Kandó Kálmán Faculty of Electrical Engineering

Institute of Telecommunication

Address: Tavaszmező u. 17, 1084 Budapest, Hungary
Tel.: +36-1-666-5131
Fax: +36-1-666-5132
E-mail: szucs.ilona@kvk.bmf.hu
Website: http://www.kando.hu/hti

Head of Institute: Dr. György Lukács

PhD Research Topics in Institute of Telecommunication

Questions of Continuity of Operating Processes Based on IT Systems

(József Beinschróth, PhD research topic)

Commonly known that in the last decades the operating processes of several organizations have strongly depended on information systems. The availability of information systems affect the proper operation of their organization processes. Since in the practice no such prevention method which guarantees the proper operation against any impact (environmental disaster, terror attack …) we should deal with prepairing actions for disaters as well.

However IT systems have critical roll in proper operation of firms it is obvious that the first aim of firms is not the proper operation of their IT systems, but theit firrst aim is to produce continuity of their business processes. So the proper operation of technology is only necessary condition. Hence the continuity of operation has another conditions too, for example human, organizational, life-cycle conditions and so on.

So it is obvious that continuity of operation can't be discussed as technological problem, it requires complex approach, which takes account the threats from technology, organzation, regulations and so on, and based on risk analysis so as to determine the proper prevention methods.

Experimenting Quality of Experience in Access Networks

(Gergely Kún, PhD thesis draft)

User perception of service quality usually very different from the quality that is determined by service providers on the base of a numerous measured parameters. The Quality of Experience (QoE) metrics describe the service usability strictly from the end-users' point of view. The well-known Quality of Service (QoS)

parameters however cannot be converted easily to QoE properties, moreover, in context of mass-services, neither describing, nor measuring of these metrics are not obvious. The aim of my research is to find methods determining QoE properties by passive measurements on an aggregated network link, (that might be applied in service providers' own network as well). One of these properties is determining the correlation between network overload and QoE. The task is not so simple since there could be several scenarios where the experienced service quality becomes less than satisfactory.

Degradation of user perception can be tied to network QoS in several cases, hence it might be correlated with some kind of QoS metrics. Network-related QoE-degradation can manifest itself as extended response time, decreased download speed, less enjoyable audio and video streaming. This is usually caused by one or more network bottlenecks, where packets get congested, queued, then delayed or dropped. There can be several link properties applied to characterize the presence of bottlenecks in packet data networks. Since I carry out measurements on aggregated links (in the network of a service provider), packet level measures get in focus that can even be applied nearly real-time on huge amount of data. A number of suitable parameters were examined, one of them is based on delay of packets that I dealt with.

The end-user often decides a network-service unusable if he/she experiences long delays. By definition, delay factor could be calculated as the ratio of the ideal and the measured sojourn times ('traveling times') of a traffic flow that traversing on a network path. Delay factor, however, can be derived from the interarrival time of flows as well, with the help of M/G/R–PS arrival model. Use of the model makes it possible that these kind of metrics could be measured not only by end-to-end (at the end/users' territories), but even in the core network. This feature is very advantageous from service providers' view. Another advantage of the method, that the original model based on traffic flows, while the new one on individual packets – thus it serves results faster and more accurate and sensitive.

The method was tested in real network environment at a major network operator as well. The metric indicated properly both the normal and congested periods. Besides there were also examinations on a smaller network segment with an artificial bottleneck, to ensure the correlation of the metric and users' (subjective) QoE. It was carry out by running a number of network application (web, audio-video, etc) and correlating their performance – appraised from users' view – and the results of the new method: it satisfied the expectations.

Questions of National and International Regulation of the Operation of the Telecommunication Networks in Emergency and Disaster Cases

(Dóra Maros, PhD thesis)

In the disaster cases, because of the damage and overload of the telecommunication networks, the communication between civil persons breaks,

and the telephone lines, emergency calls and transmission of information between rescue teams are unavailable and impossible. The reliable operation of the telecommunication resources is also very important in civil disaster alarming, emergency calls, and in the cooperation of different organizations such as police, fire fighters, ambulance, army, governmental officers and authorities.

Research Aims

➢ To discover and analyse the technical questions and problems in the emergency telecommunication by representing some real natural disaster precedents in Hungary and in Asia, and terrorist incidents in the USA and in England. To examine the preparedness of Hungarian telecommunication systems and operators for emergency situations, to discover the main problems, and give some propositions and solutions.

➢ To summarise and systematize the standard organizations, special groups and main regulations, documents related to the fields of the emergency telecommunications, and to define the main scopes of the regulation aspects. To examine, describe and analyse the Hungarian regulation system, and to explore whether the Hungarian emergency telecommunication complies with the international requirements or not.

➢ To examine the questions of Hungarian disaster defence policy, including the civil emergency calls and warning (alarming) systems, furthermore the communication of rescue teams and officers. To discover the related technical and regulation problems in Hungary and give solutions.

New Research Results

➢ I described and systemized the main scopes and characteristics of emergency telecommunication. I showed that the Hungarian telecommunication system is not ready for handling emergency situations. I suggested new technical solutions for emergency preparing works as well as to ensure central and local reserves, work out to use alternative power supplies, to establish a new central network supervisory system and a new mobile service which is called Emergency Mobile Originated Call (EMOC).

➢ I collected and systemized the international and national regulations of emergency telecommunication. I proved that Hungarian regulations do not meet international requirements, and there is nobody (persons, groups) who is responsible for determining, working out the main tasks and coordinating the actions in critical emergency situations. I proposed to establish a new Authority, called National Emergency Communication Authority (NECA) who probably can solve the problems listed above.

➢ I demonstrated that the civil alarming system and emergency call (112) handling not meet requirements laid in EU directives and recommendations. To realize a new E112 system in Hungary I suggested establishing a new

National Security Information Centre (NSIC), which meets requirements in ETSI recommendations. I also suggested working out the conditions of establishing a Civil Warning Coordination Centre (CWCC), which can handle and control the alarm calls towards the civil persons throughout different telecommunication networks (mobile and wired). I proposed to find solutions for creating a Priority Call Handling System in public networks.

Stability and Reliability of Digital Signal Processing Systems

(Tibor Wührl, PhD research topic)

Robots have become more and more important recently. Their application reduces the risks that threaten human life and health both in military and civil applications, for example in the event of catastrophe. The use of robotics or devices with remote control are proposed where the human life or health are jeopardised by the surroundings, such as high level of nuclear radiation, chemically polluted area, battlefield, or the events when a task should be solved in places that are difficult to be reached by people, etc.

Among the well-developed robotics devices the group of Unmanned Air Vehicles (UAV) are especially of great importance. However their wide use is limited by the requirement for reliability. In the case of micro category UAV the most important reliability features seem to be the redundant design of the central controlling unit, as well as the hardware and software stability of digital signal processors (DSP) implementing the central controllers.

Similarly to big systems, there are numerous techniques for the design of redundant hardware, capable for operation tolerant of errors:

- ♦ Hot-Standby processor structures;
- ♦ Processor structures used in Load-Sharing systems;
- ♦ Structures operating on the principle of majority decisions.

The structures mentioned above should be examined with consideration to their applicability in small flying devices, furthermore some experiments should be done.

However the expenses of implementation, as well as the fact that, in the case of micro UAV, the load carried may amount to few kilograms only, should be taken into consideration. This limited capability means that, in the case of a large control circuit, the useful carrying capacity significantly decreases.

Regarding the security of operation the processing of measurement data coming from the individual sensors (that identify altitude, speed and position), as well as the stability of regulating circuits are of great importance. The first and perhaps the simplest examinations should be focused on the stability of a linear model of the system. Non-linear devices and regulating circuits should be examined in the

time domain. For this purpose there are well applicable mathematics programs (e.g.: MATLAB®).

Certain realisations of the regulating circuits may surprise the designers, because the results in the case of an algorithm carefully checked by means of simulation may differ from the expected ones. People rarely think of inaccuracies in number representation (overflow, rounding) of the individual DSP realisations. Because of non-linear effects caused by rounding and quantization limit cycle phenomena may occur in systems using feedback. By using the fix-point representation, for example, the multiplication of two n-bit numbers will result in a number that in the worst case can be represented by 2*n bits, that is, the number of bits has doubled. When in a signal processing unit the result of a multiplication is placed in a circuit using feedback, the increased bit number should be reduced (quantized) to the original 'n', which appears as a non-linear effect.

Application Possibilities of Integrated and High Complexity GEO Space Station Systems

(Andrea Farkasvölgyi, PhD research topic)

Nowadays the telecommunication and measuring satellites which are orbiting on the LEO and MEO are increasingly menaced by the non-controlled objects called space debris which have accumulated on the earth orbits. The most important aim of space research is the reduction of amount of space debris or at least the slow-down of growth mainly on the lower orbits.

I examined the calculation methods of space debris loads on lower orbits where satellites are working on accordingly to the altitude and the Lagrange points. I also studied the efficiency of the different booster rockets according to that how much space debris come into existence during the putting into orbits of payloads on the LEO and how long these objects will inconvenience the earth orbits. I looked into the unused satellites which are raising the amount of debris and moving of these objects. I worked on the life time of satellites after their stoppages how long time they remain on their primal position and when they will leave their space and when they will be expected to be exploded. Data were collected about that how the different sized freely moving objects damage the active satellites circling on orbits.

I suppose there are two ways for reducing of space debris. On the one hand the number of put-into-orbit satellites should be lower, on the other hand there should be maintenance of satellites that is simple and does not cause more unneeded objects. The solution of these two ways is the same that can be an integrated space station which is situated on geostationary orbit.

The high level integrity and complexity of this space station allow several functions to be on the same place. On these bases measuring equipments and transponders for digital television channels would be placed.

Possibilities of the integration of these space stations into one system also were examined. One conceivable solution can be a space station system situated over the Equator at 36000 km altitude on the geosynchronous orbit and consists of three single space stations that are communicating each other and the degree between two objects is 120 degree.

Advantages of such system are on the one hand is that the devices on these stations can be maintenanceable and on the other hand the cover of the surface of Earth is near 80 percent. Further benefit of this system came from the height of orbit is that altitude control and position control require low level energy according to LEO and MEO.

In my opinion the best way for communication between these stations composing such a system can be done by optical links applying a so-called exo-atmospherical system.

Research and Development (Finished K+F Projects) in Institute of Telecommunication (2005)

A Mathematical Model of Statistics on Telephone Calls

The R & D has involved the survey of mathematical models of statistics needed for a detailed analysis of T-Com subscribers' telephone calls (tariff packages, the time of the day, geographic location, the route of calls, etc.). It has also involved the examination of applicability, with the purpose of making the actual statistics on calls and the definition of evaluation methods.

During the R & D activity mathematical models of statistics were made on the basis of call data supplied by T-Com and, with the use of them, statistical methods were elaborated, which can relevantly define the subscribers' behaviour. The model will be tried out with respect of the actual calls in one month. As the results achieved in the project, the applied statistical methods were presented.

The task described in the R & D contract was completed in three steps. These were the following:

1   Examination of mathematical models of statistics on the basis of data supplied by T-Com. Choosing the applicable methods for mathematical statistics.

    According to the contract, for proving the applicability of statistical models, the required details were provided by T-Com. The call data relevant to the statistics were determined by means of the corresponding data of a call record named IQ, which appeared according to full charge (rate, rerate, OCP benefit, etc.). For this purpose the statistical models were elaborated with the use of data available in the call records. To achieve this, the statistical basic data had

to be settled in co-operation with T-Com co-workers. For the processing it was necessary to be aware of the name, interpretation, type (string, numeric, logical, etc.) of the data field on call records and of the set of values of the variables as well.

2   Establishing a statistical model, defining the evaluation method, its documentation; trying them in practice with sample data and carrying out eventual modifications.

In the second part of the project work further data on the content of the record fields were found, these data were needed for the statistical analysis. In this phase T-Com provided us with the field data of calls that were made in September 2006, and which had been chosen by us in the first phase of the project. In this phase, on the basis of the sample data and field information available, our task involved the establishment of statistical models that we considered determinant when subscribers' practice is studied. In this phase of the project, however, for further examinations some more information was needed, which unfortunately was not available then. For this reason we were able to establish and try out the complete system of models in the third phase of the project work.

3   Examining the applied model in detail. Presenting the results of the project, compiling the R&D final report.

In the final report we included the summary of the basic data available, the presentation of the program prepared for statistics, the handling of the program, as well as the statistical features and their evaluation.

Establishing an Information Security Management System (ISMS) for a Hungarian Middle-size Firm

We produce a special IT security project for a middle-size firm. First we determined the current status of information security of the many-site firm and executed a risk analysis. We examined the information environment too, and made suggestions for repairing the information security gaps. The results of risk analysis gave the probability-impact matrix which showed the risk of threats. We identified the business critical systems and processes as well as availability problems and gave repairing steps. Using these results we presented the best suitable ISMS for the firm.

The sponsor of this project was a Hungarian middle-size firm working in financial sector doing special financial and commercial activity. Earlier in 2001, we completed special audit for that firm, which referred for value system of that firm. At that time it was very important because they lost huge value in every year. We suggested several solution and that firm spent almost one billion HUF during 2 years, so as to rise the level of value and personal security.

To continue that work we produce the follow-up IT security project, because at that time the problem of IT security didn't seem to be important for them. To solve IT security problem, we selected the ISO/IEC 17799 standard, we thought this standard was the best suitable to use. So the project took place according to this international standard. We determined the processes and systems which determined the critical business processes of that firm using business strategy and the 'best practice'. We should produce impact and risk analysis to support the top management to decide which risks were acceptable and which should be handled. And finally our task was to compose IT Security Policy and Regulation based the standard mentioned.

PTC Office Management System Integration

The research (applied or industrial) & development has involved the experimental development of a processing office management system and software, as well as the integration of the software modules already available, which can follow the steady changes occurring in the operation and services of a telecommunication service provider. A more flexible and more uniform office management system can provide for a telecommunication service provider the equal opportunity of market access, the achievement of a better business position. The software can be flexibly changed, its parameters pre-set, and it is also capable of handling and establishing a company knowledge based system. The investigated algorithms can handle the processes, which are used to attend on the clients of the service provider, they also advance the marketing activity and business planning, as well as the value analysis.

When the contract for the research and development activity was drawn, the service provider was running the following different software elements which served as the starting point of the applied or industrial research & development:

- ♦ Procedure administrator,
- ♦ Document administrator,
- ♦ Records of partners and contracts,
- ♦ Invoicing –OSS,
- ♦ Accounting, Finance – SAP (FI. AM CO),
- ♦ Service management system.

The objective of the research & development has been to make the data recorded by these of software elements uniform and integrated. Administration is handled by the procedure administrator, which controls the activities and provides the availability of the required data.

The document administrating software handles the documents needed in a uniform system connecting them to the stage where they should be used. Paper documents

are scanned and, depending on the possibilities, the data are automatically written in the database. The functions planned during research & development are:

♦ Electronic identification of objects and persons,

♦ Making reports (for the processes defined in procedures, or individual reports on marketing and controlling),

♦ Establishing a database,

♦ Introducing controlling points corresponding to SOX specification into the operation system.

The achievements of the research & development were handed over still in an experimental state; the subject of the contract did not include technology transfer.

PTC-SLA Development

The research (applied or industrial) & development has involved the experimental development of an algorithm and software which can follow the steady changes occurring in the operation and services of a telecommunication service provider.

The experimental software can be flexibly changed, its parameters pre-set, the enlargement of its database structure and the completion of further tasks have been made possible.

The objective of the research & development has been to make the SLA (Service Level Agreement) calculation transparent and to minimise the occurrences of human errors during data processing.

The functions planned in the research & development activity:

♦ Loading the basic data in Microsoft SQL Server database,

♦ Carrying out data processing in accordance with SLA, forming annually accumulated mass of data,

♦ Calculating the credits and penalties in accordance with SLA,

♦ Converting the accounts into tables formed legible for Microsoft Excel.

The achievements of the research & development were handed over still in an experimental state; the subject of the contract did not include technology transfer.

With knowledge of the information background of the telecommunication servicing partner co-operating in the research & development activity, the Microsoft Windows platform seemed to be the most convenient solution for the task involved. As a dedicated server computer was available for running the application, it has been functioning as an Intranet system based on Microsoft .NET architecture. The application and the database server have been located on the

same computer but this – in the case of the reduction of resources – can be changed (scaled).

For the completion of further tasks on the server there are Microsoft IIS webserver, Microsoft SQL Server 2000 and ASP .NET running, thus the SLA accounts have been designed corresponding to the same conditions. Normal Explorer clients can access the server. The application has been made in C# language with the use of Microsoft Visual Studio developing system.

After the processing has been done, the output can be obtained in XML format which is available as part of Microsoft Office 2003 and can be handled by Microsoft Excel 2003.

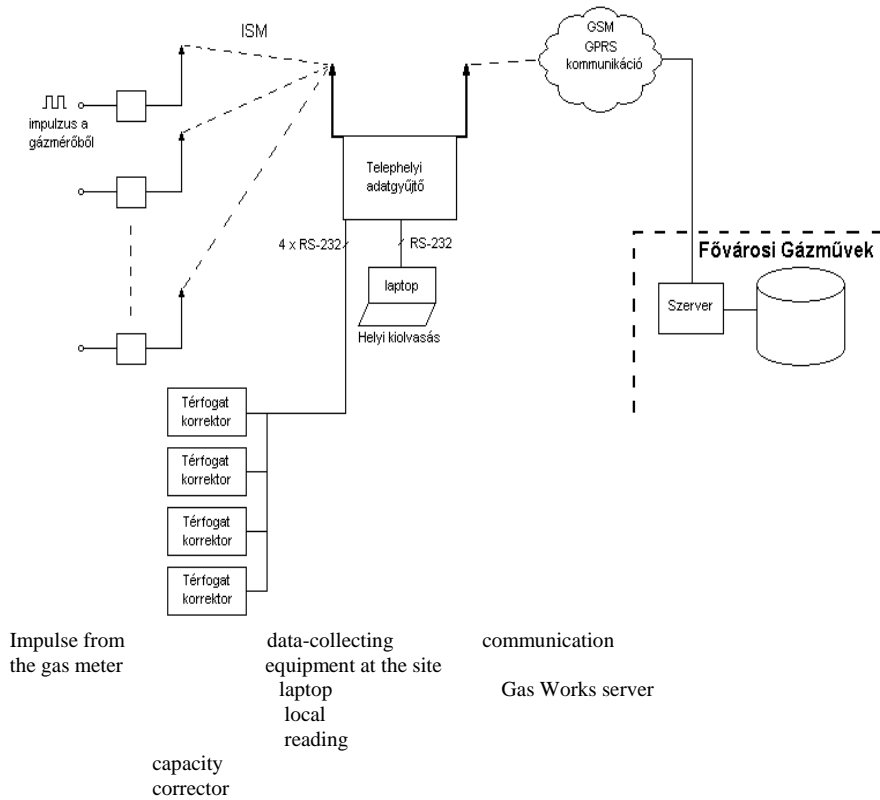### Gas Electric Meter Data Collecting and Data Communication

The objective of the research & development has been to produce an experimental data collecting and data transmitting system that can be used to store and transmit data on gas consumption.

The Research & Development has involved the establishment of a device providing the automation of measuring the consumption of gas, as well as a multiple-input system handling the data of gas meters and capacity correctors, the definition of system structure, electronic planning, the investigation of operating software algorithm. The system is suitable for data recording for transmitting them in determined intervals for the systems performing data processing.

The Research & Development has also aimed at the preparation of the technology transfer of a system, which can be suited to a gas meter, to a capacity-corrector specified by the partner co-operating in the Research & Development. It does not affect the metrology properties, it is free of manipulation, safe and easy to handle.

When completing the system, we had to take into consideration the equipment supplied by the experts of Budapest Gas Works as an integration surrounding. The structure of the system can be seen in the figure.

An impulse count proportional with the consumption comes from the gas meters. The contact is given by a reed relay. The reed relay built in the gas meter closes or releases on the effect of a magnet. During Research & Development data collecting equipment was fitted to the gas-meter to count the incoming impulses, then to process them (summarise them per hour) next to store them. By means of an ISM (Industrial, Scientific and Medical) communication channel at a frequency of 868 MHz the stored data can be transferred to the site collector.

Impulse from   data-collecting   communication
the gas meter   equipment at the site
                         laptop   Gas Works server
                         local
                         reading
          capacity
          corrector

The Research & Development has also involved the completion of the detailed specification of a data collecting equipment joined to the gas meter and of an ISM communication interface. The ISM communication transmission should be tolerant of errors; in the case of a failed or faulty transmission the measured data will be sent repeatedly. The data that have arrived free of errors will be acknowledged according to the ISM communication protocol.

The site collector receives the data on one hand in the ISM band from the data collecting equipment joined to the gas meters, on the other hand on serial asynchronous communication interface (RS-232) from the capacity correcting circuits. The site collector stores the data received per meters, per capacity correctors every hour. The data can be polled or transmitted from the site collectors in two ways. For local polling a serial asynchronous interface (RS232) can be used. A PC can be connected to the interface and the data are transmitted in a character format by means of a simple command interpreter. A GSM modem is connected to the data collector which can be reached via a GPRS network. The data stored by the collector can be loaded by a special method from a simple http server made for Open AT operation system running on a GSM modem.

The Research & Development has also involved the definition of detailed specification of the site data collector and the GSM communication device.

At the site of the Budapest Gas Works a server computer dedicated for this procedure receives the data transmitted via the GSM network. The data received are converted into XML format by the application running on the server computer. The system running at the Budapest Gas Works is capable of interpreting and displaying these data.

Company Information Security Development

The investigation aimed at testing the information system of a medium size company with consideration of security. Examinations were carried out to explore what damages can be caused by an outside invader or a dishonest co-worker or an employee of a different company who is legally staying at this site.

When doing these examinations the experts of the college tried to break in/invade the information system of the company (ethical hack) simulating the intention of a real invader. The conditions and limitations of the break-in were definitely described and included in the contract. The purpose of the simulation was to have the company's experts make the necessary arrangements that can increase to a great extent the resistance of the information system to real hacker activities.

The completion of the task consisted of three major parts:

♦ The weak points were defined by some special software running from the public network.

♦ The physical access to the network (intrusion to the company site) was carried out making use of the negligent checking of visitors.

♦ When the invader has physically accessed to the local network, their chances may exponentially increase. For this reason, as a last step, testing of the network was carried out from a local network terminal. While this was being done, attempts were made to disturb the network elements or to carry out man-in-the-middle intrusions.

All the steps of the process were precisely registered. It has been stated that no damages occurred even in the case of successful intrusions, that is, although a successful break-in has been proved, no changes in the operation of the system had occurred.

At the end of a stage of the project the document delivered included all the steps accomplished and the problems revealed, as well as the proposals regarding the arrangements needed for security purposes.