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<td><strong>Author(s)</strong></td>
<td>Sarkar, Sumitro.</td>
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Social Applications Of Wide Area Data Broadcast And Hybrid Networks

By

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SOCIAL APPLICATIONS OF WIDE AREA
DATA BROADCAST AND HYBRID NETWORKS

by

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Presented at the Seminar on "Impact of New Communication Technologies on Rural Society in Asia and the Pacific"
Jakarta
September 13-14, 1993.
Introduction

With the upcoming launch of as many as 20 satellites in the Asia-Pacific region over the next few years, the bandwidth available for VBI data broadcast networks will increase dramatically. Each new TV channel will carry within itself a 100 kbits/sec one-way data channel. The challenge will be to use this data broadcast capacity to provide wide area information services.

Traditionally data broadcast networks have been unable to use the full capacity provided by television broadcast channels. Data broadcast networks have remained on the fringe of the computer networking world, largely because they were only used by commercially self-supporting services. Once the concept of social benefit is allowed as justification for introduction of a new service, several interesting applications appear that can use this capacity.

Where interactive computer or videotex networks are present in full strength, data broadcast applications will remain restricted. However any country with a low telephone density is a potential beneficiary of data broadcasting services. India, with 7 million telephones for more than 860 million people. On the other hand, the introduction on August 15, 1993 of 5 new satellite television channels by Doordarshan, the national television broadcasting agency, using INSAT 2B was a major step in increasing data broadcasting capacity. Star TV plans to add 5 more channels soon. Hence India is a good candidate for the introduction of new teletext data broadcasting services over the next 3 years.

We will first describe a few social applications of teletext broadcast, and then discuss recent hybrid network applications and trials in India where television/teletext broadcast networks were enhanced by two-way VSAT networks. A case is made for a public "information utility" organisation with an explicit charter to identify and disseminate socially beneficial information through multiple networks if necessary.

Development and the Need for Receive-Only Information

Before examining these applications in greater detail, it is worthwhile to look at the general requirement for receive-only information in relation to the extent of national development.
A developing country like India is constantly plagued by uncertainties in every area that can be traced to a shortage of some resource. The mismatch between expectations and performance generates information demand. Even the highest income groups are affected. For example, flight delays on Indian Airlines, the public sector national carrier, result from the political priority of providing comprehensive nationwide air services, even with less than the optimum number of aircraft. Each aircraft must perform many more flight-hours per day than in developed countries. With no standby aircraft available, any delays at intermediate destinations add up by the evening.

Shortages make queues and waiting lists a fact of life. Governmental regulation makes for a fairer distribution of resources, but also adds delay to that distribution. The effect of shortages is compounded by lack of information about the current availability position of the resource. For example, a long distance train reservation in India requires booking between 7 to 30 days in advance. The only way that a prospective passenger could get some limited information on ticket availability was to personally travel to the booking office and wait for 45 minutes in a queue.

Conversely, if up-to-date information about shortages and delays is widely available, their effect can be mitigated by planning. While removing the root causes of the shortages is obviously the long term solution, even simply disseminating information about delays, waitlists, and rationed allotments allows the necessary development process to proceed more steadily and systematically. The management of the scarce resource is forced to become transparent.

For the above reasons, receive-only information systems have more relevance in developing than in developed countries. In the above example on train reservations, the requirement in a developed country would be for the actual purchase of the ticket through a two-way interactive system. The ticket availability would be taken for granted.
Wire Service Model for Data Broadcast Services

Data broadcasting originated in Europe in the early 1970s. Teletext technology made this possible by piggy-backing data on to normal television broadcast in an invisible way. Ones and zeros were encoded as bright and dark dots respectively, on the unused portion of the TV signal that lies between two picture fields. Theoretically the entire existing TV distribution network could now be used to distribute data without interfering with the ongoing picture transmission.

By 1985 several competing teletext standards were established, receiving equipment (decoders) of various types were being manufactured, and a mix of standard and experimental services was under broadcast. There were many possible directions in which teletext services could grow. Now in 1993 teletext services in Europe have settled down to News, Weather, Betting, Shopping and Travel information. The teletext service is mentally modelled on a wire service with graphics and some advertising pages. It is no surprise that most teletext services are run by TV news departments or contracted out to news agencies. Each individual service is expected to be self-sustaining. Net revenue from advertising or subscriptions is the only yardstick used to measure society's need for each particular variety of information.

Share prices and exchange rates are always broadcast in an encrypted format requiring a special decoder that can decrypt received data depending on whether or not necessary subscription fee has been paid. This, in brief, is the European model of teletext services that has emerged in the last decade. This way of using teletext technology has also been adopted by countries in the Asia-Pacific region. However, there are a number of interesting information dissemination applications that are precluded by the strict wire service model, especially those that are difficult to package and sell as a product.

Display of a Resource in Short Supply: Railway Reservations

Unlike railways in developed countries, the Indian Railways provide a mass long distance passenger service, especially for the lower income groups. Eleven million passengers are carried every day, using 7000 trains through 7000 stations. In Delhi alone, 50,000 tickets are booked every day through the terminals
of the computerised reservation system in the eight booking offices around the city. There is a heavy demand for tickets, and bookings must be made at least 2 weeks in advance to get a reservation for the desired train, date and class. A wait at the booking office could easily last an hour.

Although the actual making of a reservation is computerised, the prospective passenger's time was still wasted due to the lack of a wide area reservation status display system. There was no way to find out if a train had tickets available except by sending a messenger or personally going to the reservation counter. Finding alternatives in case a train was full meant hastily requesting the booking clerk to make one or two extra enquiries on his terminal for the status of alternate trains. This increases the queue size of customers, who had to wait half an hour to one hour to be served.

What was required was a system that would allow a prospective customer anywhere in Delhi to plan his travel in advance using a full range of information on all the 80 possible trains, 30 possible advance dates, and 5 possible classes of travel per train.

The railway reservations computer was connected to the teletext broadcast computer and the current availability position was continuously broadcast and updated every 10 minutes. A row of TVs with decoders were installed in public display halls at the Railways booking offices in the city of Delhi.

A survey at the largest of the eight booking offices showed that 5000 people a day referred to the system before coming to buy tickets. As prospective passengers knew which train to request for before approaching the booking counter, the enquiries load on the reservations computer halved, and the queue of passengers moved 10% faster.

The availability display service simultaneously provides both rolling display mode (for unattended operation at public places such as reservation counters) as well as individual selection mode (for offices and homes). It has been operational since 1988, and was recently upgraded with screens on the number of wait-listed passengers far confirmed so far for all trains leaving in the next 24 hours.
Synergy between Networks - Road Accident Information

Any time a friend or relative is unduly late returning home in Delhi, the thought of a road accident arises in the mind of the waiting person. Five people a day die in road accidents, and another 25 are admitted with serious injuries in one of the 6 government hospitals.

The Delhi Police have a force of 300 jeeps that cruise their localities looking for road accidents. The Police Control Room (PCR) remains in two-way radio contact with all the jeeps via four separate district networks. A bank of telephone operators accept emergency calls from the public. The message is written down and passed on to the radio network operators to contact the particular jeep to be dispatched for investigation. The PCR also has hot lines to all the hospitals. The problem was to disseminate the information collected by the Police Control Room infrastructure to the public.

The solution planned for December 1993 is to transfer the accident information in the form of teletext pages over a leased data line to the teletext broadcast studio computer. These pages along with other teletext pages of special public interest are also used to generate a set of rolling screens which are converted to video and broadcast as a normal television signal during non-programme hours. Thus TV viewers without decoders can also see these pages, albeit at restricted times and with no selection over the pages shown or their order of appearance.

The interface at the PCR synergises the dissemination power of the teletext network with the information gathering power of the Police network.

Hybrid Broadcast Networks

The addition of even a very low bandwidth reverse channel adds several orders of magnitude to the capabilities of broadcast systems. Naturally the resulting hybrid system does not give true full-duplex two-way interactivity in the computer networking sense, because the bandwidth in the outward (broadcast) direction is typically a hundred times greater than the incoming (user transmitted) direction. The broadcast information emanating from the site can be full-motion video, while the incoming information is restricted to a few digital codes or command strings per input channel.
Experimental interactive cable television systems already exist in the U.S.A., which allow the cable head end to poll audience opinion on views expressed on talk shows, and selection and scheduling of programmes. The extra hardware required is a keypad with a data transceiver. To ensure that each viewer’s response is registered with the broadcaster, a small fraction of the broadcast bandwidth has to be set aside for a point-to-multipoint data communications protocol.

The same idea, i.e. addition of out-of-band signalling and data collection channel to the main broadcast channel can also be used over a wide area. Using television and/or teletext over the broadcast channel, and low data rate, low cost two way VSATs for data collection, a number of interesting applications can be implemented.

Election Result Reporting

During the 1991 elections to the Indian Parliament, the NICNET network of VSATs was used to transmit round-by-round vote counts from each of the 540 constituencies. The vote counts were tabulated on a central computer in Delhi and summary tables made showing the statewise and nationwide performance of the major political parties. These tables were output across a leased line to a computer with high quality television compatible graphics located in the television studio. The tables of election results were then broadcast nationwide as part of the round-the-clock elections coverage. At each constituency a partial result was announced once every two hours on the average, hence the transmission bandwidth required of the local VSAT was very low—about 50 bytes an hour. It is not the input channel's capacity, but rather its mere existence that allows this application.

For the Election Results System, the choice of television as the broadcast media was appropriate because the subject matter was of concern to the general viewers. Where the intended audience is a specialised group, teletext broadcast is a better way to disseminate simple facts.
Allocmert of a Central Resource: Medical College Undergraduate Vacancies

In India, more than 200,000 students take a common entrance test for the 1600 seats available in Government medical and dental colleges. The top students in order of rank, are allotted the college of their choice, provided that vacancies still exist in their preferred colleges after higher ranking students have exercised their choice. Several rounds of allotment have to be run through to take into account transfers, no-shows, and wait listed candidates. A new law requires the allotment process to be completely transparent with open and immediate declaration of the result. This legal requirement rules out any off-line batch processing method.

The system designed for this application consists of VSATs installed in auditoriums across the country. These VSATs will collect the students college preference on-line, in strict order of rank. A central database keeps details of students' names, ranks, colleges selected, and remaining vacancies. The central computer is connected to the teletext studio, and the current vacancy position is broadcast nationally using teletext insertion into a satellite TV channel. Each auditorium is temporarily equipped with a TV receive-only VSAT, 5-10 TVs with teletext decoders and a large screen display in addition to the transportable two-way VSAT. While awaiting his turn in the auditorium, each candidate checks the TV screens for vacancy position of all colleges and ultimately opts for one that is still available. The allotment process is completed in a matter of days rather than months. This system has been used in a local moie in Delhi in September 1993. As there was no national data broadcast, candidates had to come to Delhi from all over the country. To save candidates this trouble, a pair of two-way VSATs will be installed at allotment centres in the major metro cities beginning in 1994.

The two-way VSAT in this system has only to transmit a three digit college code representing the candidates' selection every minute or so, resulting in a net data rate of only a fraction of a bit per second. A similar scheme can be used whenever a central resource has to be allotted amongst a dispersed group of applicants in a manner that is transparent at every micro step.
Hybrid Network: Application For Distance Learning

A well-known system that uses analog media in this way is the Classroom 2000 concept. An educational TV program is broadcast to a number of classrooms, each of which has a one-way audio channel linked to the production studio. Students ask questions over the audio channel, and the instructor replies over the broadcast channel. When a student identifies himself, the practice is to retrieve his/her photograph from an album in the production studio, and telecast it while the question is being asked. If VSATs are used for the audio return path, a single channel can be shared among all the classrooms. VSATs use the satellite channel only when they have something to transmit.

A further enhancement consists of keypads for each student whose outputs are multiplexed together onto a data transmission circuit provided for each classroom. A computer in the production studio receives the keypad input from each student in all the classrooms. The data channel is used to collect answers to quizzes, and also to gather instant answers to multiple choice questions asked by the teacher during the class. The central computer provides the teacher with an on-line indication of the percentage of students selecting each multiple choice answer. The teacher then knows whether he has to clarify further the current topic, or can safely move on to the next one.

A field trial named "Classroom 2000" was conducted in India by the Central Institute of Educational Technology in May 1993, using dial-up long distance calls for the audio return path.

Information Utilities

With the proliferation of satellite networks for television, data broadcasting, and VSAT interactive communication, a new kind of organization will be required to implement the above kinds of social applications on a regular basis. Following Masuda, we will refer to this organization as an "information utility". In developing countries the first information utilities would be supported by the government. In Masuda's words

"The capital required for the governmentally managed information utility would be provided from the national budget, the goal of which would be to increase the well-being of the people as a whole. The national government would operate the utilities, with the dual support of taxes and revenue from the utility rates in payment for services. The services would include
all forms of public relations, information about government policy, statistics, information to serve the public interest (weather, pollution, transportation, etc.) and information services of a social welfare nature, such as education and medical care.

The chief merits would be the low rates for usage and the requirement that such utilities exist for public good. Negative values would derive from the inefficiency associated with bureaucratic organization and the danger of increased governmental control over society."

In addition to the continuous stream of pre-packaged information provided by wire service type organizations, society has frequently occurring temporary demands for specialized information. Events like school and university admissions, competitive examination result announcements and elections generate bursts of information demand. The organizations administering these events do not have networking skills. Even private companies who may have the technical background are not experienced in the full range of communications media. It is economical for developing countries to centralize the equipment and skills into an information utility. This does preclude other information utilities being started by business, individuals or communities.

One of the skills of the information utility will be the ability to set up and dismantle the right combination of wide area networks needed by the application. The utility has to hire capacity from various (television, radio, data broadcast & interactive VSATs) wide-area network operators. Public Services television broadcasters and value-added computer network service providers have a headstart in growing into information utilities, as they already have experience and control over at least one type of network.

Although network set-up is an essential activity, the main task of the information utility is at the application level. Its existence stems from the recognition of the following two facts.

- There are some information services which society demands but which cannot be supported using subscription fees and advertising.

- These information services are nevertheless worth providing if the social benefit / cost ratio is high.
The first task of the information utility will be to identify all the broadcast information needs of the society. Once identified, the necessary information services may be intermittent, because of limited duration of demand on any one occasion.

**Strategies for the Information Utility**

**Tapping Existing Computerised Sources**

The information utility (IU) should first concentrate on obtaining socially demanded information automatically, by setting up data links with agencies who already have data on a computer, regularly updated by a trained staff. This approach has a dual advantage. Not only was the data seen by teletext viewers up-to-date, but also the cost to the information provider was low. As data entry into his own computer is a normal part of the information provider's operation, and transfer to the teletext computer is automatic, very few overheads are required to keep the information supply permanently flowing.

**Enlisting Information Providers**

As the IU is required for non-commercial applications, support through advertisements may not be forthcoming or appropriate. Source organizations holding information of public interest need not see the effort to network this information as cost effective.

-- They were not sure whether significant numbers of people had or would buy decoders to see the broadcast information.

-- Even if a person had a decoder, he might not be a regular "customer" of the organisation, so the effort in getting the information to him would be wasted.

This reluctance on the part of potential information providers can be overcome by adding the element of "Public Display" to the teletext broadcast. Public information displays, consisting of a row of TV sets with decoders, are set up in the premises of the information provider. Each decoder is pre-set to display a separate page of that particular provider's information to the
visiting public. The enquiries burden on the staff is thereby greatly reduced. The information provider sees a direct benefit to himself by providing the information to the teletext service, as both the objections noted above are satisfactorily answered. The broadcast data is of course visible to anyone with his own decoder, so the service benefits as a whole. Teletext has the lowest cost of any public display if several geographically scattered premises of the provider need the display.

A second way of enlisting information providers is to provide a brief summary of their information on the visible teletext programme that fills the hours when no regular programme is broadcast. As this visible teletext programme is just like any other broadcast, it can be seen without a decoder and hence can have a very large audience. In order to benefit from this free air time, the information provider must provide his bulk data to the main (invisible) teletext service, because it is from the main teletext service that the visible teletext programme is automatically generated at the broadcast centre.

Summary

In summary, the dramatic increase in availability of satellite bandwidth in the Asia-Pacific region will make possible not only more lower cost two-way and data broadcast networks, but also hybrid networks where both are used in the same application. The addition of even a minimal two-way data collection and signalling channel to a television or teletext broadcast network opens up new applications in the wide area electronic information dissemination. Developing countries will have to set up information utilities if they are to benefit from new social information dissemination applications.
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