A Logical Structure based Reliability Evaluation Model for Information Systems and its Application

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Abstract. In order to evaluate the reliability of information system with hybrid structure, a logical structure based reliability evaluation model for information systems is proposed for assessing hardware and software reliability for information system, in which the hybrid structure is used to architecture the reliability model, and the reliability value is used to quantitatively describe the reliability of information system. And then the NGBOSS architecture and its core processes is described. Furthermore, a reliability evaluation result is obtained by collecting and analyzing the date of two sub-processes of the core from China Mobile Group Guangdong Co., Ltd.

Introduction

The reliability of information systems include a number of quality characteristics, such as correctness, maturity and fault tolerance, etc. It takes the frequency of problems into account and involved running experience and the influence of errors directly. The measure of reliability refers to performed quantitative measurement to the given property which belongs to the system and can affect the system, including the reliability of hardware and software [1].

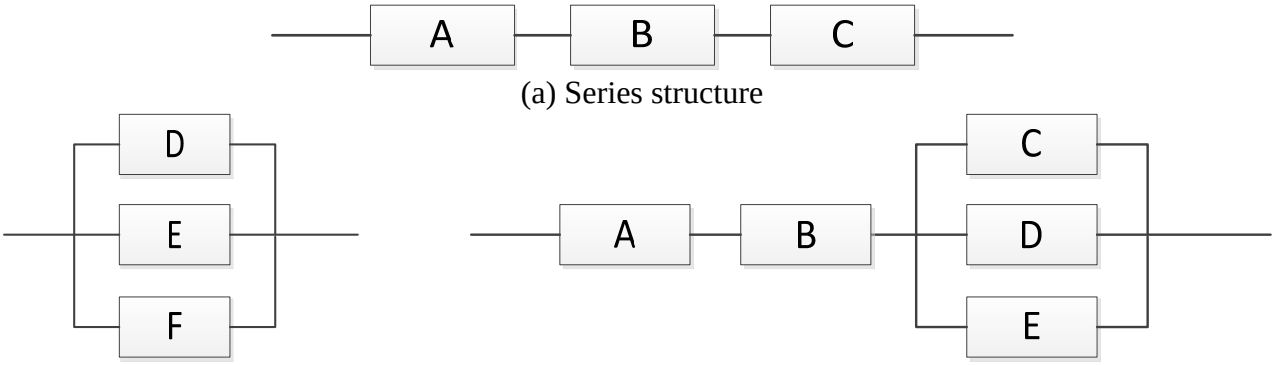
NGBOSS (Next Generation Business Operation Support System) is China Mobile's new generation operation support system. One of the major differences between NGBOSS and former business operation support system is ABM (Account Balance Management), which established a unified view for pre-pay mode and post-pay mode from a management perspective by the new mode of billing system. The burden of huge user date, however, has created a great challenge to the billing system. The research of reliability in billing system of NGBOSS is of great significance under such a background [2].

Fault type of information system and the evaluation method of reliability

The failure of information systems is divided into hardware failures and software faults in general. The reliability evaluation of information system, therefore, is divided into hardware and software evaluation. There are significant differences between the two evaluation methods as they failed for different reasons. Hardware failure is usually caused by the aging of components, and software failures are often due to design defects or overloading the computational load, etc. Therefore, it is needed to make a distinction on the type of fault before to design the evaluation method of reliability in information.

Hardware failure of information system and the reliability evaluation. There are a variety of reasons that produce hardware failure including hardware unstable, aging of components and hardware affected by adverse environment.

For the information system threatened by hardware failures, the reliability can be evaluated from the association between single-unit hardware and the other hardware, in the general, the hardware structure can be treated as a hybrid structure of series and parallel [3]. Fig. 1 shows three types of hardware connections in general.



(a) Series structure

(b) Parallel structure (c) Hybrid structure

Figure 1(a) represents the hardware series structure, in which each component's failure can cause the failure of entire structure. The reliability of this structure is the product of the reliability of each component.

$$R = R(A) * R(B) * R(C) \quad (1)$$

Figure 1(b) represents the parallel structure of hardware, in which each component failure will not cause a system failure, and this structure has the characteristics of disaster tolerance. The reliability of this structure can be represented as the following formula.

$$R = 1-(1-R(D)) * (1-R(E)) * (1-R(F)) \quad (2)$$

Figure 1(c) can be seen as a hybrid structrue, and the reliability of the system described in it can be represented as the following formula.

$$R = R(A) * R(B) * [1-(1-R(C)) * (1-R(D)) * (1-R(E))] \quad (3)$$

Software failure of information system and the reliability evaluation. The quality of software is connection with a lot of factors, including the development environment of software system, the complexity of functionality, the level of production management, the quality of the developer and the material of software production (the development time, funding etc.). A narrow understanding of the reliability of software system is that the probability of failure-free operation of software in a specific operating environment and a specific period of time.

The reliability evaluation of software can be carried around different perspective, one is evaluated by the structure of software, and the other is evaluated by a model which is based on reliability evaluation. The method used by the former is similar to the method of hardware reliability analysis [4], and the latter is though selecting the evaluation model to fit the software, and to use the definitive algorithm to obtain the reliability indicators of software.

The determinants of reliability of software is the error of software which is connection with input data, is a function of data and the state of internal program, which can be measured by the probability of fault $\lambda(t)$(the probability density of failure in the dimension of time), or reliability $R(t)$(the probability of failure does not occur within the time interval [0, 1]) [5]. Addition to the single process reliability, the more important indicator to calculate the reliability in software is the reliability of the software as a whole, which requires analysis of the structure of the software. It should be treated differently when calculate the reliability between the different information system, since different systems concerns different focus.

An application of reliability evaluation to billing system of NGBOSS

The architecture of billing system in NGBOSS is shown in figure 2.

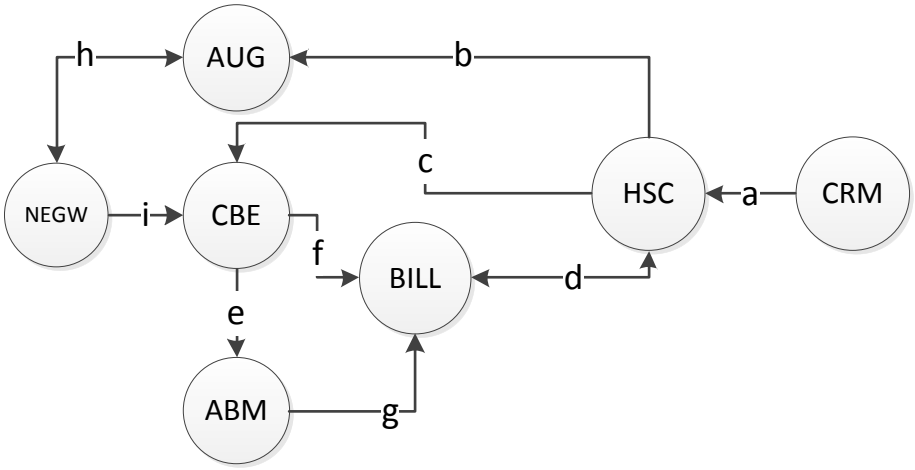


Fig. 2 NGBOSS architecture

In the starting of the process, the billing system of NGBOSS synchronize user's ordering information from CRM to HSC (a database used for store the user's basic information), and AUC (Authorization Center), CBE (Charging and Billing Engine) and BILL (integrated management platform of bill) update their information through refreshing the memory separately from HSC subsequently. Then CBE designated price for the real-time consumer bills of the products authorized by the AUC-p0 from NEGW (Network Element and Gateway), and change the balance in ABM according to the price be designated. Ultimately, BILL will generate consumer records according designated price and movements of balance.

Such a design make a step forward compared to the previous generation billing system of China Mobile Group Guangdong Co., Ltd. The key pointed of reliability in billing system of NGBOSS, from the perspective of security, can be considered as the reliability of synchronization for user's data, since the charging function of NGBOSS is implemented depended completely on the data's synchronization of the databases of the different functional modules, to a system, in particular, which has an amounts of data owned. We, therefore, can evaluate the reliability in the billing system of NGBOSS through evaluate the reliability of information synchronization between the different subsystem [6].

In actual operation, we take months to be time unit to measure reliability, since the accounts of China Mobile's customer are settled on a monthly basis generally, and get the reliability of sub-process through examine the consistency of user information in different sub-modules per month. **Instance of reliability evaluation for sub-process between CRM and HSC.** Taking into account that the amount of data in the database is too large to collect and calculate, so we use the sampling method to data acquisition, and according to a fixed product categories, fields and time limits to extract. The data between the different modules will be used to compare to calculate the reliability.

Table.1: Comparison between CRM and HSC for ordering information.

Ordinal	Data Description	Data Count Of CRM	Data Count Of HSC	Data Count Of Deviation	Reliability
1	User who ordering and using a product A in April	32190	32190	0	100%
2	User who ordering and using a product B in April	11032	11031	1	99.991%
3	User who ordering and using a product C in April	1188	1190	2	99.832%
4	User who ordering and using a product D in April	1113062	1112285	1530	99.863%
5	User who ordering and using a product E in April	20929	20922	7	99.967%

Table.2: Comparison between HSC and CBE for ordering information.

Ordinal	Data Description	Data Count Of HSC	Data Count Of CBE	Data Count Of Deviation	Reliability
1	User who ordering a post-pay product A in April	338258	338254	4	99.999%
2	User who ordering a post-pay product B in April	84720	84713	7	99.992%
3	User who ordering a post-pay product C in April	318	318	0	100%
4	User who ordering a post-pay product D in April	9881	9880	1	99.990%

Conclusion

Reliability evaluation of information system is a complex problem of systems engineering, and it need us to have a deep understanding of the system structure, to have sufficient understanding of the various process in the system, and to calculate the reliability according to the truth of the system. There is no an evaluation method can be used for all systems.

This paper presents an approach to evaluate the reliability of telecommunications billing system, does not make a comprehensive evaluation of billing system of NGBOSS. Judging from the current practical results, this is an effective idea and method to evaluate the billing system in NGBOSS.

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