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Service Level Agreements and dependability

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Abstract. *The Service Level Agreement (SLA) is an efficient and proven tool for regulation of the relations between the supplier and the user of services that is designed to ensure their quality. Such agreements are well known and successfully used in the information and communication industry. They are also applicable in other areas. Essentially, SLA stipulates certain requirements for the service level of which the fulfilment is guaranteed by the provider. In case of SLA violation the service provider is usually financially liable. As a rule, in such cases the user is remunerated with a discount for services provided in the following accounting period. Dependability requirements are an important part of the SLA. The purpose of this paper is to familiarize a wide range of experts from various industries with the general matters of SLA application and the aspects related to the dependability requirements specification. The paper refers to the relevant documents of international standardization organizations (ITU, ISO/IEC, ETSI, TMForum) and the Russian standards. Recommendations are given for selecting the dependability indicators and standard values to be included in the SLA, as well as for defining the amounts of compensation payed by service providers to the customers in case of non-compliance with requirements for the availability factor. The availability factor is normally used in the SLA as the primary dependability indicator that defines the allowable total time of non-operability over the specified base period. Additionally, a client might be interested in restricting the duration of each individual downtime as well. For that purpose, the guaranteed recovery time can also be specified and exceeding this time would be deemed an SLA violation. The choice of the standard values for inclusion in the SLA is a search for a compromise between the intent to satisfy the user requirements and the wish to get ahead of the competition on the one hand and the requirement to ensure the feasibility of the assumed obligations and minimize the risk of SLA violation that involve financial and reputational losses on the other hand. Therefore, before proposing an SLA to a customer, a service provider must thoroughly analyze its actual ability to make sure that the probability of SLA requirements violation is sufficiently low. The computational or computational and experimental methods are suggested for its evaluation. The amount of compensation for a violation depends on its gravity, i.e. the achieved and the standard values of an indicator. In practice, this relation is usually expressed with a step (piecewise constant) function. A formula is proposed that expresses the theoretical relation between the relative amount of compensation for violation of the availability factor requirements and the severity of violation and the standard value of this indicator. It can be used in defining the technically substantiated reference for SLA conditions development and assessment, of which the value will be relevant to both the service providers and users.*

Keywords: *Service Level Agreement, standards, dependability indicators, availability, compensation.*

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The Service Level Agreement (SLA) is a tool to regulate the relations between the supplier and user of services that is designed to ensure their quality. Such agreements are well known and successfully used in the information and communication technologies (ICT) industry. Essentially, SLA stipulates certain requirements for the quality of service of which the fulfilment is guaranteed by the provider.Dependabilityrequirementsareusuallyamongstthem.

There are many publicationscovering the application of SLA in ICT (including several articles by the author [1-6]). However, such agreements are also applicable in other areas.In particular, [7]indicates the utility of their use in the housing and communal services, while[8]suggests the power supply services.Nevertheless, SLAs are generally little known outside the ICT industry.

The purpose of this paper is to familiarize a wide range of experts from various industries with the general matters of SLA application, relevant international and Russian regulatory documents, aspects related to the SLA dependability requirements specification. In particular, recommendations are given for selecting the dependability indicators and standard values to be included in the SLA, as well as for defining the amounts of compensation payed by service providers to the customers in case of non-compliance with the specified requirements.

The following documents of international industry organizations are devoted to the SLA application in telecom munications:International Telecommunications Union (ITU) Recommendations E.860 [9] and M.3342 [10],European Telecommunications Standards Institute (ETSI) Handbook EG 202009-3 [11], TM Forum (formerly TeleManagement Forum) HandbookGB917 [12]. A Russian standard was developed[13] based on these documents and the considerations outlined in [2].

In the informationtechnology (IT) industry the so-called InformationTechnologyInfrastructureLibrary(ITIL) became ratherwidespread. It was created in the second half of the 1980s by the order of the Great Britain Government and describes the best practical ways of organizing the work of companies or business units providing IT services.The process approach used in it complies with the ISO 9000 series standards.The seven volumes of the library describe the entire set of processes required to ensure the quality of IT services and the satisfaction of their users. The SLA application is amongst them.

Based on the ITIL, the British standard BSI 15000 was developed and was later adopted as an international standard ISO/IEC 20000 withalmost no changes.This standard consists of several parts, for the first two of which there are identical Russian standards [14, 15] ([15] is the translation of the ISO/IEC version of 2005, replaced with a new one in 2012).

Unfortunately, there are a number of terminological remarks to the standards [14, 15]. Firstly, they are not fully consistent, which is evident even in their names: the term “service management” is translated to Russian differently in [14] and [15]. Secondly, the translation of “SLA” in them is less logical and does not correspond with the term previously agreed in the telecommunications industryand stipulated in the standard [13].It is also worth mentioning that there is a third “SLA” translation in some publications.Another terminological flaw [14, 15] will be considered below.

As mentionedabove, SLA typically includes dependability requirements.Here one should pay attention to a certain inconsistency: SLAs are dedicated to services, but in the Russian [16] and international [17] standards dependability is defined as a property of a technical object.The idea that undertoday’s conditions the concept of “dependability” should be extended to services has already been suggested (see, for example, [18]).The dependability of services is actually mentioned in the ISO/IEC 20000 standard and in several ITU Recommendations, the dependability indicators of gas transportation services are officially set forth in Russia [19].

However, within the framework of existing standards, we have to deal with a specific object, when considering dependability. The solution to this problem proposed in [20] is as follows. For each service, the so-called service frame is defined, that is a set of technologies involved in the service rendering. This service frame is the object, the dependability of which should be considered. Note that this method is not a pure formality, since it is still necessary to define the service frame, in particular, to calculate dependability at the design stage.

The main dependabilityindicatorused in the SLA is the availability factor(K_a). It can be viewed as the fraction of the availability time during the baseperiod. Let ussuppose that the standard value $K_{as} = 0.995$, and the baseperiod is one month (30 days).Then the allowable downtime (time of nonoperability) per month is $30·24·(1 – 0.995)$ h = 3.6 h. Thus, if the total downtime per month does not exceed 3.6 hours, the SLA requirement for the availability factor is considered to be met, if it exceeds this value, there is a violation of the SLA.

Pre-planned periods ofmaintenance, measurement, switching, software updates,etc.are usually excluded from consideration. This corresponds to the definition of the availability factor [16].A note specifies that planned periods when the object is not used as intended can be excluded from consideration.This fact should be taken into account when drawing up the SLA wherethe frequency and duration of such planned interruptions in work should be stipulated.

Speaking of the availability factor, there is one more terminological inconsistency.In many publications in Russian, the term “availability” is translated in a way that is appropriate in a common parlance but does not correspond to the fixed term in the dependability theory. In addition, in telecommunications there is the term “accessibility”, which is translated into Russian in the same way. The existence of two different concepts of the same term leads to confusion. This terminological misunderstanding was considered in detail in [21].

Unfortunately, that inexact translation is used in standards [14, 15]. One can also reproach the developers of the ISO/IEC 20000 standard, where instead of coming up with their own definition of "availability" they should have used the definition from the international terminological standard with reference to it (at the time of development of ISO/IEC 20000 such standard was IEC 60050-191:1990, the precursor of [17])as prescribed by the standardization rules.

Besides the total downtime that characterizes the availability, a client might also be interested in restricting the duration of each individual downtime as well. For that purpose, the guaranteed recovery time can be specified and exceeding this time would also be deemed an SLA violation. Sometimes average recovery time is suggested for restricting the duration of downtime, however this indicator has a serious drawback that many meancharacteristics share:a long downtime can be compensated by a large number of short ones.Moreover, the normalization of the average recovery time can provoke a service provider into arranging several short breaks in order to compensate for the long downtime that has already occurred.It was mentioned in [22] that using the average recovery time as the standardized dependability indicatoris unadvisable.

An approximate algorithm of choosing the standard values for inclusion in the SLA was given in [2]. The solution to this problem is a search for a compromise between two conflicting aspirations. On the one hand, the intent to satisfy the user requirements and the wish to get ahead of the competition makes service providers set the standards high, but on the other hand there is the requirement to ensure the feasibility of the assumed obligations and minimize the risk of SLA violation that involve financial and reputational losses.

Therefore, before proposing an SLA to a customer, a service provider must thoroughly analyze its actual capabilities. It is also important to be able to evaluate the probability or rate of each SLA requirement violation in order to make sure that it is sufficiently low. If these characteristics prove to be unacceptable, then one has to lower the requirements or take measures to increase dependability. Since failures are rare in a well-functioning system, a direct experimental evaluation of the violations probability may take too long. Therefore, in such case it is reasonable to use the computational or computational and experimental evaluation methods for which the relations proposed in [3] can be used.

In case of SLA violation, the service provider is usually financially liable. As a rule, in cases of violation the user is remunerated with a discount for services provided in the following accounting period. The amount of compensation depends on the violation severity, i.e. how much the actual value of the indicator differs from the standard one. In practice, this relation between the amount of compensation and severity of violation is usually expressed with a step (piecewise constant) function. The following example is given in [9]: if the difference between the standard and the actual value of the availability factor expressed as a percentage is less than 2%, then the discount will be 15% of the rate, if this difference is 2 to 4%, the discount will be 30%, if the difference is more than 4%, the discount will be as high as 50%.

In practice,the amounts of compensation stipulated in SLAs vary significantly depending on the service provider (specific examples for communication services are given in [2]). To a large extent, they are determined by marketing policy and market conditions. Nevertheless, it is useful to be able to define the technically substantiated amounts of compensation that could be used as reference for SLA conditions development and assessment. This information can be relevant to both the service providers and users. In [4], a formula that expresses the relation between the amount of compensation for violation of the availability factor requirements and the severity of violation and the standard value of this indicator was proposed. It can be written as:

$$p = [1 - \log(1 - K_a)/\log(1 - K_{as})]\cdot 100\%,$$

where$p$is therelative amount of discount expressed as a percentage, $K_a$andK_{as}arethe actual and the standard values of the availability factor ($0 < K_a \le K_{as} < 1$), logarithm can be of any base. For example, if $K_{as} = 0.99$ and $K_a = 0.98$ than $p = 15\%$.

The main conclusions of this article are:

SLA is an efficient and proven tool for regulating the relations between the providers and users of services that is designed to ensure their quality. The application procedure for it has been established in a number of international and Russian standards.

Essentially, SLA stipulates certain requirements for the service level of which the fulfilment is guaranteed by the provider. In case of SLA violation the service provider is financially liable.

Dependability requirements are an important part of the SLA. The availability factor is normally used as the primary dependability indicator that defines the allowable total time of nonoperability over the specified base period. Additionally, the guaranteed recovery time can be specified.

The proposed formula expresses the theoretical relation between the relative amount of compensation for violation of the availability factor requirements and the severity of violation and the standard value of this indicator. It can be used in defining the technically substantiated reference for SLA conditions development and assessment.

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