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TELECOMMUNICATIONS IN DEVELOPING COUNTRIES - BENEFITING FROM NEW TECHNOLOGIES

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1. ABSTRACT

Recent advances in technology have brought down considerably the cost of transmission and switching hardware. The emerging intelligent network technology provides further possibilities of reduction in investment for the new expanding networks. A judicious application can result in very significant cost savings.

2. INTRODUCTION

Recent advances in solid state electronics, digital signal processing and software development and management techniques has significantly brought down the cost of transmission and switching components of a telecommunication network. Although there is considerable scope for reducing the average investment for providing one telephone line, in practice there is no significant impact as yet. One of the reasons for this is the continuation of the traditional ways in which telecommunication plans get implemented. Our studies indicate that by adopting a new strategy, it may be possible to reduce the level of investment per line from 30% to 50% of the present levels. In order to be able to achieve this, a three pronged approach is required. Technology, topology and operations are three most important factors. A set of digital switching and transmission products well matched to the countries' needs is perhaps the single most important factor in effecting economy. The next important factor is the network topology that will take into account the powerful signalling and information networking capabilities that are now provided by even the smallest switches. Use of remote maintenance unattended operation, graphics-oriented network management and control tools help further in bringing down the overall investment.

3. TECHNOLOGY OPTIONS

Following are the technology components that are of immediate relevance:

- Optical fibres
- Digital microwave
- Digital crossconnects
- Digital/cellular radio
- ISDN and CCS7 signalling
- Digital signal processing
- VLSI components
- Speech processing
- Graphics
- Software tools
- Intelligent network technology

3.1 SOME APPLICATION EXAMPLES

3.1.1 TRANSMISSION

Optical fibres, and to a lesser degree, digital microwave provide a cost effective solution for high bandwidth long distance interconnections. Analog and digital radio in VHF and UHF band, on the other hand is excellent for short range requirements in both urban and rural areas. Less expensive multiple access radio systems are expected in the near future.

3.1.2 SWITCHING

The cost of switching has been dropping significantly over the past several years. The new systems provide higher call handling capacity, digital connectivity and, above all, transit capability which simplifies networking in the rural/low density areas. Further savings are possible by improved integration of radio transmission with the switch, eliminating expensive line circuit components. Digital cross connect systems with network management control are very important for

transaction processing) it leads to the powerful and versatile intelligent network technology.

3.1.4 NETWORK TOPOLOGY

One has to take a fresh look at the way in which new networks are designed. Traditional methods based on thumb rules may not be valid in the new context. Integration of switching with transmission and the availability of powerful messaging capability permits us to implement networks in which the switches are placed closer to the traffic, thus reducing the cost of switching as well as transmission. Also remote operation and maintenance can be introduced without much difficulty.

3.1.5 POWER REQUIREMENTS

This aspect is important especially in the developing countries and the rural areas where the main power is either very irregular or totally absent. Very low power components based on complementary metal oxide silicon are now available in wider range and higher complexity. This makes it possible to have very low power systems which can be powered optionally by solar cells. An area that seems to have been neglected is the solar cooling (refrigeration). Development of this technology will provide us a reliable low cost cooling solution for desert areas. A number of solutions based on passive and active (absorption) techniques are available but they are yet to be applied in large scale for telecommunication purposes.

3.1.6 UPGRADATION OF OLDER NETWORKS

One of the serious problems in modernization is the upgradation of older networks. The wide gap between the facilities provided by the new systems and the older systems forces us to consider full replacement. However this is not necessary in all the cases. If there is a reasonably reliable and efficient basic POTS network, then the more advanced facilities such as call detail record, subscriber "controlled" long distance calling, automated operation and maintenance, network management and control can be introduced by an intelligent add-on interface. Such an interface can be implemented through a microprocessor based signalling handling unit and a set of computers (data bases) interconnected by a packet network. Such intelligent add-ons can also be used for implementing 800 and 900 types of services, credit card calling, etc.

4. INTELLIGENT NETWORK TECHNOLOGY

As the customer needs become more and more complex and varied, their implementation needs more efficient ways of handling messaging and data base engineering and management. The focus shifts from the traditional transmission, switching and terminals to signalling and networking. Through this is evolving the new intelligent network technology. This is expected to have significant impact on the new networks and facilities.

Networks that are termed "intelligent" are still in the process of evolution. The first stage is the IN/I. In this phase, essentially the "intelligence" is "added on" to the old networks. Existing network expansion based on relatively dumb switches (the service switching point, SSP) interacting with an intelligent centralized data base (the service control point SCP) which also contains several service specific application software and customer records. This permits introduction of new services at the highest level. The inherent limitation of this approach is its service dependent software; each service requires a new software package that in turn requires considerable effort and time. However it does have an advantage in its ability to upgrade old networks for new services.

The next stage of advancement is the IN/2 network. This aims at providing a fully service/application independent architecture to meet a wide range of new, expanding services with an easy method of service creation and management. Implementation of this needs more intelligence at the local switches and several new hardware and software elements at each node. There is a standardized service creation environment which allows new services to be defined and implemented without reference to the specific network elements. The facilities also permit quick and easy way of protyping new services. All this would need significant upgradation of local exchanges which, without network expansion, may not be cost effective.

IN/I+ is an intermediate solution based essentially on existing hardware and software. Here the intelligence is not fully distributed throughout the network but at certain specific points which standard functional messages (service independent) to the local switch.

4.1 THE PRIVATE VIRTUAL NETWORK (PVN)

Among the several facilities that are provided by the intelligent IN, the ability to create private virtual networks (PVN) is very important. PVN will permit implementation a service with which a business can tailor its own network based on the resources of the public network with IN capability. The user pays for the resources and the network guarantees that the resources will be there when needed without actually allocating a physical resource permanently to a specific user. A network management system is also available to the user along with the PVN.

These PVNs allow the user to implement Value Added Networks (VANs) in a very cost effective way. It is not necessary to make any large investments in permanent physical resources. By having a large IN as a backbone, the public network is able to benefit from the economies of scale and the wide bandwidth provided by the optical fibres.

5. IMPLEMENTATION

Networks of countries such as India, China, Brazil, Indonesia, Chile, Peru and Mexico that are presently in a state of rapid expansion can benefit from the new technologies. As a specific example, the Indian network is expected to expand from the present level of about 5 million lines to over 20 million lines in the next 10 years. A recent study indicates that by adopting only a few of the techniques suggested, the cost per line can be expected to come down by as much as 40%. The most important requirements are:

- Establishing a very high capacity [560 Mbps/140 Mbps/34 Mbps] digital backbone network that will meet the immediate and future needs. This will be based mainly on optical fibres and, to a lesser extent, on digital microwave for interconnecting the main, primary and secondary centres.

- All centres to have digital cross-connect systems (1000 to 100,000 ports) for providing better connectivity, alternate routing and fault tolerance. Facilities include digital patch-panel, 30 channel switching capability and network monitoring.

- Cellular Subset and/or 10/30 channel digital rural radio to be used in rural areas.

- Apart from large switches required for metropolitan areas, small switches (50-500 ports) and medium switches (500-5000 ports) are required in very large numbers. Small switches serving rural areas must be capable of operating without airconditioning and with irregular power supply. All switches will have facilities for handling transit traffic, centralized maintenance and operation.

- Rural radio with 10 channel (ITU) standard and 30 channel (CEPT) standard.

- There is considerable scope for novel cost effective solutions such as integration of the rural switch with multiple access radio for rural application.

- An open ended digital connectivity to facilitate introduction of ISDN-type services in the future.

- Evaluation of intelligent network technology immediately for implement- ing private networks, introduction of new services and facilities and improvement in resource utilization. Smaller countries can cooperatively share a large network through this technology. It is estimated that savings in the range of 20% are possible.

6. CONCLUDING REMARKS

A number of technologies that have direct impact on telecommunication facilities and cost have been perfected and commericalized in the recent past. Apart from basic hardware and software components, concepts from new emerging intelligent networks are likely to have beneficial impact on

the investment and cost of providing high grade communication facilities. Based on preliminary studies, the savings could be in the range of 30-50%.

It is to be noted that the intelligent network technology will provide advanced facilities even without the full implementation of ISDN. Only large scale implementation of CCS7 signalling is required.

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Impact of Telecommunications Facility on Rural Development in India

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1. Abstract

The paper examines the economic and social impact of Rural Automatic Exchange (RAX) on the village, Kittur, in India and analyses the characteristics of telephone users and the use of telephone services. It describes how access to communications with outside places is barred by the outdated concept of hierarchical privileges.

2. INTRODUCTION

Kittur, a village with a population of 11,457 (1981 Census) in Belgaum district, Karnataka State - (For further information on Kittur, please see Annexure 2) - had trunk booking facility through Strowger electro-mechanical exchange. But the users were very much disappointed with it and considered telephone " a useless luxury," "an ungainly decoration." Subscribers were lucky to get Belgaum, the district headquarters some 64 kilometres away, in "two to three hours whilst many a time Belgaum number could not be had on trunk for days." (Quotations are reactions of telephone users.)

For a villager who is isolated by distance from services, facilities and information, instantaneous contact with the neighbouring towns and cities is a must: to know about market prices, to buy his requirements or to sell his produce, to get doctor's advice and services, to contact administration in case of dacoities, tensions, droughts, etc., and for social contacts with his fellow beings. With this objective in view, the Telecommunications Department commissioned the first Rural Automatic Exchange (RAX) in Kittur on July 21, 1986. (See Annexure 3).

Earlier, Kittur had a Strowger type Exchange with forty-five connections. With the installation of the RAX, all persons waiting for telephone till July 1986 were given telephone connections. This is the first Rural Automatic Exchange developed in the country by the Centre for Development of Telecommunications (C-DOT). It was set up in Kittur to test it under working conditions and to remove the bugs. Gradually, the bugs were removed and by October 18, 1986 the Exchange was stabilised and now operates without any breakdown. Moreover, even when there used to be some fault in the Exchange, as the Exchange is equipped with alternate passive lines, it automatically took over operations ensuring continuous service to the telephone user. Compared to Strowger, the C-DOT Exchange requires only half the power. Strowger Exchange had only one out-going line and one in-coming line which led to considerable delays in getting connections. The C-DOT Exchange has 12 unit circuits, 5 of which are reserved for out-going calls, 4 for in-coming calls and 2 for trunk bookings, thus ensuring that the user can instantaneously get access to subscriber trunk dialling (STD) facilities. The Exchange is so equipped that it records all the commands of the user and acts upon them. It is also possible to introduce new commands to the Exchange as also to delete the old commands where necessary.

The Kittur Exchange does not require air-conditioned enclosure for its working and as there are no moving parts, there is hardly any wear and tear in the Exchange. Kittur Exchange being connected through STD to other towns and cities in India and abroad, has attracted persons from neighbouring towns such as Dharwar and Hubli who come to Kittur to get foreign countries such as Switzerland, U.S.A., U.K., Germany, etc. Before the installation of RAX, a call from Kittur to Belgaum, the nearest city with wholesale market, hospital and other facilities some sixty-four kilometres away, used to cost Rs.2/- (1). Moreover, the subscriber was lucky if he could get Belgaum within two to three hours, as many a time the Belgaum number could not be had on trunk for days together. Now Belgaum is available instantaneously, and as the meterage for Belgaum is of 36 seconds pulse, a caller who terminates his call in a minute has to pay only Rs.1.20. Formerly, the call rate to Hubli, another city in the vicinity of Kittur (some 60 kilometres away) was Rs.4/- whilst now Hubli is available at 36 seconds pulse.

Initially, the users were hesitant to use the STD facilities as they were under the apprehension that they would have to pay very high charges. Now they have found that compared to the previous Exchange not only

they get the outside station at their will, but they have to pay much less for the call as it is based upon the pulse rate and the time one speaks. The biggest users of the telephone are a paddy merchant, a transport operator and a paan shop respectively.

We attempted to assess the impact of the Rural Automatic Exchange (RAX) facility on the development of the village Kittur. Our study is in three parts, viz.,

- Telephone use and characteristics of telephone users,
- Economic impact of the automatic Exchange, and
- Social impact of the automatic Exchange.

3. TELEPHONE USE AND CHARACTERISTICS OF TELEPHONE USERS.

3.1

Of the 74 lines in the automatic Exchange 65 were given to subscribers, 7 to the public call offices, whilst 2 were being utilised at the Exchange itself for enquiries and complaints.

3.2 OCCUPATION OF TELEPHONE USERS

Out of the 65 subscribers, trade accounted for 31 telephone connections. Occupation of the rest of the users was: Agriculture, Restaurants, Transport operators, Banks, Manufacturers, Educational Institutions, Doctors, and Government offices.

Of the 65 subscribers 11 had barred the Subscriber Trunk Dialling (STD) facility. Five of these were government offices, two educational institutes, two restaurant owners, one bank and one trader (petrol pump). Besides, all the seven public call offices were barred from STD facility.

3.3 EDUCATIONAL QUALIFICATIONS

Of the total subscribers 4.62 per cent were graduates and diploma holders, 15.38 per cent had passed Secondary School Certificate examination; whilst the balance 55.38 per cent were below the Secondary School Certificate level.

Fifty-nine per cent of the users make less than 50 STD calls in two months, 18 per cent between 50 to 100 calls, 16 per cent make between 100 to 200 calls, and 7 per cent make more than 200 calls. Analysis of the total calls made shows that the STD facility is used extensively by the villagers for communication with taluka and district places. Moreover, 25 per cent of the traders and 50 per cent of the agriculturists use telephone for communication outside the district and only a small percentage use this facility for calls outside the State.

3.4 TELEPHONE REVENUES

The telephone revenue from telephone users with STD facilities and trunk call bookings shows that compared to the first bi-monthly period from 16-7-1986 to 15-9-1986 when the telephone revenue was Rs.10,867.50, (1) it went up to Rs.24,706 during the fourth period, 16-1-1987 to 15-3-1987. For the sixth period, 16-5-1987 to 15-7-1987 the revenue was Rs.22,262. Though the number of calls went up by 44 per cent in the fourth bi-monthly period, the calls came down by the sixth period to only 4 per cent over the starting period. The revenue went up from the original level by 127.2 per cent in the fourth period and was 108.5 per cent over the original level in the sixth period.

The increase in revenue was partly due to the increase in the telephone tariff introduced by the Department from December 1, 1986 and partly due to increase in the length of conversation per long distance call. The telephone tariff in India for rural areas is as follows:

a) A flat rate of Rs.125 for every two months which includes 200 free calls.

b) Above 200 free calls, the rates before 1-12-1986 and those w.e.f. 1-12-1986 are as follows:

Calls	Before 1-12-1986
Up to 2000	40 paise per call
Above 2000	60 paise per call
	W.E.F. 1-12-1986
Up to 2000	60 paise per call
Above 2000	80 paise per call

The per day local and trunk calls for successive bi-monthly periods indicated that the per day local calls (with STD calls included) went up from 291 in period 1 to 399 in period 4 and came down to 282 in period 6. Per day trunk bookings at the Exchange went up from 15.5 in period 1 to 17.5 in period 5 and was 15.7 in period 6.

The call frequency denotes that the villager is very prudent and uses telephone services only when necessary.

4. THE ECONOMIC IMPACT OF THE RURAL AUTOMATIC EXCHANGE

We collected data from various sources to assess the economic impact of the automatic telephone Exchange at Kittur. We drew blank at the District Statistical Office where we had hoped to get economic census data. Ultimately, the Panchayat Office of Kittur village and the Taluka Headquarters at Bailhongal gave us some data, but it was not of much use in computing economic progress of Kittur as we could not get any idea of the economic activities of the village, leave aside the employment and production therein. Moreover, the authenticity of the figures entered into for houses, families, workers, etc., for different years seemed to be doubtful.

We listed this data in the hope that it may help researchers interested in studying the developments in Kittur at a later stage.

We interviewed traders who were telephone subscribers and others without telephone, to assess their employment, turnover and profit. The traders, however, were reluctant to give figures for both their profits and turnover. The growth rate of traders varied from 8 per cent to 50 per cent for both telephone users and non-users. The categories of traders were:

Petrol pump,	Truck operator,	Cycle shop,
Fertilizer shop	Paan shop,	Medical Stores,
Liquor shop,	Grocer,	Tea shop,
Cloth shop.		

The number of employees at the end of years 1985 and 1986 indicated that employment in case of traders using telephone increased from 94 to 98 whilst in the case of traders not having a telephone it remained static at 89.

The bank deposits in the two banks (Syndicate Bank, and Belgaum District Co-operative Bank) in the village showed that their deposits increased from Rs,2,31,77,355 on 30-6-1986 to Rs.2,80,18,000 on 30-6-1987 showing a growth rate of 20.88 per cent during the year, which is above the overall growth rate of the Syndicate Bank's deposit during 1986 of 18.57 per cent.

One year is too short a period to assess the economic impact of the automatic Exchange, as some time has to lapse for people to realise its advantage and to start new enterprises and activities.

5. SOCIAL IMPACT OF THE RURAL AUTOMATIC EXCHANGE

We contacted all the telephone users in Kittur to find out their reaction to the installation of RAX. These included traders such as grocers, cloth and fertilizer shops, medical stores, agriculturists, petrol pumps, rice mills, financial institutions, truck operators, restaurants and hotels, medical practitioners, educational institutions and general citizen like Director of a Sugar Co-operative, a land-lord, etc. We also contacted the public call offices and the government institutions and agencies. (Reactions of the subscribers are given in Annexure 1.)

We noted that the traders gain considerably from the installation of RAX. They could find out competitive prices to buy their requirements as also sell the local produce in the market where they would get the highest price. They could replenish their stocks as and when required and could meet demands of the customers without going out of stock. If there was sudden demand for a particular commodity they could get the supply from outside and earn good profits. For instance, when there was spurt in demand for fertilizers the dealer contacted suppliers in Belgaum and got supplies which enabled him to earn good profit.

The truck operators found that they could assess demand for their trucks from outside places which enabled them to get better returns from their business of freight carriage. They could despatch the trucks only where there was likelihood of getting full truck-load of freight. They could get spare parts when the trucks went out of order and could keep in touch with the trucks when these were out of Kittur. In case of accident, the truck drivers could contact their offices as also get messages regarding freight and destinations.

RAX was useful for many a person when there was serious illness in the family; to get the doctors or to get the medical advice on treatment, to get ambulance from the city, to get admission in the city hospitals whether for sick patients or for delivery by women.

The educational institutions like colleges found RAX very useful in times of examinations as they could sort out their problems by telephoning examination authorities at Dharwar or Bangalore. The Public School for Girls which formerly considered telephone " a useless luxury" and "an ungainly decoration" has, with the installation of RAX, come to consider it as a necessary life line and contact medium with the outside world.

Social service rendered by RAX is equally important. Many a person has stated that when their relatives expired they contacted the concerned parties as far away as Bombay and Tamil Nadu so that they could attend the funeral ceremony, which is considered an important ritual in the Indian social structure. Similarly, RAX was considered very important for arranging marriages as also for making arrangements for marriage parties in time.

RAX helped in informing about accidents on the roadways to the police; to recover a suit-case a traveller had forgotten in a bus by telephoning the bus-depot at Haliyal, a town some distance away; to get police help when threatening crowd gathered around a telephone user's house during the elections; to contact relatives in different parts of the country to know about their well-being. To a reporter working from Kittur, RAX has helped in getting and sending news items.

Having savoured the benefits of RAX, ten telephone users suggested that this vital system should be extended to all villages.

An equal number of telephone users are grateful to RAX as it has spared them from the negligence and unconcern of telephone callers by Belgaum Trunk Exchange.

6. OBSERVATIONS

The reaction of the telephone users of Kittur confirmed that RAX increased the return to traders and truck operators, helped quicker medical services and attention, reduced anxieties of the residential school, solved examination problems of colleges and gave a host of social benefits to the people such as attendance at funerals, arranging of marriages, attending to sudden arrival of marriage parties, locating forgotten baggage, getting police assistance in case of accidents and when threatened by a hostile crowd as also for social contacts and for getting and passing on news items.

The public call office serves a very vital role. From one call office police were informed when two murders took place in the village which helped in arresting the culprits in time. From another call office phone call was made and admission of a patient to city hospital ensured in time, as carrying the patient in a bullock-cart and then searching a hospital for admission would have been too late. A person bitten by snake could be saved as the doctor could be contacted by phone in the nick of time, whilst on an earlier occasion a person died of cobra bite because of the delay in contacting a doctor. When rival groups started fighting on agricultural land issue, police were contacted, which helped in preventing the threatened fight. Agriculturists asked on phone about prices of commodities, such as red pepper, and then despatched their produce where they could get better prices.

Public call offices complain that they are barred from making STD calls through RAX. We were impressed by the plea of the public call offices that they be extended STD facilities as people come to them only in times of emergency and waiting for hours to get trunk booking negates and defeats the objective of speedy communication.

Important government and financial agencies, which should have open access to outside communication, are barred from STD facilities. For example, Sub-Treasury Office, being the revenue office and representative of the State authority, should be in touch with the District and State Headquarters to meet emergencies as also to convey information of vital importance or calamities such as droughts, fire, dacoities, epidemics, etc. The Taluka Panchayat Committee should be able to contact at least the District Headquarters to get assistance and help such as a tanker for supplying water to the villages in times of droughts, as also to extend speedy assistance and help to the people of the Taluka. The Electricity Board Office should be able to contact its Headquarters when the current fails or the electricity wires break down; whilst the bank being a financial institution should be in touch with the financial market and rates, if it is to serve its community adequately. However, the system of allocating STD facilities based on rank and not on need has led to barring the STD connections to these public agencies. Whilst the Government of India sets up Rural Automatic Exchange to facilitate telecommunication in the rural areas, the government agencies bar STD facilities to their offices in rural areas.

The system of allocating STD facilities based on 'rank' and not on 'need' in the government offices and agencies has led to the barring of STD connections to these public agencies. The biggest drawback of the villages is gap in communication. The RAX system overcomes this gap. It is anomalous, therefore, that despite the provision of this facility, government agencies should bar their functionaries in the villages from STD connections.

The social impact of overcoming the isolation of space through RAX is so overwhelming, either for health, education or social life of the villagers that it is urgently necessary to provide the RAX facility to all the villages so that they overcome their isolation in communication which is one of the biggest obstacles in the development of villages.

NOTE: (1) $1.00 = Rs.13.11

ANNEXURE 1

REACTIONS OF THE TELEPHONE USERS

1. TRADERS

I now know of the ups and downs of the market instantaneously which helps me a lot in my business. (Telephone Nos. 245, 275, Grocer).

Formerly, I had to go to Dharwar/Belgaum to replenish my stocks. Now, I do it mostly on phone. (Tel. Nos. 211, 232, 213, Grocers).

RAX is essential for finding the rates and for replenishing our stocks. (Tel. Nos. 229 and 249, Grocers).

The fertilizer company as also the fertilizer users now contact me on phone. This enables me to replenish my stocks in time as also to meet clients' demands. (Tel. No.205, Fertilizer dealer).

When there was a spurt in demand for fertilizer I could contact dealers in Belgaum and get supplies which enabled me to earn good profit. (Tel. No.272, Cloth & Fertilizer shop).

I contact wholesalers on phone and purchase from the one who gives the most reasonable quotations. (Tel. No. 216, Medical Store).

I know the prevailing rates in different markets for my crops and get better returns. (Tel. No.250, Agriculturist).

With RAX I now contact film distributors for film hire and receipt. (Tel. No. 255, Cinema theatre operator).

I now get raw materials at competitive prices as and when I want. (Tel. No.256, Powerloom Sari Manufacturer).

I now order petrol replenishment as and when required, which has enabled me to meet demands of customers without break. (Tel. Nos. 262, 252, Petrol Pump).

Formerly, we had to go out to District Headquarters to find out the current rates, which now, thanks to RAX, we do on phone. (Tel. No. 226, Co-operative Rice Mill).

"I was able to get huge deposits from one of the customers of Belgaum when I contacted him on STD. Any delay would have caused the deposits to go to other bank." (Tel. No.225, Bank Manager).

I can contact dairy co-operative Headquarters at Belgaum for which formerly I had to run to Belgaum frequently. (Tel. No. 209, Dairy Co-operative).

The telephone helps me contact persons without wasting much time and money. (Tel. No. 203, P.W.D. Contractor).

2. TRUCK OPERATORS

I have a truck. Now that I have a RAX phone, an agent in Belgaum asks for my truck when he needs it. If there was no RAX phone my truck would have remained idle for most of the time, as the rice mill work does not keep the truck occupied for full time. (Tel. No. 212, Rice Mill with a truck).

With RAX, only when I know whether I will get truck load of paddy in cities like Bangalore, that I send the truck there. I also keep in contact with the truck when it is out of Kittur and get truck spares speedily when the truck goes out of order. (Tel. No. 223, Rice mill with a truck; No.259, Rice Mill).

With RAX, I now telephone for a truck only when I have sufficient logs to despatch. Because of this I have avoided arrival of trucks only to be sent back empty - which used to occur frequently before RAX. (Tel. No. 224, Plantation Manager).

I now know whether the truck has reached its destination or not. Formerly, I had to personally go to find out if the truck was stranded on the way. (Tel. No. 234, Transport Office).

The RAX is of utmost importance to truck drivers in times of accident and to contact their offices for messages regarding freight and destinations. They phone right up to Bombay and Bangalore. (Tel. Nos. 262, Petrol Pump; No.252, Petrol Pump).

I had to receive my truck transport bill. I pursued this on phone and got the bill paid quickly. Formerly, I would have to go personally to collect the bill. (Tel. No.235, Grocer with a truck).

3. EDUCATIONAL INSTITUTIONS

RAX is very useful during examination time as I can contact Dharwar and Bangalore which reduces many a problems. (Tel. No. 243, Arts College).

When the girls who had gone on a distant trip did not return in time, I contacted the Station Master, Hubli, who informed that because of heavy rains the track was washed off, but the girls were safe and would be back soon. I could convey this news to the girls' parents. This removed the cause for anxiety which would have gnawed me and the girls' parents for hours, if not for days, in the pre-automatic Exchange era.

formerly, I was looking at the telephone as a costly luxury and an ungainly decorative piece, serving no useful purpose. With automatic Exchange, it has become a necessary life line and contact media with the outside world. (Tel. No.237, Principal, Public School for Girls).

I well remember how previously when the Governor who was to attend the annual day celebrations altered his itinerary slightly, both the Governor's Secretary and I spent hours and days to contact each other and the stress and anxiety this caused me. (Tel. No. 237, Principal, Public School for Girls).

4. PUBLIC CALL OFFICES

Recently, two murders took place in this village. We contacted the police on phone who succeeded in getting the culprits. PCO Tel. No. 246. No STD).

At delivery time, people phone and get ambulance and admission in a hospital. Otherwise, they would have to carry the patient in a bullock-cart and search for admission to hospital. (PCO Tel. No. 247. No STD).

Formerly, person bitten by a cobra could not be saved as there was delay in contacting the doctor. With RAX, recently, a person bitten by snake could be saved as a doctor was contacted who came well in time. Rival groups were threatening to fight over some agricultural land. A phone call to police to intervene saved the holocaust. (PCO Tel. No. 265 and No.257. No STD).

Agriculturists ask for red pepper prices and despatch goods where they get better prices. (PCO Tel. No.240. No STD).

People have to wait for hours (some times six hours) to contact police by trunk booking. RAX would help in contacting persons immediately, especially as persons use telephones in villages in emergency situation.

For instance, a truck hit a bullock. The vet doctor was contacted and bullock was attended to in time, but for which the bullock might have died. The phone is used when there is accident, when some one dies and to find out the market rates - for all of which RAX would be more useful. (PCO Tel. No. 217 and No.230 - Postmaster - No STD).

I have to wait for two to three hours to get a trunk connection. In summer drought I phone Belgaum for a tanker so that people in the neighbouring villages can be supplied drinking water.

If I am allowed STD facility, I can contact the tanker supply speedily and so meet villagers' demand for water. (Tel. No.228, Taluka Panchayat Committee. No STD facility).

5. GENERAL TELEPHONE USERS

5.1 MEDICAL ATTENTION

Before RAX, my mother was serious. Despite trying to contact a doctor in Belgaum up to 4.00 A.M. in the morning I could not contact him. Ultimately I took my mother to Belgaum - but it was too late. (Tel. No.214, Landlord, Sawkar).

With RAX, there are greater possibilities of quick attendance and better chances of saving the lives of people.

My neighbour was seriously ill. I contacted the doctor on phone though it was night and got the doctor to attend to him. (Tel. No. 214, Landlord, Sawkar).

With the telephone, I am able to attend to patients quickly. The neighbouring villages should be connected to Kittur on STD which will enable the medical practitioners to attend to their patients without loss of time. (Tel. No. 204, Medical Practitioner).

Whenever a patient is critically ill, I contact doctors/hospitals in Dharwar/Hubli on phone and give them information about the illness of the patient and arrange for his/her admission speedily.

For rural areas RAX is a sheer necessity for speedy health care and attendance. (Tel. No. 277, Medical Practitioner).

People from the surrounding villages contact me on phone when their animals are ill and I can render assistance in time. (Tel. No.277, Government Veterinary Surgeon).

5.2 OTHER BENEFITS

Recently, my relative expired. I contacted on phone his son in Bombay who flew to Belgaum and attended the funeral. The arrival of their son would otherwise have been considerably delayed. (Tel. No.278, Grocer).

When my mother died, I contacted all my relatives up to Tamil Nadu so that they could attend the funeral ceremony. Otherwise, I would have to despatch men all over, which would have very much delayed the ceremony, and some would not have got the message in time. (Tel. No.262, Country liquor shop).

When my relatives died in Belgaum and Dharwar, I could contact all relatives speedily. Otherwise we would have to do quite a lot of running. (Tel. No.270, Cycle shop).

The mother of our neighbour, who had gone to Bangalore died. We informed him on RAX and he came back speedily to attend to the funeral of his mother. (Tel. No. 253, Rama Sewa Co-operative Society, Cloth Merchant).

I learnt that persons were coming to discuss about marriage alliance and so could make proper arrangements to receive them.

One of our relatives expired. His son had to come to Bombay from Dubai. I contacted him on RAX and he could attend the funeral in time. This all became possible only because of RAX. (Tel. No. 244, Paan Shop).

I was in Bangalore to arrange a marriage. I contacted Kittur on RAX and speedily settled the terms of marriage. Without RAX, I would have wasted time and perhaps the marriage alliance would not have been possible. (Tel. No. 218, Restaurant, Hotel).

Being on Highway, there are very many accidents about which I inform the police who attend to the accident and the injured speedily. (Tel. No.251, Hotel on trunk road).

Whilst coming by bus from Haliyal to Kittur, I forgot my suitcase containing clothes in the bus. I immediately contacted Haliyal Bus Depot on phone and got my suitcase. If there was no RAX facility, I would have had to go personally to Haliyal. The delay caused would, perhaps, have resulted in the loss of the suitcase. (Tel. No. 201, Grocer).

During elections, rowdies gathered around my home; I phoned for police help which averted danger to my life. (Tel. No. 254, Director, Sugar Co-operative Society).

My brother stays in Hubli. Thanks to RAX, we contact each other frequently to know how we are getting along. (Tel. No. 216, Medical Store).

RAX has helped me getting and sending news items. (Tel. No. 261, Reporter).

6. GENERAL

All villages should be connected by phone - as this service is essential in rural areas. (Tel. Nos. 277, 257, 249, 275, 232, 212, 250, 245, 242, 213).

Places not having STD facilities are difficult to contact. (Tel. No. 223).

Belgaum Exchange does not give good treatment to trunk bookings. STD has helped us out of this. (Tel. Nos. 278, 269, 254, 253, 246, 243, 234, 223, 255, 267).

We get wrong STD connections. (Tel. No.233).

Booking and enquiry service should be improved. (Tel. No. 203, P.W.D. Contractor).

We get wrong calls. We do not get Bijapur and get enhanced bill for Vijapat.

Sometimes, STD facility does not work though local service is available. (Tel. Nos. 229 and 201).

Sometimes we get wrong numbers. We hear others' voices.

STD bills should be separate from local bills. (Tel. Nos. 244 and 214).

Old Phone instrument should be changed to new one. (Tel. No. 222).

If industries are started here, they will get real benefit from it. (Tel. No. 226, Co-operative rice mill; and No.235).

If phone gets out of order at night there should be repair services available. (Tel. No. 234).

Sometimes phone is disconnected whilst speaking. (Tel. No. 236).

During rainy season, phone is not repaired for days. Phone charges are high. (Tel. No. 241).

The local Exchange should be enlarged. (Tel. Nos. 254, 231).

STD pulse code to different places should be made known. (Tel. No. 262).

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ANNEXURE 2

KITTUR VILLAGE

Kittur is a village with 11,457 population (1981 Census) in Bailhongal Taluka of Belgaum district, Karnataka State. It is situated on National Highway 4, midway between Belgaum and Dharwar. It has seven primary schools, two high schools and one arts college. It is served by a post and telegraph office, telephone exchange, and electricity. It gets drinking water from taps and wells. Of the total area of 4,702 acres, 336 acres are irrigated. The nearest town, Bailhongal is 26 kilometres away.

Kittur has a small temple dedicated to Basava. There is a twelfth century inscribed-stone in the temple recording a grant by the Kadambas of Goa. The emblems on the stone depict: a Ling on a pedestal in the middle; a figure of Basava with the sun above it to the left; a worshipper with the moon above him and beyond him a cow and calf and over them a knife to the right. The thirty-nine lines inscription in the Kanarese character is incomplete. It narrates how a dispute between two priests over a piece of land was resolved by an order of the minister of Jayakeshi III (1175-1199 A.D.), the ruling Kadamba chief. He subjected the parties to a fire ordeal before the merchants of Degamve village three miles west of Kittur. As the red-hot plough share did not burn the hand of the priest who stood for Kalleshvara, the case was decided in favour of Kalleshvara. Kittur formed the estate of Yusuf Khan, a Turkish nobleman under the Bijapur King Ismail Adil Shah. At the close of the 17th century Kittur was under Medi Mallappa, an important Desai of the Karnataka Raj. The fifth Desai of this line established himself at Kittur, which was formerly called Gijaganahalli or Weaver-bird town.

In 1746 A.D., the Nawab of Savanur ceded Kittur to the Marathas. In 1778 A.D., Haider Ali conquered the whole country south of Malaprabha river and received the usual tribute from the Kittur Desai. In 1779 A.D., Parashuram Bhau Patwardhan captured Gokak and took Kittur Desai a prisoner. In 1785 A.D., Tippu Sultan seized Kittur and placed a strong Mysore-Detachment there. The Marathas formed an alliance with the Nizam against Tippu and attacked him at Badami and Kittur. The detachment under Tukoji Holkar succeeded in driving out Tippu's troops from every part of Kittur except the fort. Under the treaty of Srirangapatana (1792 A.D.) Kittur Desai's lands again became part of Maratha country, and were assigned to Parashuram Bhau.

In 1800 A.D., Dhundia Bagh attacked Kittur and remained there for a few months till General Wellesley defeated him. In 1809, Kittur Desai entered into an agreement by which he promised to pay the Peshwa yearly tribute in return for the grant of his estate and the title of 'Prataprao.' In 1817 and 1818, when the British had confrontations with Bajirao Peshwa, Kittur Desai actively aided the British. The British did not recognize the adoption of Shivalingappa by Shivalingarudrasarja for various reasons. They declared that thenceforth Kittur would come under the direct rule of the British.

Rani Chennamma, the widow of Mallasarjya, and step-mother of Shivalingarudrasarja, ignored the British proclamation. When Mr. Thackeray, the Chief Political Agent, insisted that one of his men should thenceforth administer Kittur and attempted to take it over, the Rani of Kittur and her followers fought for the honour of the State. In the violent battle that followed, Thackeray was killed and many of his assistants were taken prisoners. Thereafter, the British troops under the command of Lt-Col Deacon marched in large numbers and invested Kittur. A good deal of diplomatic negotiations between the British and Kittur authorities took place. The English were eager to secure the release of their prisoners, while the Rani was anxious to protect the rights of the State. But negotiations failed and even though the Rani released the English prisoners, the British did not honour their word. With their superior military power, the British succeeded in occupying Kittur, and took Rani Chennamma a prisoner on 5th December 1824. Another widespread rising took place at Kittur in 1829, under Sangolli Rayanna who fought for the independence of the State and for four months paralysed the British Administration in the area. He was, however, betrayed by his own men and was caught and hanged.

It is in the memory of Rani Chennamma that a residential school for girls known as Rani Chennamma Residential School was founded on 17th September 1967 at Kittur. The school has classes from sixth to twelfth and follows the Central Board of Secondary Education pattern. It is headed by Wing Commander Muttu and has a band of dedicated women teachers on its staff. The school campus is situated on the hills facing Kittur and spreads over nearly 200 acres of land.

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ANNEXURE 3

THE RURAL AUTOMATIC EXCHANGE

The Rural Automatic Exchange designed and developed indigenously by the Centre for Development of Telematics (C-DOT) meets the unique requirements of a developing country, viz., high traffic density, low maintenance possibilities, and paucity of airconditioned cabin for the exchange. Automatic diagnostics enables one to detect faults which are rectified by replacement of the faulty card. Moreover, all critical electronic components are duplicated for fault tolerant, uninterrupted service, thus offering continuous service to the users. The basic software controlled digital switch architecture has been developed to serve as a building block for small and medium sized telephone exchanges.

The C-DOT Rural Automatic Exchange (RAX) is a Digital Stored Program Controlled (SPC) system, with the capacity of 128 terminations. The terminations include: Subscriber lines, Trunk lines, Supervisory tones, Conference facility for trunk offer and maintenance panel circuits. The RAX features a completely non-blocking switching network - the basis for a high capacity, total availability system. The system has been designed for fault tolerance. Duplication of critical electronics ensures that no failure affects more than 8 terminations.

Ease of installation, high system reliability during operation, automatic on-line diagnostics for fault isolation and recovery are some of the requirements that have influenced system design. The system has been designed with in-built ruggedness. The use of low power components reduces system power consumption and cooling requirements.

Modularity in hardware and software permits flexible system dimensioning and an easy to use set of features that meets most organizational communication needs.

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NOTES:

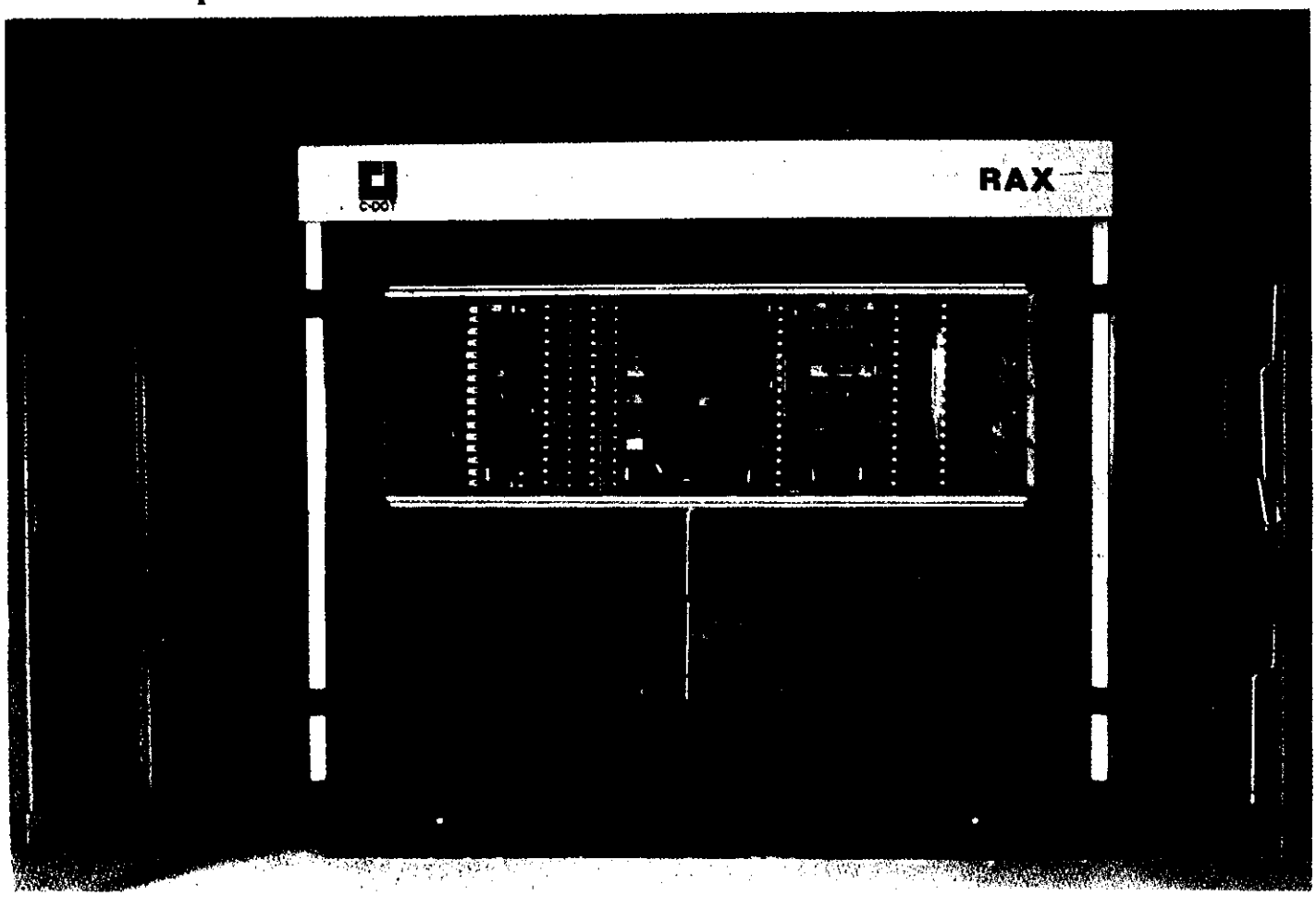
In this paper, all tables have been omitted.

The Government of India has decided to install one Rural Automatic Exchange a day in the year 1988.

TELEMATICS
NEWS FROM C-DOT
C-DOT

August 25, 1986

C-DOT 128 port RAX



A Breakthrough in Technology for Developing Countries

On July 21, 1986, C-DOT's 128 port digital electronic Rural Automatic Exchange (RAX) was put into commercial field trials at historic place Kittur, Karnataka. RAX is the second by-product of C-DOT's main development on large sized digital switching system. This technology meets the requirements of rural areas of developing countries, where nearly 75% of their population lives, especially — no air-conditioning and low power consumption. The latter permits battery operation of the exchange during prolonged mains failure.

Today, 70% of total number of exchanges required in India are the exchanges of less than 100 line capacity. There is a demand of more than 1000 exchanges per annum for such exchanges (MAX III Category). Less than 50% of the demand is met by electromechanical exchanges. Production of these will be phased out within the next 3 years. Thus, the only viable alternative for this application is the C-DOT digital technology. Here begins the digitisation of rural network for providing data and other services to support the information network of the future.

Mr. Jakati, Principal & Social Worker, Kittur making the inaugural call on C-DOT RAX to Mr. K.P. Lukevydhian, GM, Telecom Circle, Karnataka on July 21, 1986.

How Kittur People Feel About C-DOT RAX

32 subscribers at Kittur have been talked to from Delhi regarding C-DOT RAX performance. Just to tell you about their reactions:

"Service is good. There is no problem."	Mr. Vastrada * 252
"Very good service."	Mr. Pharlashetty * 235
"No Problems."	Public Call Office * 230
Service has improved. But outgoing STD is difficult. Incoming STD no problem."	Manager, Karnataka Honey Producers Association * 209
"No Problem."	Mr. Thigadolli * 246
"Service has improved much. Normally booking of call is very fast. STD is fine. I am really amazed to find the change."	Principal, KRC Residential School * 237
"No problem. Service is very good."	Dr. B.R. Umaraju * 202
"Service has improved. STD is working fine."	Inspector, Police Station * 233
"Getting wrong numbers while trying for STD."	Mr. Marihala * 245

* subscribers' telephone numbers

Remote Monitoring of C-DOT RAX Performance	You can dial STD Code to Kittur 083342 followed by the test number 200 and you will get the following tones: • Ring Back Tone i.e. System is O.K. • Busy Tone i.e. One of the power supplies is functional	• Dial Tone i.e. System is working in Simplex • Number-Unobtainable Tone i.e. Battery needs charging
RAX Features	The indigenous RAX works reliably even in * temperature range of 0° to 45° C * humidity range of 9% to 95% * dusty environment * power fluctuations • it is fully duplicated beyond 8 ports • has remote monitoring facility • has online diagnostics • requires very little space	• can be directly connected to TAX for STD • software meters for charging of calls • remote alarm in the event of fault • remote monitoring of exchange status • low installation time — few hours • costs 50% less than the technology available for import.

Media on C-DOT RAX

The Role of RAX and PBX in C-DOT's Main Project

The primary aim of C-DOT's first technology mission is to develop a large main automatic exchange within the time frame of 36 months.

The system design being highly modular gave the opportunity to the two by-products — 128 port PBX and RAX, using the terminal unit hardware which forms the basic building block of the main exchange. This provides a lead time for ultimate integration of a large exchange. This terminal unit forms 65% of the total equipment requirement for the large main exchange. Out of 33 card types required for the main exchange, 6 cards in the Terminal Unit are used in PBX and RAX. The advance establishment of PBX and RAX manufacture would solve a number of problems in technology transfer of C-DOT designs. This will hasten the production of the large main exchange.

PBX Technology Interaction

First by-product of main development — 128 port digital PBX was developed within a year of C-DOT's inception. Forty eight organisations have signed the agreement for technology transfer for productionising it. Advance interaction has commenced with the following eight manufacturers: BHEL, CDIL, Delta Hemlin, Debikay, ITI, NELCO, Hindustan Brown Boveri and INDCHEM.

Having paid the first installment of the technology transfer fee, these manufacturers are now busy setting up their infrastructures for production. It is expected that by December, 1986 some of these manufacturers will be in a position to market 128 port PBXs.

Shri Ram Niwas Mirdha, Minister of State for Communications, presenting a set of technical documents to the representative of manufacturers, Shri I.K. Gupta, Executive Director of Debikay, to formally commence technology interaction of C-DOT 128 port PBX.

Appreciation

Extract from the letter received from Shri Ram Niwas Mirdha, Minister of State for Communications and Chairman, C-DOT Governing Council, after persuing report of the Inter Departmental Committee on progress made by C-DOT.

"I have noted with pleasure that the work of development of Digital Switching System undertaken by C-DOT has been progressing as per schedule and that C-DOT is full of confidence. I trust that you and your colleagues will continue to work with zeal and complete the work as scheduled."

C-DOT

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