Global Communications Newsletter

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Wireless Communications Track in Brazil

By Michel Daoud Yacoub, Carlos Eduardo Vassimon, and Helio Waldman, Brazil

Brazil is a mercurial and contrasting country. Heterogeneity can be perceived in all walks of life, as the basic outlook of the Brazilian society shifts from one generation to the next. Wireless communications, by the same token, have followed a peculiar, typically Brazilian path. Remarkably, wireless services were first deployed outside the major regional market (the State of São Paulo), and as demand was swiftly met, those people in the lower income brackets who had never had access to any private means of communication were also surprisingly served. It is noteworthy that until then, many of the new wireless users did not even have access to public telephones, which were relatively scarce. One can say that wireless communications turned out to be a very popular and indispensable service in Brazil, helping thousands of people to improve their quality of life. One may then hope that one of the historical imbalances of the Brazilian society, namely the access to communications services, may be on its way to oblivion. In many parts of the country, wireless communications services have emerged even before basic sewage, transportation, and health services have become available.

The wireless experience in Brazil started in 1990, still under a regulated market. For obscure (certainly bureaucratic) reasons, under the state-run ruling model of the time, cellular services were first deployed in Rio de Janeiro, the country postcard, and Brasília, the country capital. Only in the second half of 1993, still under a regulated market, was service introduced in São Paulo, which was then the center of an 11 million population metropolitan area, representing the largest unexplored cellular market in the world.

Although "state companies" are not usually seen as focused on market-oriented results, the strategic vision of Telebrás, the state-controlled holding of almost all telecom operating companies in Brazil up to 1998, was highlighted when it established automatic roaming as the standard for the integration of the Brazilian cellular networks. Considering the continental dimensions of the Brazilian territory, this definition was crucial to compensate for the limitations of the analog technology then adopted by Telebrás.

While under government control the Brazilian cellular system lagged behind demand as well as emerging quality standards, especially in large metropolitan areas. The idea then emerged to look for resources to support the feasibility of a modern communications infrastructure, compatible with the search for insertion into a global unregulated world.

Almost at the end of 1995, a policy arose that would guide the onset of competition in the exploitation of services. Such a policy established rules concerning the privatization of the operating companies under federal control (Telebrás) and restricted the role of the State to that of a regulating and supervising agency. In October 1998 the Brazilian telecommunications business model transition was changed through one big privatization round that would reshape the whole Telebrás system and auction some large chunks of it (one long distance, three fixed telephony, and eight cellular companies) to private bidders. International (mostly European) corporations have invested significant amounts in the purchase of the national communication networks. A new agency, called Agência Nacional de Telecomunicações or National Telecommunications Agency (ANATEL), became the national regulator of telecommunications services in the country.

Just before these events, the so-called B band had already been auctioned to private companies interested in the wireless services business. The privatization of the state companies that were operating in the A band occurred some time later, when the B band incumbents were already well positioned in their markets.

There is no doubt that the business model applied in the organization of wireless services in Brazil led to fast assimilation of new facilities by the market and users. New technologies, service profiling, coverage quality, and customer assistance are evolving, although customer satisfaction is still elusive. Creative solutions for professional and personal life have been identified and assimilated by most Brazilians, as people find out how to take advantage of the use of the prepaid phone only to receive calls and make them collect, preserving their own pocket at the expense of the cellular operator.

Following the global trend, Brazil is also aiming at personal communications service (PCS) and third-generation (3G) services. Early approaches by ANATEL, however, have shown that the agency was overly optimistic in believing that the Brazilian market had room for three more bands (C, D, and E). At least one of them (C) has been forsaken for the time being. ANATEL's decision to go for a competitive business model in mobile services implies the migration of all operators to PCS, including those already operating the traditional A and B bands. Although the country still has a lot of potential users to join the service market, it is likely that investors in the new bands will not be interested in offering them to their traditional client base. Competition will then focus on the corporate market, aiming at future profitability for current and future operators.

One gets then to the real issue: will Brazil grow? If yes, how fast? The outlook now seems favorable, especially as seen from abroad, and a new wave of cautious optimism may already be felt in some sectors (apart from soccer, of course!). Even though this may afford some positive expectation of demand for wireless communications companies, it still seems that the ideal number of frequency bands would be three, not five. In summary, Brazil is still capable of producing great surprises in all aspects of its activities. It is undeniable, however, that one of the reasons of the failure to auction the new

(Continued on page 4)

The INTERMIP Project

A Project for the Traffic Engineering and Evaluation of Multimedia IP Networks

By Georges Fiche and Guy Pujolle, France

Introduction to the Project

With telecommunications network technologies evolving as they are, and their increasing performance, it is now possible to envisage the deployment of multimedia applications. Such applications involve data, sound, and fixed and moving images, and they affect all aspects of modern life: person-to-person communication, information broadcasting, games, education, commerce, banking, medicine, publishing, and culture, to name just some.

These applications will be deployed in the context of multiservice networks, distinguished by their ability to satisfy considerable bandwidth and widely varying quality of service (QoS) requirements.

Although in the beginning asynchronous transfer mode (ATM) seemed to be the target transfer mode for multiservice networks, it now appears that a range of solutions will use IP as the network protocol. The main criticism of today's IP networks is that QoS cannot be controlled other than by overdimensioning the resources. However, efforts are currently being made to define IP network services enabling data flows to be transported according to their varying constraints, and to define mechanisms and protocols that allow traffic engineering to be tailored to the networks. At the same time, universities and manufacturers must be made to work together to define and develop the traffic handling and dimensioning rules needed to optimize traffic engineering in these new multimedia IP networks. Such is the goal of the INTERMIP project.

INTERMIP is a research project conducted by the RNRT, the French National Telecommunications Research Network. The RNRT was formed in 1997 following the liberalization of telecommunications in France that threatened the organization of research and development in the industry (the role of France Telecom R&D, formerly CNET, for example, which is now the R&D center of an operator working in conditions of unrestricted competition). The RNRT originates from an initiative of the French Ministry of Research to create a new framework for flexible and dynamic cooperation between all the players in the telecommunications sector (equipment makers, operators, software producers, and small and medium enterprises). The three-year INTERMIP project was launched in this context at the end of 1999 and, in line with the RNRT's recommendations, harnessed the efforts of manufacturers (ALCATEL and FT R&D), academics (the LIP6 laboratory of the CNRS and the INT), and one small/medium enterprise (DELTA PARTNER).

The Project and the State of the Art

Today, some of the networks, mechanisms, and protocol services being defined at the Interent Engineering Task Force (IETF) are very similar to those specified by the ATM Forum and the International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) when ATM was being standardized.

The IP network services being defined are integrated services (IntServ) and differentiated services (DiffServ). IP IntServ define categories of services and require the explicit reservation of resources for each corresponding IP flow. They are therefore similar to the ATM service categories. We can thus assume that the bearer mode for these services in IP will be similar to that considered for ATM networks. IP DiffServ are based on the principle of flow aggregation and will probably require new traffic engineering methods. The introduction of multiprotocol label switching (MPLS) to support Diffserv would appear to allow the use of some of the mechanisms and engineering rules defined for ATM networks. However, there are still many questions concerning call acceptance rules and levels, at the access point and in the core network, and the need for rules governing bandwidth reservation.

The project's main aim is to study the traffic engineering of an IP multiservice network offering QoS guarantees. Traditionally, traffic engineering is understood to cover all the rules, ensuring that certain performance indicators are met while using a minimum of resources (bandwidth, nodes).

The traffic engineering rules for telephone networks are well known. In a multiservice network, the problem of defining such rules is much more complex. Rules are beginning to emerge for ATM networks for which there are several service categories (constant, variable, unspecified bit rates: CBR, VBR, UBR; etc.) with their own bandwidth and QoS requirements. However, tools still need to be perfected to route the connections associated with these service categories and to dimension the networks.

THE PROJECT FULLY REFLECTS THE PRIORITIES SET BY THE RNRT. TRAFFIC ENGINEERING EXPLICITLY CONCERNS "THE METHODS OF DESIGNING AND OPERATING NETWORKS" THAT THE RNRT STATES AS ONE OF ITS PRIORITIES.

For IP networks, there is still no real theory for devising traffic engineering rules. In today's IP networks, QoS is either provided by reactive dimensioning or simply not provided. The work of specifying DiffServ categories in IP has not been finalized, and the mechanisms for supporting them are still being designed. The concepts of streams and elastic flows are opening up new potential for differentiation and dimensioning that must be explored.

The second aim of this project is to integrate into an evaluation and dimensioning tool some of the models perfected when analyzing engineering rules for multiservice networks. The performance evaluation and network dimensioning tools currently available on the market are feeble or ill-targeted responses to the issues raised. These tools offer a small number of ATM or IP-based models and traffic models that are usually incomplete.

The project fully reflects the priorities set by the RNRT. Traffic engineering explicitly concerns "the methods of designing and operating networks" that the RNRT states as one of its priorities.

The Internet/intranet environment is currently a major concern, and the advent of QoS could rock the world of network architecture. It is therefore particularly important to understand, analyze, and predict the performance that can be achieved with these IP networks. The help of an underlying ATM structure could be crucial, but no one is able to correctly predict how these particularly complex systems will behave. Also, there are no computer tools to help the network designer construct and dimension it.

Project Organization

The project is divided into three subprojects:

- Characterization of traffic and identification of classes of service
- Analysis of engineering rules for IP networks providing QoS
- Dimensioning and simulation environments

The roles of the first four players (CNRS/LIP6, INT, FT R&D, and Alcatel) are quite similar even though two are academic institutions and two are manufacturers, while DELTA

(Continued on next page)

PARTNERS focuses more on subproject 3.

The results obtained by the consortium are validated as the project progresses using methods ranging from simulation to full-scale trials and including comparison with results from experimental measurements (measurement comparisons mainly by FT). The main results are tried out on the MIREHD network.

Subproject 1: Characterization of Traffic and Identification of Classes of Service

The main aim of this subproject is to characterize the different traffic categories to be found in a multimedia network. Each category will be linked to a network-level QoS.

End-to-end QoS depends on the totality of the entire system. To translate the QoS required by a service into a corresponding network performance level, different aspects must be studied in this subproject. We have essentially identified the following three tasks:

- The first task of this subproject will be to characterize the flows generated by all the services that require a specific QoS from the network. We will also study the aggregation of flows and the measurement of QoS.
- In the second task, each user service will be correlated with an appropriate network class of service (i.e., one that can provide the required QoS from end to end). In addition, we will propose a mapping of QoS classes and parameters between IP and ATM.
- Finally, the third task, on the basis of the above results, will be to build scenarios of traffic load in the network; these will be used to identify the requirements in terms of performance modeling and evaluating different network techniques and architectures.

Subproject 2: Definition of Engineering Rules for IP Networks Providing QoS

The main aim of this subproject is to define the engineering rules for IP networks providing QoS.

Supporting QoS in a telecommunications network means implementing several types of mechanisms:

¶Traffic control mechanisms at the point of entry into the network and more generally into any domain requiring a certain level of QoS to be observed.

¶Traffic routing mechanisms for directing the traffic through the network according to its characteristics and the resources available in the network.

¶Traffic management mechanisms in the nodes: introduction of time priorities (priority access to transmission) or space priorities (selective rejection mechanisms), and traffic shaping (smoothing, clipping). More generally, these mechanisms are to apportion access to the transmission resource (contention management) and access to the buffers (loss management), based on a policy decided by the equipment manager.

¶The last family of tools to be considered is the family of network dimensioning tools designed to ensure that user demand is satisfied. In other words, we should concentrate on QoS not just in terms of allocated bandwidth but in terms of blocking probability or the probability that the network will reject the request. A key function of traffic engineering is network dimensioning. This involves calculating the capacity of the links according to the traffic offered so that a certain QoS can be maintained. This QoS could be expressed, for example, in terms of the probability of a new request being refused admission or the average rate achieved by an elastic transfer. In general, dimensioning and routing of requests are examined together so that a least cost network can be constructed. In this project, we have limited ourselves to examining the mathematical relationship between capacity, traffic, and performance without considering economic optimization.

The relationship in question is similar to Erlang's formula, on which telephone network dimensioning is based, and should take account of the particular characteristics of the various types of flows envisaged. The multirate extensions of the Erlang model and their approximations will be studied with a view to applying them generally to stream flows with varying characteristics and elastic flows.

The subproject involves identifying, along the four lines listed above, the main tools required in an IP network to support the services that require QoS. It will consider not only network-related aspects (the problem of an IP service offering and associated network dimensioning) but also equipment aspects (the location of the traffic control and shaping functions). This will be facilitated by an operator (FT) and a manufacturer (Alcatel) working together.

This subproject must consider the IP services and their characteristics as identified from subproject 1; it will be based on the modeling activities and will provide the basics of the models to be considered in subproject 3.

THIS SUBPROJECT WILL INTEGRATE THE MODULES FOR DIMENSIONING, TESTING, AND EVALUATING SYSTEM PERFORMANCE PREPARED IN THE OTHER SUBPROJECTS. THIS SET OF TOOLS WILL BE MADE AVAILABLE TO THE PROJECT PARTNERS.

Subproject 3: Dimensioning and Simulation Environments

The aim of this subproject is to incorporate the different modules developed in the other parts of the project, particularly in subprojects 1 and 2.

This subproject will integrate the modules for dimensioning, testing, and evaluating system performance prepared in the other subprojects. This set of tools will be made available to the project partners.

Many dimensioning and simulation tools already exist, having been developed to meet the requirements of specific projects. They are generally incomplete, not very open-ended, and belong to the system promoters. Simulation is a widely used technique for optimizing telecommunications systems and will be employed in this subproject to validate the analytical modules. The dimensioning and simulation workbench that will be developed in this subproject must be:

- Powerful enough to study future multimedia applications with very high target performance levels and the many complex techniques to be developed
- Open and standardized enough to accommodate modules developed by specialists in various telecommunications techniques, to offer them an all-embracing environment

This workbench must accept modules developed in the other subprojects.

Progress

Several deliverables reflecting the tasks to be performed have already been produced. Some very interesting and new results have been produced, in particular on the characterization and dimensioning rules for stream and elastic traffic. These results give hope that it will be possible to devise relatively simple and pragmatic IP network engineering.

The Players

The partners in the project and their research teams are represented by Guy Pujolle for CNRS/LIP6, Gérard Hébuterne for Institut National des Telecom (INT), James Roberts for FT R&D, Georges Fiche for Alcatel, and Pierre

(Continued on next page)

Report on EDOC 2001

By Guijun Wang, U.S.A.

The Fifth IEEE International Enterprise Distributed Object Computing Conference (EDOC 2001) was held from September 4 to 7, 2001, in Seattle, Washington, USA. EDOC is a series of conferences that address issues related to the design, management and evolution of enterprise systems. Papers presented at EDOC conferences discussed technical issues and experiences in enterprise modeling, enterprise workflow and transactions, enterprise architecture and system development, supply chain management, e-business, inter-enterprise collaboration, as well as enterprise system implementation and maintenance techniques.

EDOC 2001 (http://edoc.doc.ic.ac.uk) was co-sponsored by the IEEE Computer Society and IEEE Communications Society, in cooperation with ACM and the Object Management Group (OMG). Continuing in the tradition of previous years, EDOC 2001 had excellent technical programs and social events. The technical program comprised six tutorials, two keynote presentations, two invited talks, three panel discussions, and 28 paper presentations. Out of 56 paper submissions, 21 papers were selected as full papers and seven as short papers following a rigorous review process (at least three, usually four reviews per paper). Researchers and practitioners from 11 different countries attended EDOC 2001.

The two keynote presentations were one by Dr. Clemens Szyperski of Microsoft Research, entitled "Is It a Component? Is It a Web Service? No, It Is ..." and another by Dr. Chris Horn, Chair of Iona Technologies, entitled "A Decade of Middleware: Plus ça Change?" Their presentations highlighted some major achievements and issues concerning distributed component technology, Web services, and middleware. Dr. Sridhar Iyengar of Unisys was invited to give a talk on OMG's initiative on model-driven architecture (MDA), in a talk entitled "MDA: Motivations, Status, and Future Possibilities." Dr. Martin Sachs of IBM was invited to talk about the latest XML standardization efforts in e-commerce, in a talk entitled "ebXML: Status, Issues, and Future Directions."

Technical papers covered a wide range of areas from enterprise modeling and enterprise applications to enabling technologies for enterprise middleware and interorganizational collaborations. Particular emphasis was placed on the architectural and modeling aspects of component-based enterprise software.

There were lively debates in three panel discussions. The first panel discussed the UML profile for EDOC: the component standard for Internet computing. The UML profile for EDOC was a recent effort in the OMG to define a standard for enterprise distributed object computing (EDOC) using Unified Modeling Language (UML). The second panel discussed the topic of MDA, the OMG's recent initiative to push for a seamless framework to enable platform-independent modeling and platform-dependent model implementations. The final panel drew lessons from a decade of enterprise system modeling, architecture, and middleware, and discussed strategies and research issues for Internet-enabled business environments and enterprise systems of the future.

EDOC 2002 will be held from September 17 to 20, 2002 in Lausanne, Switzerland. The conference Web site is at http://icawww.epfl.ch/edoc.

Thanks to all of those involved in making EDOC 2001 a great success.

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WIRELESS COMMUNICATIONS IN BRAZIL/*(Cont'd from page 1)*

bands is the fact that the demand for wireless services is reasonably fulfilled. Besides, a high default rate among users is also found. Therefore, it would seem that the deployment of 3G systems in Brazil will come as an outgrowth of the global trend, not as a natural demand from within.

It is interesting to recall the official document of the Brazilian Ministry of Communications describing the Programa de Recuperação e Ampliação do Sistema de Telecomunicações e do Sistema Postal, or Upgrading and Expansion Program for the Postal and Telecommunications System (PASTE), published in 1995. The forecast was then that 17.2 million mobile telephones would be operating in the country in 2003. Nearing the end of 2001, however, the number of cellular phones reached the figure of 30 million, democratically distributed among all Brazilian social classes. Current forecasts are now more optimistic: 38 million users for 2002, 46 for 2003, 53 for 2004, and 58 for 2005. May these numbers be a source of motivation for the dissemination of public services in Brazil.

THE INTERMIP PROJECT/*(Cont'd from page 3)*

Bacquet for DELTA PARTNER.

The Web Site

The CNRS-UVSQ Web site contains information on the INTERMIP project. Access to the INTERMIP site is restricted (password) and reserved for those involved in the project. The public description of the project is available on the site at http://www-rp.lip6.fr/intermip/. CNRS-UVSQ is responsible for keeping the INTERMIP site up to date.