of Canada's eastern provinces [17]. Using two voice grade connections, remote locations have two-way audio connections to the central location, plus the ability to receive and view text or graphic information (written, typed and drawn) and to respond to the text or graphic material through editing or annotation. This arrangement has proven to be very successful, and more than 70 locations are now on the network which has recently been extended to the neighbouring Canadian provinces of Newfoundland, Nova Scotia and Prince Edward Island. The courses offered on the network range from basic literacy training through trade-related courses under the provincial apprenticeship programme to a wide range of university credit courses for both part-time and full-time students.

The network locations, which are in small communities and have strong linkages and relationships within the communities, also serve as access points for information on the Internet and to other information libraries. The province is developing modularized information packages with specific focus on small business development and the agriculture sector.

All the telecommunications that the system requires is two voice lines, so it can be efficiently used wherever basic telecommunications exist. It has proven to be both user friendly and powerful, at a very modest cost compared to, for example, videoconferencing.

New Brunswick has recently established a "twinned" relationship with the Northern Cape province of South Africa, and will be proposing the introduction of this system to serve the rural and remote areas of the Northern Cape.

The paper "Making Rural Telecommunications Profitable" [6] has explored the profitability of Rural Telecommunications in Pakistan, Botswana and Zimbabwe. There was found to be a strong correlation between the availability of telephone service and economic activity. Experience in these countries indicates that the optimum rural telecom strategy provides telephone lines for PCOs and institutions and businesses, maximizing revenue from these high-usage customers. This also contributes the greatest economic and social development benefit to the rural area served. In addition, it generates significant foreign currency as a result of inward international calls from emigrants and expatriate workers.

But telecommunication services and information technology are a necessary but not sufficient precondition for rural development. These services and this capability must be organized so as to support the rural communities and the initiatives that they undertake in all areas of development, and to take maximum advantage of the valuable resources that need to be located in the community. A way of doing this that has proven to be effective is through the establishment of Multipurpose Community Telecentres (MCTs). These centres are also known by various other names, e.g. Community TeleService Centre, Telecottage, phoneshop, Wartel, etc. These centres could offer a broader range of services including public services, e.g. health care, social services, postal services, electronic library, "boutique de service publique". This ensures extensive usage of the valuable and expensive equipment resources, and also provides an efficient way of providing the necessary skilled support, as experience in many countries, both developed and developing, has demonstrated, [8] and [18].

iv) Convergence and conclusions

Good telecommunication services support all aspects of economic, cultural and social development. In agriculture and fisheries, markets can be matched with supply, weather and environmental information can be made available, and "best practice" techniques can be shared. Manufacturing and handicraft activities benefit from more efficient markets, both for input resources and for sale of goods produced. On the service side, tourism becomes attractive in areas that previously were ignored, remote financial and other transactions become possible, and better governance is enabled through better communications both to and from the villages.

The advantage which telecommunications bring to rural and remote areas is substantially greater than in more densely populated areas because the alternative means of passing information and messages is more costly and time consuming. Without telecommunications, messages and information can only be passed by a personal visit or via a messenger, involving a trip which is often difficult and time consuming, and sometimes dangerous. Alternatively, the message or the information could be withheld, and its benefit lost. In rural and remote areas, the "opportunity cost" of the alternatives to telecommunications is much higher than in more densely populated areas. As a result, the information or the message is much more likely to be withheld. The relative advantage of being able to communicate electronically, rather than via visit or messenger or not at all, has a relatively greater positive impact on economic, social and cultural development in the rural and remote areas.

To maximize the benefit of telecommunications for economic, social and cultural development of the millions of people who live in the world's rural territory, modern telecommunication services are needed, including facsimile, electronic mail and voice messaging. These services require good quality, reliable data network services.

Good quality rural telecommunications, coupled with the economic, social and cultural development that is now feasible, offer the possibility of reducing or even reversing the urban migration, particularly of the more highly skilled and more progressive young people, that is a problem in many countries. The introduction of good quality telecommunication services in the rural and remote areas will make "knowledge work" feasible in the villages, and will be a strong encouragement to these people to stay in the rural areas.

6 Topic d) – Appropriate regulatory structures in a liberalized telecommunication regime as recommended by Study Group 1 as a means of encouraging the extension of telecommunication services to remote and rural areas

i) The view from the ITU

The winds of change have been sweeping through the telecommunications industry throughout the world, and these winds continue to blow. The clearest evidence of this is the continuing interest and action in restructuring and increased liberalization within the industry, which is evident in virtually every country in the world. This is increasingly evident in the evolving international bilateral, multilateral, and truly worldwide relationships and agreements.

WTDR-94 (see [2], Chap. 4, p. 50 et seq) explores the breadth and diversity of the issues, the alternatives, the choices that have and are being made, and, to the extent possible, the evident outcomes. The contribution of the service sector to economic wealth is clearly on the rise. At the same time, technological innovation is increasing capacity and lowering costs dramatically, most evidently in the long-haul transmission field, and also in switching, and in operational support and commercial systems. In the loop (or "access") network, some costs such as right-of-way, powering and civil works are resistant to reduction, although the new technologies offer much improved quality and flexibility.

The "old" PTT model seems suddenly strangely archaic. It is increasingly evident that posts and telecommunications really are fundamentally different, and also that financial subsidy of the former by the latter does not further national interests. It is increasingly accepted that the newly unfettered ROAs must be permitted, in fact obligated, to operate as commercial ventures, i.e. "Corporatized", although ownership remains with the national (or perhaps state) government. Inherent in the concept of Corporatization is the understanding that operational autonomy is permitted and encouraged, and that revenue and profits are permitted to remain with the ROA, to enable faster network development and greater efficiency.

Many countries have taken the next step, and have "Privatized" their ROAs, often retaining a proportion of state ownership, and often selling significant portions to major ROA-related foreign organizations, who typically and appropriately bring telecom industry expertise and experience as well as investment funds. In many cases, certain areas of competition are being permitted, usually in terminal equipment, often in services, much less frequently in infrastructure. It should be noted that the taxation implications of privatization may discourage network development.

An early need in the evolution of the ROA is the provision of a form of regulatory overview, separate from the ROA and under national government auspices, typically and appropriately with a broadly defined mandate and independence from day-to-day government control. Two areas which always need regulatory consideration, and the establishment of appropriate terms and conditions, are the interrelationship of service competition and tariff rebalancing, and network interconnection (see [2], pp. 68 and 69).

Worldwide, tariffs established under monopoly conditions have traditionally subsidised local service from national and (especially) international long distance revenue, business service subsidizes residential service, and urban service subsidizes rural service. When service competition is introduced, the new service providers quite naturally direct their attention to the service areas where price is established well above cost, and shy away from areas where cost equals or exceeds price.

Considering interconnection, the new service providers need to connect their customers' calls through the established ROA's loop ("access") network, certainly at one end of the call, and usually at both. The terms and conditions of this interconnection, and the required payment for making it, are typically central to the business case of the new service providers.

ii) Individual countries' experiences and findings

Probably the best example of a country which has established telecommunication service throughout its rural and remote areas through the regulatory implementation of a specifically defined and targeted concession obligation is Mexico. When Telmex was privatized in 1990-1991, the privatization Concession included very specific terms and conditions for extending telecommunications to communities of specified populations throughout the entire country. An overview follows.

At the time of the Telmex privatization, a Rural Telecommunications Policy was already in place, and a Rural Telecommunications Programme was in progress in Mexico. The network planners had considered the technologies which were available and relevant, and the most promising were already being introduced into the Mexican network. However, progress to date had been slow, and was lagging well behind the desired schedule.

The terms of the Telmex Concession included the requirement that telecommunications be extended to all communities without service in Mexico, as indicated in the Table which appears below.

Telmex compliance expansion requirement matrix

Population of the community							
	0-500		**500-2 500**		**2 500-5 000**		**>5 000**
Applicants (A)	<100	>100	<100	>100	<100	>100	(B)
By end of 1994	Nil	Nil	(C)	(C)	(C)	(D)	(E)
1995 and beyond	(F)	(D)	(F)	(D)	(F)	(D)	(E)

NOTE (A) – Applicants, with three-month deposit paid.

NOTE (B) – No waiting applicant requirement. Automatic exchange service must be provided to all communities with populations over 5 000.

NOTE (C) – Minimum requirement, pay telephone and/or agency. "Access to basic service".

NOTE (D) – Provide Automatic exchange service within 18 months of 100th waiting applicant.

NOTE (E) – Automatic exchange service must be provided to all communities with populations over 5 000.

NOTE (F) – Provide service if 75% of costs can be recovered.

At the time of the Concession, based on existing census information, it was estimated that this requirement would involve the provision of service to approximately 9 600 additional communities, with the expectation that additional census data before the end of 1994 would both add additional communities to those that required service, and change the category of some of those communities already on the list.

The Mexican experience, following the Telmex Concession, is probably as good an example as can be found of a well executed and successful Rural Telecommunications Programme: one that was orderly, efficient, and implemented economically, and that met its goals. It was planned and carried out over a four-year period, with clearly defined terms of reference, and a specific target performance and a mandated completion date. During this Programme, both the Telmex staff who were involved with the Programme and the vendors' personnel who served them "moved up the learning curve", and as they built up their experience, developed skill and expertise at carrying out all the functions necessary to implement the Programme effectively. The technology used for the major part of the Programme was Point-to-Multipoint Microwave Radio ("Subscriber Radio") using TDMA technology, and all three of the worldwide leading vendors of this technology were major suppliers to Telmex. Both in terms of the requirement of the Concession and in its execution, the Telmex example stands as an excellent model of what can be done in providing telecommunication service to the rural and remote areas. It should also be noted that Telmex is one of the most profitable ROAs in the world (see [5], p. 50).

iii) Other studies, research and results

Successful and sustainable rural telecommunications can only be achieved within an appropriate policy and regulatory environment. The World Bank (see [15], p. 9) sees itself as having a role in assisting and supporting developing countries to establish policy and regulatory environments which will encourage profitable investments in rural areas. The policy objective will be to establish conditions which will attract private sector investments. The Bank could provide technical assistance in following broad principles to develop country-specific tariff and interconnection policies which will lead to the commercial development of telecommunication services in the rural and remote areas. Examples of countries where such initiatives have already proven successful include Mexico, described above, and Bangladesh, cited earlier.

iv) Convergence and conclusions

Experience indicates that the regulatory regime which most successfully supports the development of Rural Telecommunications includes the following arrangements and conditions:

- A regulatory authority is in place which is as independent as possible.
- Appropriate tariffs and revenue settlement arrangements are in place.
- The concession obligation shall take into account the financial integrity and sustainability of the rural telecommunication service.
- Interconnection terms and conditions must be addressed and defined.
- Efficient spectrum utilization requires effective spectrum management.
- The regulator's authority can best be applied through licensing and concession arrangements.
- Licensing arrangements should be consistent with efficient network structure.

The basis of providing telecommunication services to rural and remote areas should include the following principles:

- Service is provided through PCOs and MCTs, and lines to serve non-residential customers.
- Rural investment is encouraged in ways which are broadly consistent with the price/cost relationships.
- Innovation is encouraged in providing rural service.
- Rural PCO and MCT operations are franchised to the private sector, especially to local entrepreneurs.

The relationship of cost and revenue are key considerations for the regulatory agency, in particular an understanding of the volume and revenue of inward message toll traffic, including the inward international message toll traffic. The regulator must require an adequate and appropriate, but not excessive, "local revenue contribution" from all the message toll traffic, both outward and inward, both national and international.

An obligation which mandates the provision of service to the rural and remote areas will often be needed. The financial obligation should be kept as low as practical, consistent with assuring the financial integrity and sustainability of the rural telecommunication service.

An approach which has proven to be successful is through establishing conditions, in the ROA's license or concession, which mandate accelerated and sustained rural service provision.

7 Topic e) – Options available for financing rural and remote projects including co-financing, foreign investment, etc.

i) The view from the ITU

The advantages and the rationale for providing telecommunication services throughout the rural and remote areas of developing countries worldwide are clear, well defined, and compelling. However, at the end of the day, these services can only be provided and sustained if the required financial resources can be made available, under terms and conditions that are consistent with providing and sustaining these services.

In the World Telecommunication Development Report – 1994 (see [2], Chap. 5, "Telecommunications Development", pp. 72 to 94), the ITU explores this subject in considerable detail, including a review of experience by regions of the world, and an investigation of "High achievers", countries which have been particularly successful in promoting telecommunications development.

Section 5.5 of this chapter specifically addresses "Financing telecommunications development", discussing in detail the following possibilities:

- Revenue reinvestment.
- Multilateral development assistance.
- Bilateral assistance.
- Private sector participation.

Of course, these are not mutually exclusive options. Combinations are usual, and the obvious preferred route is to finance telecommunications development through revenue reinvestment to the greatest extent possible. Two paragraphs from the Conclusions of this chapter are worth quoting (see [2], p. 94).

> "While the majority of telecommunications investment is in developed countries, this is due more to a question of national policy rather than to a shortage of funds. The large amount of money that has flowed into the sector following privatization and the keen interest by the private sector for concessions or joint ventures are but two signs of the money available from a source as yet untapped by many developing countries.
>
> The common thread to achieving really dramatic improvements in telecommunications development has been a commitment by governments to the sector. All of the high-achieving countries invest a large share in telecommunications relative to other sectors. The high achievers also began their growth after a significant policy decision: corporatization of the operator in Botswana in 1980, establishment of Korea Telecom in 1982 or privatization in Chile in 1988."

As the World Bank notes [16], both multilateral and bilateral assistance are in increasingly short supply, just at the time when more investment funds are needed by the developing countries, in particular to provide telecommunication services to their rural and remote areas. Clearly, internal financing and/or private sector participation are the only possible alternatives.

The cornerstone of providing successful and sustainable rural telecommunication services is to base them on commercial business principles. The ROA's decisions must be based on business economics, to clearly understand and address both costs and revenues, seeking every opportunity for minimizing the former and maximizing the latter. The ROA must be permitted, and in fact encouraged, to set and follow its own agenda, without government direction and interference other than a sensitive and "minimalist" regulatory function. A concession obligation for the rural territory is likely to be necessary. Careful attention by the ROA to economics and profitability will go far to lighten the burden of the obligation. In addition, careful consideration should be given to the Recommendations developed in Question 4/1, on the key issue of financing the development of communications for rural and remote areas.

ii) Individual countries' experiences and findings

Documented examples of profitable rural telecommunication services initiatives are always valuable. Development aid funding has supported the purchase of telecommunications systems in several developing countries. The experience with three "point-to-multipoint" systems in the mountainous rural area of Bolivia [7] underlines the revenue and profit-making potential of serving even very difficult topography. In this Bolivian example, lines were provided to institutional and business customers, with access to telecommunications for the general public provided by public call telephones. This has resulted in high calling rates per installed line. The substantial amount of high revenue, high margin inward long-distance calling, both national and international, was also noted. Although the installed cost per line was relatively high, due largely to the need for several mountain-top repeater sites to serve the difficult topography and the need to use solar power, revenues have been buoyant and the systems have proven to be profitable.

These findings are consistent with another development agency study which explored the profitability of rural telecommunications in Botswana, Pakistan, and Zimbabwe [6]. This study confirmed the economic efficiency of providing service lines to institutions and commercial users, and providing residential telecommunications access via Public Call Offices (PCOs) and payphones.

As already noted, Bangladesh ([9] and [20]), with limited public sector resources, has embarked on a programme to bring telecommunication services to the rural and remote areas through private sector initiatives. The Government of Bangladesh is pursuing this initiative by establishing a transparent and predictable regulatory environment, and putting into place a telecommunications reform package based on a clear telecommunications policy statement. The Bangladesh initiative and experience will be very well worth watching over the next few years.

As already noted, there are two other countries which have implemented (Mexico) or are implementing (Thailand) major rural telecommunications programmes, and which are notably profitable (see [5], p. 50). These countries also warrant continued observation.

Widespread experience in many countries confirm that rural service provided in this way is generally profitable.

iii) Other studies, research and results

Since the ROA that brings service to the rural and remote areas must be seeking every opportunity for minimizing costs and maximizing revenue, creative and innovative ideas for accomplishing this are very appropriate. Some suggested concepts follow.

One way of reducing the cost of serving sparsely populated rural areas is through the use of telephone cooperatives [21]. While the suggestion comes from a developed country, it relates to the most remote rural areas of that country, and offers similar possibilities for the rural and remote areas of developing countries. Participation in the cooperative could involve the use of volunteer labour to build telephone plant, with the obvious related cost savings. The management of the cooperative would normally be on a volunteer basis. A sense of “pride of ownership” among the members and in the community would follow naturally from involvement in the cooperative. There is an obvious opportunity for the cooperative to link closely, and perhaps to even form a single integrated unit, with the PCO/MCT that serves the community.

A key concern in developing the positive business case for rural telecommunications is to ensure that every line that is in service generates sufficient long distance revenue, including both national and international revenue, and both outward and inward calling. While this need can in general be addressed by providing lines only to PCOs/MCTs and to institutions and commercial enterprises which generate significant long-distance calling, there will no doubt be some potential residence subscribers who feel strongly that they should also be provided with lines. If these potential subscribers are in fact heavy users of long distance services, generating substantial long distance revenue, then providing residential service to them will help the business case. To ensure that the long distance revenue from such subscribers is adequate, the “Take Or Pay” Tariff Principle could be used [22]. Under this principle, the subscriber who is provided with a line at his residence will undertake to pay a specified “base amount” of long distance revenue, even if his long-distance calling volume falls short of that amount.

Much of the high margin international inward long-distance calling to the rural and remote areas of developing countries comes from family members and friends who are working as expatriates in other countries, or who have emigrated. Often, that caller is much more financially able to pay for the call than is the called party. Also, the distant person is much more conveniently available to receive calls, since he/she has a telephone line at his/her residence. A valuable source of international revenue would be an “International Call Me” service, similar to that used today at the national level in countries such as Canada. This service provides an automatic acceptance of “Collect” calls from the individual who is authorized to use the “Call Me” service. A “developed country example” is a situation where a grandchild is authorized to call a grandparent at the grandparent’s expense. A comparable “developing country example” would be a situation where a parent is authorized to call an adult son or daughter who is an expatriate worker in another country. The parent would go to the PCO/MCT, and use the “International Call Me” service to call the distant son or daughter, at the latter’s expense.

iv) Convergence and conclusions

There is increasingly convincing evidence that a “Positive Business Case” for rural telecommunications is both possible and practical, and it is obviously highly desirable. The provision of Universal Access through PCOs/MCTs will ensure heavy traffic usage per line in service. Since the PCOs/MTCs are centred in the communities, the major part of the calls, both outward and inward, will be “long distance”, generating a “long distance” tariff. Since none of this calling would have been possible if rural telecommunication service had not been provided, all of the resulting “long distance” revenue, outward and inward, national and international, relates to the advent of rural telecommunications. Appropriate

revenue-sharing arrangements constitute a revenue settlement issue, to be determined under regulatory direction and supervision. There is substantial evidence that the revenue-sharing arrangements are of the utmost importance in ensuring the "Positive Business Case" for rural telecommunications.

Inward international calling to developing countries, largely by "expatriates" calling to their homes, is rising dramatically. Very often the "expat" can more readily afford the cost of the call than the called party, and the payment is in scarce foreign currency. It is appropriate to take every opportunity to promote international calling that is billed to the distant location. Examples include the promotion of "International Call Me" service, and the provision of the capability to leave voice messages for mothers, sweethearts and friends at the PCO/MCT.

Worldwide experience indicates that the demand for long distance service is very elastic. As prices drop, total revenue increases dramatically. Since new technologies are showing the ability to greatly reduce the cost per circuit of new long-haul transmission systems, long distance tariffs could be reduced, and total revenue increased.

A Rural Telecommunication Programme and service portfolio with a Positive Business Case will attract private sector capital to invest in and support construction of the required network, and to operate and maintain the service on an ongoing basis. A major factor in leveraging the Business Case for rural service is the investment of internally generated funds to the greatest extent possible. Some modest encouragement through a concession obligation may well be necessary. In the final analysis, the Positive Business Case is the only way that a Rural Telecommunication Service can be assured of being sustainably viable.

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[35] Study Group 2 contributions (in particular from Sector Members: TRT, SR Telecom, Inmarsat, etc.).

List of Contributions received

ITU-D Study Groups 1 and 2 – Study Period 1995-1997

Contributions received as at 16 September 1996

Question	Ref. other Questions	Administration	Members ITU-D	Other	Meeting	Document[1)]
4/1	4/2	Canada			CE 1 – March 95/CE 2 – May 95	1/009 + 2/016
3/2	4/2	Myanmar			CE 2 – May 95	2/042
3/2	4/2	Lao (PDR)			CE 2 – May 95	2/040
4/2			TRT, France		CE 1 – March 95/CE 2 – May 95	1/033 + 2/023
4/2		United States			CE 2 – May 95	2/072
4/2			INTELSAT		CE 2 – May 95	2/059
4/2			INTELSAT		CE 2 – May 95	2/058
4/2		Canada (CIDA)			CE 2 – May 95	2/054
4/2		Burkina Faso			CE 2 – May 95	2/045
4/2	5/2 + 6/2	Bhutan			CE 2 – May 95	2/044
4/2		Lebanon			CE 2 – May 95	2/039
4/2		Canada			CE 2 – May 95	2/031
4/2		Bangladesh			CE 2 – May 95	2/008
4/2			Inmarsat		CE 2 – May 95	2/002
3/1	4/2		Motorola, USA		CE 1 – Nov. 95/CE 2 – Dec. 95	1/142 + 2/167
4/1	4/2		TRT, France		CE 1 – Nov. 95/CE 2 – Dec. 95	1/139 + 2/166
4/2		United Kingdom			CE 2 – Dec. 95	2/202
4/2			Alcatel/TRT France		CE 2 – Dec. 95	2/201
4/2			Telefónica de España		CE 2 – Dec. 95	2/186
4/2		Kenya			CE 2 – Dec. 95	2/184
4/2				World Bank/ University of San Francisco	CE 2 – Dec. 95	2/177
4/2			Alcatel France		CE 2 – Dec. 95	2/172
4/2			TRT, France		CE 2 – Dec. 95	2/169

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Question	Ref. other Questions	Administration	Members ITU-D	Other	Meeting	Document[1)]
4/2		Mauritania			CE 2 – Dec. 95	2/165
4/2		Niger			CE 2 – Dec. 95	2/164
4/2		Rwanda			CE 2 – Dec. 95	2/161
4/2		Uganda			CE 2 – Dec. 95	2/147
4/2		Equatorial Guinea			CE 2 – Dec. 95	2/146
4/2				TeleEducation New Brunswick, Canada	CE 2 – Dec. 95	2/140
4/2		Sudan			CE 2 – Dec. 95	2/133
4/2		Burkina Faso			CE 2 – Dec. 95	2/132
4/2		Benin			CE 2 – Dec. 95	2/131
4/2		Bangladesh			CE 2 – Dec. 95	2/130
4/2			Alcatel, France		CE 2 – Dec. 95	2/129
4/2			Alcatel, France		CE 2 – Dec. 95	2/128
4/2		Haiti			CE 2 – Dec. 95	2/098
2/1	4/2		Inmarsat		CE 1 – Sept. 96	–
4/2			SR Telecom, Canada		CE 1 – Sept. 96	–
3/1	4/2	Oman			CE 1 – Sept. 96/CE 2 – Sept. 96	–
4/1	4/2	Canada (CIDA)			CE 1 – Sept. 96/CE 2 – Sept. 96	–
2/2	4/2		I-CO Services, United Kingdom		CE 2 – Sept. 96	–
4/2	2/1		Inmarsat		CE 1 – Sept. 96/CE 2 – Sept. 96	–
4/2		Bangladesh			CE 2 – Sept. 96	–
4/2		Benin			CE 2 – Sept. 96	–
4/2		Burkina Faso			CE 2 – Sept. 96	–
4/2		Canada (CIDA)			CE 2 – Sept. 96	–
4/2		Central African Republic			CE 2 – Sept. 96	–
4/2		Chad			CE 2 – Sept. 96	–
4/2		China			CE 2 – Sept. 96	–
4/2		Gambia			CE 2 – Sept. 96	–

List of Contributions received *(end)*

Question	Ref. other Questions	Administration	Members ITU-D	Other	Meeting	Document[1)]
4/2		Equatorial Guinea			CE 2 – Sept. 96	–
4/2		Mali			CE 2 – Sept. 96	–
4/2		Myanmar			CE 2 – Sept. 96	–
4/2		Rwanda			CE 2 – Sept. 96	–
4/2		Sao Tome-and-Principe			CE 2 – Sept. 96	–
4/2		Uganda			CE 2 – Sept. 96	–
4/2		Yemen			CE 2 – Sept. 96	–
4/2			Inmarsat		CE 2 – Sept. 96	–
4/2			INTELSAT		CE 2 – Sept. 96	–
4/2			INTELSAT		CE 2 – Sept. 96	–
4/2			Telefónica de Argentina		CE 2 – Sept. 96	–
4/2			Telkom, South Africa		CE 2 – Sept. 96	–
4/2			TRT, France		CE 2 – Sept. 96	–
4/2			TRT, France		CE 2 – Sept. 96	–
42				Teleconsult	CE 2 – Sept. 96	–
4/2				Teleconsult	CE 2 – Sept. 96	–
4/2				Teleconsult	CE 2 – Sept. 96	–

1) Not all contributions have resulted in a separate document.