Maximum of load database of GPS service with recovery

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Abstract

The paper analyses the database global position system (GPS) services load with recovery. A mathematical model of the interaction with the database services is developed. On the basis of mathematical modelling procedures for the exchange services, the possible delays and the presence of large queues to services are defined. Suggestions to improve the exchange of services are developed. Development of an integrated transport management system enables to solve a local task of reducing the "order-delivery" cycle and creating a positive image for the company in the eyes of the clients due to accurate execution of undertaken obligations related with order execution terms, minimization of the delivery failure risk and the opportunity of creating a flexible feedback system

Keywords: Heterogeneous services, client and server requests, network queuing systems, heterogeneity

1 Introduction

The main purpose of any database is to provide efficient services to users. One of the fundamental works on relational databases [1] identifies four main types of database services: "Projection", "Intersection", "Selection" and "Union" and four types of special services: "Subtraction", "Descartes product", "Connection" and "Division". All these services are independent from each other, although special services can be expressed in terms of the basic relational operators. Each of the services in the database is processed during the period of time determined by the type of query. This indicates the presence of heterogeneity in database network queries processing.

2 The mathematical model of the database services interaction without recovery

In [2] a mathematical model of the interaction between the workstation and the server is presented, one that takes into account the presence of two types of services. However, it was noted above that for the exchange of data in a database the number of services may be of more than eight types. To account for these factors, a mathematical model of the interaction of the services with the network database is presented below. The general scheme of interaction of clients and the database server can be represented as a closed network queuing system (QS). The scheme of such a network is shown in Figure 1.

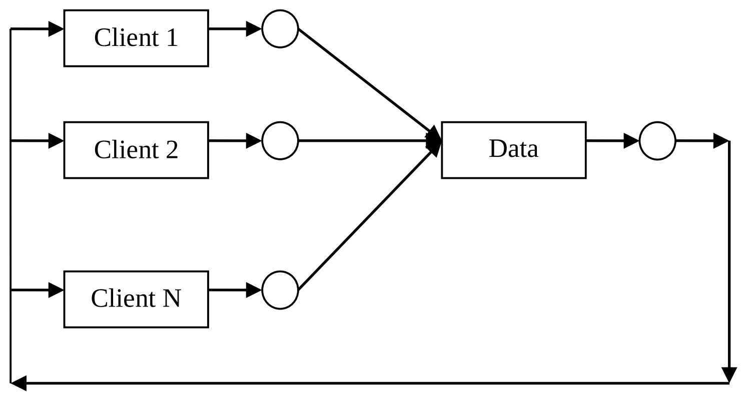

FIGURE 1 Schematic portrayal of the interaction of the client and server queues.

Each client program sends a request to the database. This request may be of any length. In general, the length of this request is random. Each client's request lengths depend on many random factors. This randomness is manifested in servicing these requests by the database. The database is required to respond to each client request. Furthermore the database itself can generate queries. The times of occurrence of these requests are random, and the length of these requests is random as well. In each case, the client must respond to the query of the database server. Thus, a closed loop of interaction between the database programs and the client emerges. Client work can be interpreted with the help of QS models. In Figure 1, each QS of the client is marked with its own rectangle with the name 'Client' and the corresponding number of the client. Transitions of requests from the client to the server and from the server to the client are marked with arrows. These transitions are probabilistic in nature. The times of servicing requests by both the server and the client also random. Client service time is homogenous because this time is determined by the time of the implementation of the programs of one client. The time of servicing requests by the server is heterogeneous. A study of QS networks with heterogeneous service laws is presented in [3]. However, in our case, the network QS is mixed, since it contains both homogeneous and heterogeneous queries. In [4] an expression was obtained that estimates of mean number of customers in one particular QS network node with heterogeneity. This expression has the following form:

$$N_{(R)} = \sum_{i=1}^{R} \lambda_i / \mu_i + (\sum_{i=1}^{R} \lambda_i) \left[(\sum_{i=1}^{R} \lambda_i / \mu_i^2) / (1 - \sum_{i=1}^{R} \lambda_i / \mu_i) \right] . \quad (1)$$

Here λ_i - the average intensity of entry into the system of the i - the type queries, μ_i - average service rate of these requests, R – the number of service types, $N_{(R)}$ - the number of requests that are in the queue and serviced by the heterodyne QS.

In the particular case when R = 1, we turn to the homogeneous service. Average number of demands in a homogeneous QS for this case is determined by the following expression:

$$N = \lambda / \mu + \lambda^2 / \mu^2 / [(1 - \lambda / \mu)] . \quad (2)$$

Equation (1) yields the average queue length for a database server, and using the relation (2) we can find the average queue length on the client side. These relationships make it possible to assess the effectiveness of the database without taking into account the emergence of its failure and recovery.

3 The mathematical model of interaction of database services with recovery

All questions related to data recovery are defined by restoration procedures and failure rate. Various algorithms are used to ensure recovery; they are implemented in the program as special points of rollback, control and data recovery. For the implementation of the recovery model, we assume that the occurrence of failure is instantaneous. Creating control points, the time of data recovery and service requests are distributed along the time axis in the form of appropriate actions that are shown in Figure 2.

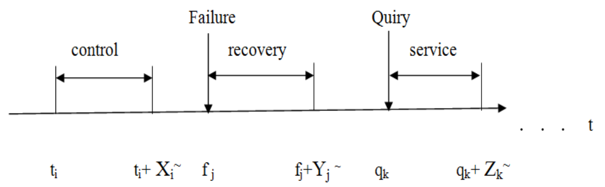

FIGURE 2

Here, $X_i^{\sim}$ indicates the time of the i- th control request, $Y_i^{\sim}$ - recovery time of the j- th failure and $Z_k^{\sim}$ - service time for the k- th order.

That said, the instants of occurrence of queries and the moments of occurrence of errors may take place during the processes of control, repair and service. We can assume that two or more operations cannot be executed simultaneously by the database server. Because of this assumption, and in accordance with the analogous assumptions that have been made in a number of works on the restoration of databases [4, 5] that arise in the course of requests' servicing, we can assume that failures and moments of queries in the database take place in accordance with the laws of Poisson. The average service time of requests can be accepted as exponentially distributed [6]. I must say that this assumption may well be justified, more so because the estimations of the load in the databases which are exploring the performance in reality almost always take the critical value. Let us now turn to the assumptions regarding the timing control. Stationary probability distribution for the database monitoring system can be obtained using the generating function, which has many generations [7]. Figure 3 shows the distribution of the steady-state control over time, which consists of at least two generations of requests - service requests and requests for control.

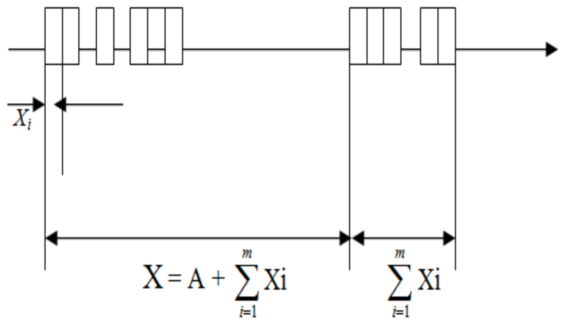

FIGURE 3

In Figure 3, X denotes the time between the control moments in a single monitoring session, A – the time interval between the moment of closure of the previous control session and the start of the next, X_i – the time of treatment for commands executed in a single control point, m – the number of control points in the session.

The generating function of the first generation is the function with respect to the duration of the monitoring process:

$$Q^{(1)}(s) = \exp(-X + X * s) . \quad (3)$$

The generating function of the second generation is a function that is determined by the probability parameter p - the probability of controlling with a single control point:

$$Q^{(2)}(s) = \sum_{j=1}^{\infty} p * [(1-p) * Q^{(1)}(s)]^{j-1} . \quad (4)$$

Substituting 3 in 4, we find that:

$$Q^{(2)}(s) = p / [1 - \exp(-X + X * s) + p * \exp(-X + X * s)] \quad (5)$$

The obtained expressions (4) and (5) make it possible to determine the average number of queries to the database for a single control session and monitoring of requests by the server. For overall assessment, a general model of requests service is considered below. A graph of the general model for incoming requests and their service by the database server is shown in Figure 4.

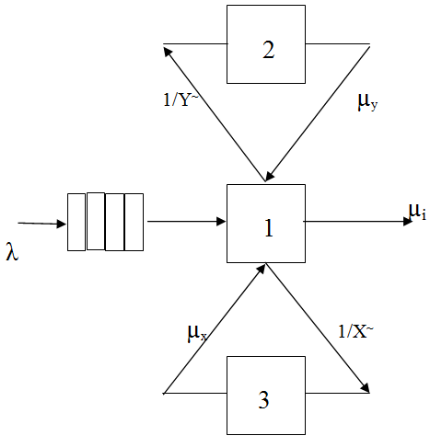

FIGURE 4

Here $Y^{\sim}$ is the average time of occurrence of failures, $X^{\sim}$ average time of control.

The system of differential equations describing the behaviour of the process of Scheme 4 is as follows:

$$d\left(p(0,1,t)\right)/d\ t = \mu_i p(1,1,t) - (\lambda + Y^{\sim} + X^{\sim}) p(0,1,t);$$

$$d\left(p(n,1,t)\right)/d\ t = \mu_i p(n+1,1,t) + \mu_x p(1,3,t) + \mu_y p(1,2,t) + \lambda p(n-1,1,t) - (\lambda + Y^{\sim} + X^{\sim}) p(n,1,t), n \geq 1;$$

$$d\left(p(0,2,t)\right)/d\ t = \mu_y p(1,2,t) - Y^{\sim} p(0,2,t);$$

$$d\left(p(n,\ 2,\ t)\right)/d\ t = \mu_y p(n+1,2,t) + {}+Y^{\sim} p(n+1,1,t) - (Y^{\sim} + \mu_y) p(n,2,t) n \geq 1;$$

$$d\left(p(0,3,t)\right)/d\ t = \mu_x p(1,3,t) - X^{\sim} p(0,3,t);$$

$$d\left(p(n,3,t)\right)/d\ t = \mu_i p(n+1,3,t) + X^{\sim} p(n+1,1,t) - (\mu_i + X^{\sim}) p(n,3,t),\ n \geq 1.$$

From the resulting system of equations, one can find the distribution of stationary probabilities of states $P(n,k)(n = 0,\infty,\ k = 1,2,3)$. Here, n is the number of requests in the system. The solution of this system can be found by using the method of substitution or by using the following generating function :

$$G_k(s) = \sum_{n=0}^{\infty} P(n,k) s^n, k = 1,2,3 \quad (6)$$

The values of the stationary probabilities $P(n,k)(n = 0,\infty, k = 1,2,3)$ determine the length of the queue to the server. By solving the above system of differential equations, and simplifying and taking into account the heterogeneity of services in accordance with the expression (1), we establish the following expression for the mean queue length on the server:

$$N^{\sim}_{servser} = [\lambda / \sum_{i=1}^{R} (\mu_i + 1/X^{\sim} + 1/Y^{\sim})] / [1 - (\lambda / \sum_{i=1}^{R} (\mu_i + 1/X^{\sim} + 1/Y^{\sim}))]. \quad (7)$$

5 Evaluation of database service downloads

Expression (7) makes it possible to estimate the average utilization of services in a client - server database in the presence of failures and recoveries. From the point of view of the efficiency of use of these devices, the important features are the dependencies of the queue lengths on the amount of client requests, that is, their work intensity. To account for these possibilities, in evaluating the performance of queuing systems, one typically introduces the concept of system load. Queuing system load is the ratio of the intensity of the incoming requests to the system to the intensity of their service. For our case - when the servicing system of a database server is used - this ratio takes the following form:

$$\rho = \lambda / \sum_{i=1}^{R} (\mu_i + 1/X^{\sim} + 1/Y^{\sim}). \quad (8)$$

Using the obtained expression (7) and the designation (8), we can construct a graph of how the length of the queue depends on the system load for the server and client parts of the database. These dependences - for different mixtures of requests in the server database - are shown in Figures 5 and 6.

On the graphs, the mixtures of requests to the server are related to the different types of queries. According to database theory, proposed by (Codd E.F 1970), the main types of queries are "Projection", "Intersection", "Selection" and "Union" queries. These are the most time-consuming ones from the point of view of their treatment by database management systems. On the presented graphs, the types of mixtures of requests are scaled in relation to the "Selection" type of query and are defined as follows.

The first type:

$$X^{\sim} = 0{,}3, Y^{\sim} = 0{,}4, \sum_{i=1}^{R} \mu_i = 0{,}5,$$

The second type:

$$X^{\sim} = 0{,}2, Y^{\sim} = 0{,}1, \sum_{i=1}^{R} \mu_i = 0{,}8,$$

The third type:

$$X^{\sim} = 0{,}1, Y^{\sim} = 0{,}08, \sum_{i=1}^{R} \mu_i = 1,$$

The fourth type:

$$X^{\sim} = 0{,}08, Y^{\sim} = 0{,}05, \sum_{i=1}^{R} \mu_i = 1{,}8.$$

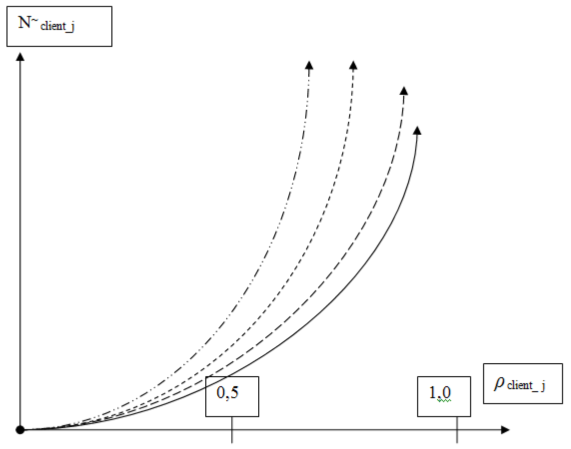

FIGURE 5 The dependence of the length of client service queues on the load

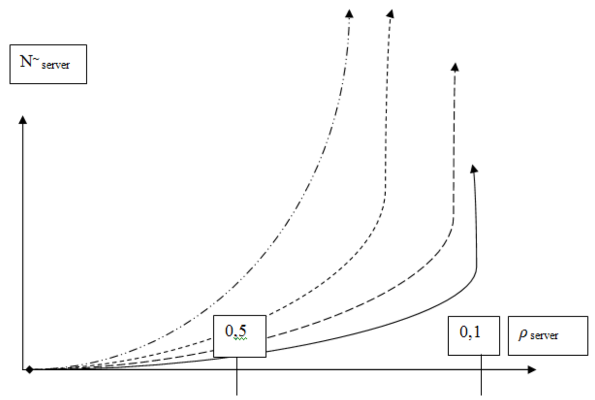

FIGURE 6 Dependences of the length of server service queues on the load

The first type of mixture is calculated based on the fact that the request pertains only to the "Projection". The second type includes "Intersections" requests. The third type includes "Selection" and the fourth type pertains to "Union".

The graphs show that the greatest load on the server comes from "Projection" type requests. When client - server systems are at a load around 0,8 – 0,9, variations in service delay time increase tenfold compared to a load of 0,1.

According to queuing theory [8], the length of the queue in the QS can be significantly reduced if the service discipline is changed. In our case, a rational change in the discipline of servicing is to apply heterogeneous services. The alignment of services in the queue can be changed, for example, by using the ORACLE database management system's utility QUEUE_SIZE. In [6], it is shown that, given the prioritising of query service, it is most advantageous to assign a higher priority to the shortest queries. To implement such a service discipline in the database server, one must insert a service type estimation block and a request service length estimation block. Then, using the utility QUEUE_SIZE, the service priority is assigned according to its minimum assign data length. Thus, it is possible to reduce the average queue length in a database server to 20 %.

6 New opportunities

Regular research carried out in Riga Technical University [9-11] present gradual criteria changes according to which the GPS service is selected. Low price and high quality of goods are undoubtedly the most important ones on the list; however, those are not desired characteristics, but rather the mandatory standard of a competitive service instead. Nowadays consumers pay more attention to additional criteria, such as time of delivery, possibility of getting ordered goods in the determined period as well as high-quality information maintenance of order delivery process.

Nowadays not all companies are able to offer delivery of goods to their clients on the day of order receipt (common practice is delivery on the following day). However, it is evident that presently service standards tend to become stricter and a company's position in the market depends on the ability to meet these standards.

Dispatcher services using the abovementioned modern systems obtain the following options for managing motor vehicles:

- analyse information and take decisions based on the data shown on the scalable electronic map;
- store data on the movement and status of the objects under control and prepare reports based on this information, including the data visualised on an electronic map;
- receive detailed reports about non-routing and emergency situations requiring operative response.

Furthermore, in case of an incoming call from a client the dispatcher has complete information about the status of the order at the present moment and is able to answer any questions, including the estimated time of arrival (this information can also be shown online, thus clients can get free access to it).

As a consequence the efficiency of vehicle use increases, transport logistics improve; transport management is carried out, strict control is implemented over improper vehicle use and the number of failed deliveries decreases which enables the company to reduce the "order-delivery" cycle and improve the level of services provided to the clients accordingly.

7 Problems with Evaluating Efficiency of motor Vehicle Monitor Monitoring System by using GPS

One of the main problems in improving the efficiency of GPS use in the motor vehicles is the problem related to evaluation of efficiency of such systems. Efficiency of these systems can be evaluated by mathematical calculations using queuing systems. The vehicle GPS signal receivers as such can be interpreted as separate systems of queuing which receive queries about their locations from the system dispatcher. GPS signal receivers can generate queries to the system dispatcher. Management of queries received from GPS receivers is shown in Fig. 7 as a schematic image from the perspective of queuing. Each queuing system shown in Fig. 7 is a device that manages the GPS queries. Queries are managed on a first in, first out basis in rotation and return from GPS receiver to a dispatcher, then they are transferred back to GPS receivers from a dispatcher. One of the characteristics of this query management scheme is the availability of different rules on query management by GPS receivers. This diversity on one part can be explained by diversity of queries and the diversity of the receivers' characteristics. Unfortunately, in terms of applying queuing systems, the network device diversity is recorded extremely rarely or considered if there is a correlation between the rules on query behaviour when queuing for service and the diversity or with other queues [10–12].

As to GPS efficiency evaluation, cases should be taken into consideration when the types of queries do not depend on the status of query in the queue. Therefore this research suggests characteristics calculation method for GPS systems on the basis of the assumption that management in the network nodes is subordinated to management rules.

Approbation for use of this method for corporate computer network analysis is reflected in various works of the authors [8 - 10]. Along with analytical researches presented below, the authors carried out the experimental methods of GPS system assessment [13] and the researches based on simulation modelling methods [14]. This research suggests selecting the mathematical tool of queuing stochastic networks as a basis for studies of the characteristics of GPS receiver network consisting of several nodes. In these networks, queries can select a network node for management randomly. It is suggested to perform the analysis of computer networks first based on the fundamental queuing system with the hyper-exponential management law and the superposition of Poisson query stream acting at the system input and then a transition to a stochastic network of queuing systems takes place. This method enables studying the networks with hierarchical organisation of the structure where subnets can be used as service units.

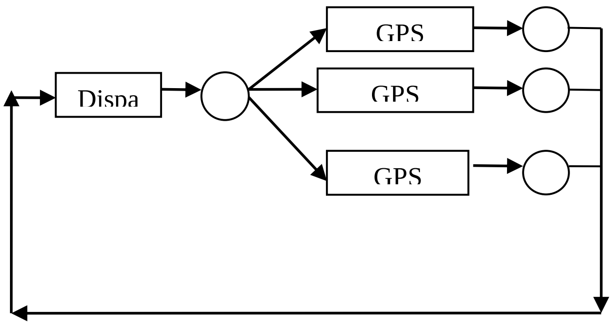

FIGURE 7 GPS receivers

The closing system mentioned above, may have peak periods in which traffic is very heavy, so that queues build up which, however, are taken care of later in the system. We may then be interested in total throughput or in peak like maximum queue length. In all those examples the only way to interested in the steady state response of an on-line computers networks can we chose between replicating run and continuing one long run. We feel that in practical studies steady state, off-line computer networks are an exception, where as in theoretical studies such systems prevail.

If we replicate runs and new set of random numbers for each run then each run yields one independent observation, e. g. the average waiting time in run “1”, then:

$$x_i = \sum_{j=1}^{m} w_{ij} / m \ , \tag{9}$$

where w_{ij} denotes the waiting time of customs j in run (I=1,2…n).

Traditional techniques can be applied to estimate the standard deviation of the response:

$$Z_x = \sqrt{\sum\nolimits_j^n (x-x)/(n-1)}\ . \tag{10}$$

In this equation we forget how x_i was composed individual observation w_{ij}

As initial conditions for on-line computer networks we simple take the nature.

Al conditions:

- Replicated runs yield independent observations so the analysis problem, problem standee-state behavior and problem off-line computer networks simulation.
- The practical problem is to detect whether the system one is simulating has such renewal states. There are also some diagnostically and statistical estimation problems, since the point confidence intervals are not using straightforward formulas like equations (10).
- For a single prolonged run we distinguish 2 approaches: the measurement extractor and the analysis tools.

7 The Measurement Extractor

The goal of this tool is an on -line collect of information in the Operations Systems computer networks. A listing might be received with a monitoring in the computer networks. Statistics we can be gathered at three levels:

The user job level - here we can measure the programs called for job step: compilation, execution, lines printed etc., the run time option selected and called diagnostics;

The system level – here we measure job traffic, service time, resource allocation, job and task queue lengths;

The I/O level – here we measure channel and I/O equipment activities.

They are suggested from analytical and simulation models of the on-line and off-line computer networks and of workstations and console lights and from reflection on what parameters are likely to be important. The general approach is essentially that of a diagnostic there is a transfer of control to a routine, which collects data and stores it for later analysis. The sampling rate and amount of data collected must be low enough so that the overhead due to the monitoring is acceptable. We distinguish two types of monitoring computer networks: system accounting programs and periodically run or to obtain information off packages programs. The accounting programs and periodically run must be some special problem.

The normal accounting information which cam users and is collected in computer network for billing is an extremely rich source of data for monitoring process. But the information from billing source is not full. An accounting programs cam a very detailed profile of user job with rude precessions.

Most of equation (10) observable can by means of packaged software monitoring, but at greater cost in time. The problem software monitoring it is operating employing program in the same option operation system of on-line and off-line computer networks. The software monitoring is not yet used regularly and it must be installations by loading important program modules. Several kinds of collect subroutines are considered, we give below the list collects programmed in the current version.

A. Evaluation of the load workstation: operator dialog; batch processing commands; primary and secondary commands; steps accounting; supervisor calls.
B. Evaluation of the files manipulation: logical input-output; opens and closes of files.
C. Evaluation of the task management: workstation queues; system task activity; utilities and command for workstation activity and queues in the system activity.
D. Evaluation of the computer utilization: CPU occupation; peripheral and channel occupation and core memory occupation.
E. Evaluation of the system reliability: system error; server's errors; user aborts and various value overly.

8 The Measurement Extractor

A measurement off-line and on-line computer networks accompanied of analysis. The analysis tools importance was often undervalued. These essential problems of analysis measurement in off-line and on-line computer networks are:

- Probability, in order to perform analysis on different computer or network systems;
- Easy modification, because results of a first analysis may conduct to modify several parameters for the next analysis;
- Easy utilization, because this tool is used on various centres.

The detecting system will be assumed in the standard monitoring mode. The monitoring mode may be described as follows on Fig. 8.

It is assumed that requests for monitoring and failures occur according to two processes. The time sharing those processes shout of the Figure 9. One process it is independent failures Poisson process of rate λ=1/Y. Y it is average time of y=a+b. Second process it is monitoring process. A monitoring process may be assumed from Geometrical process of rate p=1/x. X it is average time from equation (9).

The date base system under monitoring mode of operation can be considered as a server to request for monitoring system (for example in server of Oracle).

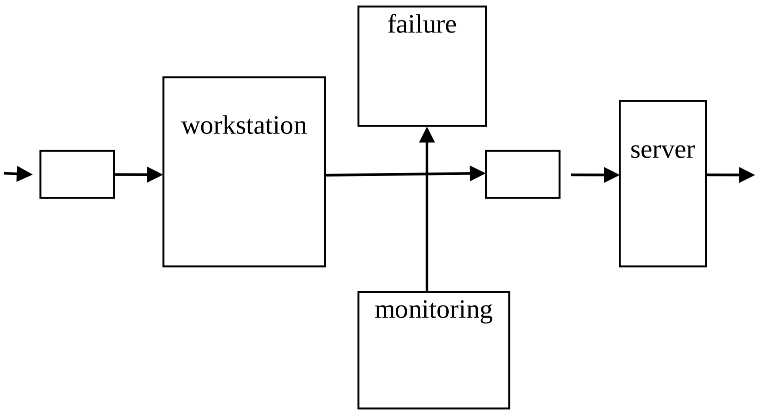

FIGURE 8 Described monitoring mode

The stationary probability distribution for the data base monitoring system can be obtain for generating function which has many generation. For Figure 9 stationary probability can be obtain for generating function which has two generations.

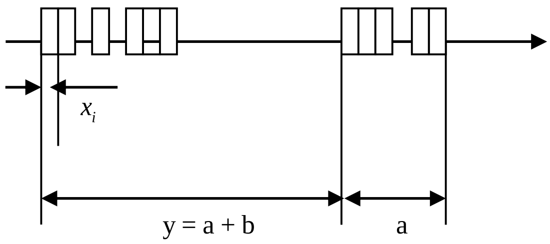

FIGURE 9 Generating function which has two generations

First generation function it is generation function from failure process. This is function can be obtain of equation:

$$Q^{(1)}(a) = \exp(-\lambda + \lambda * a) . \tag{11}$$

The generation function for monitoring process it is function of second generation. For geometrical distribution this is function has equation:

$$Q^{(2)}(b) = \sum_{j=1}^{\infty} p * [(1-p)*Q^{(1)}(b)]^{j-1} . \tag{12}$$

This is equation it is geometrical progression from which we will give expression for general function of monitoring process:

$$Q^{(2)}(b) = p / [1 - \exp(-\lambda + \lambda * b) + p * \exp(-\lambda + \lambda * b)] . \tag{13}$$

This is result give become equation from arrival number measurement for one monitoring séance.

From equation (13) describing state transitions and distribution stationary probability f the system measurement, bet we showing the becoming the arrival number measurement and standard deviation for this number. The described the arrival number measurement for one séance measurement can be becoming from first derivative equation (13) for s=1. From this transformation we have:

$$\begin{aligned}\alpha_{(s=1)} &= dQ^{(2)}(s)/d(s) = \\ & d\{p/[1-\exp(-\lambda+\lambda*s)++p*(-\lambda+\lambda*s)]\}/d(s) = \\ &=[(p-p^2)*\exp(-\lambda+\lambda*s)*\lambda\ ]/[1-\exp(-\lambda+ \\ &\lambda*s)+p*\exp(-\lambda+\lambda*s)]=[(1-p)*\lambda\ ]/p\end{aligned} \quad (14)$$

For described the standard deviation can be becoming from second derivative equation (13) for s=1.

Skip the operations of derivative we have:

$$\begin{aligned}\psi_{(s=1)} &= d^2Q^{(2)}(s)/d(s)^2 \\ &=[(1-p)*\lambda*(2-p)]/p^2\end{aligned}.$$

The different of measurement system have different values and have the different parameters, bat the different characteristics this system can be design in statistical terminology for equation (13) and (14). In this paper we discuss selected analysis and measurement that seem of practical use in the design and diagnostic off-line and on-line computer network in general. The equation (14) given use compare several off-line and on-line computer networks.

9 Summary

The organisation which is focused on the long-term business activity and the quality of its processes must follow development trends in the information technologies, make progress in this area and react timely to the changes in this area in order to optimize its processes and increase the overall work efficiency.

During the last few years organisations have had huge amounts of unstructured content, including documents, e-mail messages, video clips, instant messages, web-sites and many others. This information is often in disorder which prevents the organisation from using these valuable assets efficiently in order to share knowledge, improve relations with its clients and increase efficiency of processes.

Many companies currently have the following widespread issues:

- processing of and search for documents is not efficient and requires too much time;
- business processes are not managed efficiently;
- lack of an integrated information source or its insufficient activity;
- increase of costs related with compilation, copying, sharing and storage, as a consequence, the company suffers from the inefficient work organisation.

Implementation of a GPS system in a company is a complicated and time-consuming process requiring a tedious analysis, studies and thorough preparation.

Eventual risks should be precisely assessed during implementation of automation systems as it is in any management process. Risk evaluation is an important stage of work. Adequate selection of the system, implementation terms, costs and further use of the selected system by personnel depends on this stage. Apart from the eventual risk evaluation the manager should calculate risk probability and severity and elaborate a plan for minimizing all of assessed risks.

This research also demonstrates risk management in case of GPS system implementation as a case study of a particular organisation. For instance, the risks that are ranked as medium status “Improper GPS system, strategy” and “Work interruption” have the following indicators: 0.08 and 0.10 accordingly.

Implementation of a new company content management system has also revealed the necessity to upgrade the employees’ qualification. This matter can be solved by organizing special trainings. Moreover, various levels of motivation, such as salary revision, payment of bonuses, bonus system and free education are offered in order to increase responsibility of the company’s employees and willingness to master the new system faster and with a serious attitude

As a result of studies of the offers in the GPS system market, individual needs of the company, risk analysis and evaluation and proposed measures to minimize them, experts’ evaluation of the organisation’s maturity level and necessary optimization calculations, the decision was made to use web-sites for the project implementation. The expert group acquired the following result when evaluating the significance of the most important advantages as per the degree of their significance:

- reduction of the time spent by employees - 94%;
- business process optimization - 84%;
- improvement of the employees’ work quality - 81%.

Determinant choice criteria were (as per the degree of significance, according to the evaluation of the expert group): project payback rate - 93%, low maintenance costs - 78% and functional characteristics of the system - 77%.

Implementation of GPS system provides significant advantages; however, this process is rather complicated, as various factors have to be taken into consideration. Further effect is mostly determined by the adequate choice of the system and the realization of the implementation process. If the system is selected correctly and the implementation process is carried out successfully, the employees of the organisation are able to use their working time more efficiently and do more work thanks to the reduction of time for routing operations. The systems also enable optimizing activities of particular departments and the organisation as such and obtain analytical information which is used for making various important managerial decisions.

10 Conclusion

This paper presents a study of database load. A service interactions model is developed. Expressions for estimating the load of the database server are derived both for working conditions without and with failure recovery. It is shown that services have properties of varying degrees of load of the nodes in the network, i.e. the properties of heterogeneity. Constructing mathematical models allowed us to make the calculations of average services' queue length to the database. These calculations showed that the database server can function catastrophically badly if run with a load of close to 0,9. Improving the efficiency of services can be achieved using heterogeneous service disciplines. The performed calculations have shown that the expected time gain in using services by network servers through the selecting the optimal load of network nodes and application of heterogeneous services can exceed 20% .

The polls carried out show that the use of modern positioning systems for transport and motor vehicle control systems is economically feasible.

Thus, it is evident that the economic effect from their implementation in large companies performing thousands of deliveries every day will definitely exceed the costs for its purchase, implementation and maintenance. Furthermore, it will be much easier to manage the transportation company.

Development of an integrated transport management system enables to solve a local task of reducing the "order-delivery" cycle and creating a positive image for the company in the eyes of the clients due to accurate execution of undertaken obligations related with order execution terms, minimization of the delivery failure risk and the opportunity of creating a flexible feedback system.

References

[1] Codd E F 1970 Relation Model of Data for Large Shared Data Banks **13**(6) 377-83

[2] Boicov V 2009 *Automatic Control and Computer Sciences* **43**(3) 123-8

[3] Boicov V 2009 *Automatic Control and Computer Sciences* **43**(6)303-8

[4] Kumar V 2001 Introduction to Database Systems Database Recovery. Department of Computer Networking University of Missouri-Kansas City 80

[5] Gelenbe E Derochette D 1979 *Performance of rollback recovery systems under intermittent failures* **21** 493-9

[6] Boicov V 2012 *Automatic Control and Computer Sciences* **46**(3) 112–8

[7] Boicov V 2011 *Automatic Control and Computer Sciences* **45**(6) 201–5

[8] Kleinrock L 1979 Queuing systems Computer application University of California Los Angeles **2** 600

[9] Belinska V Boicov V Kluga A 2008 *Telecommunications and electronics* **8** 48 – 51

[10] Boicov V Semjonova V 2008 *Conference Information Technologies and Management* ISMA 27 – 36

[11] Kluga A Kluga J Semjonova V Grabs E 2008 *Electronics and Electrical Engineering* **6**(78) 69-72

[12] Kluga A Grabs E Zelenkovs A 2008 *Telecommunications and Electronics*

[13] Gross D Shortle J F Thompson J M Harris C M 2008 *Fundamentals of queuing theory* 512

[14] Fokkink W 2007 *Modelling distributed system* 156

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