

Analysis of Citizens' Appeals in Heterogeneous Web Services

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Abstract. The article contains the material on solving the problem of citizens' confidence in the authorities. Considering the problem, attention is focused on increasing the number of citizens' appeals. The method of using different types of online communities to create citizens' appeals is substantiated. The rules for submitting information in online communities are analyzed. The importance of the reliability, completeness and objectivity of the provided information. The value of user registration to create a database. It is analyzed what online community information can be used to create appeals. After all, work in the social network group requires some prior approvals: registration and compliance with rules. The importance of data on the source of the information on which the request was made, namely: the name of the online community, its type, subject, and rating in the system of processing appeals of citizens. For a better understanding of a process is created the formal model of the author of appeal. There are presented methods that will help determine the level of trust in the author, such as monitoring, attestation, organization and personification. Each of these methods is described. Areas of use and factors that are necessary for their implementation.

Keywords: Web Service, Online Community, Citizens' Appeal, E-Governance, E-Democracy.

1 Introduction

In the transition to e-governance and e-democracy, the leadership of public authorities faces the problem of a low level of public confidence in the activities of the authorities. There are also situations where it is necessary to increase the number of appeals of citizens to the authorities [1, 5]. In particular, this applies to those cases where it is necessary:

- To increase the workload of the employees of the relevant departments and services of the authorities in connection with a small number of appeals from citizens. Such incidents happen when a society has a low level of trust in the authorities, and

therefore citizens exchange information or share their problems in online communities;

- To investigate the state of affairs in a certain direction of activity of the authority. To do this collecting information in online communities based on certain criteria that are relevant to the direction of the government.
- To improve the level of work of the authority, namely – the search for new social problem areas that require the intervention of government officials – thereby increasing the level of public confidence in the authorities.

An effective solution to this problem is the use of an advanced level of implementation of the system for processing citizens' appeals. The realization of this level consists of the creation of the system for search, revealing and formalization of citizens' appeals based on information from users, which is contained in the posts of various online communities. Detection and processing of explicit and implicit appeals of citizens are necessary for online communities, as it enables more precisely outline the range of questions and problems that concern citizens [2, 7, 8]. The availability of such information in online communities is due to the properties of the communities themselves and their content, namely [9]:

- The participation a large number of people in online communities provides the opportunity for "wide informing", that is, the publication of the appeal in the online community allows for a high level of public response;
- The main function of online communities is providing communication capabilities between their members, that is, the online community is a communicative platform for sharing thoughts, experiences, advice, etc. Therefore, when looking for ways to address certain, for example, housing and communal problems, citizens turn to the experience and advice of participants in online communities.
- The presence of a history of the social and communicative connections between the members of online communities, on the basis of which the level of trust in the information content of each participant is determined, provides the opportunity for verification and communicative filtering of questionable, unlikely or provocative appeals.
- The online community is a heterogeneous Internet environment because it includes various forms of user communication and ways of presenting content.
- Each type of online community has its own peculiarities of information representation (contextual and thematic content).
- Based on these features, we distinguish the following types of online communities: social networks, web forums, and commenting systems (including feedback systems, for example, with readers of news sections in electronic media).

By appointment and variety of topics covered by social networks are:

- General (Facebook, VK, Twitter and WE.ua);
- Professional (LinkedIn, Plaxo, Scientific Social Community, Profeo.com.ua);
- Specialized (politiko.ua, Plitkar.com.ua).

The most popular social networks for today are Facebook, VK and WE.ua.

2 Related works

Professional and specialized social networks are analogous to the thematic group in general social networks. Web-forums are also general and specialized.

The systems for publishing comments are an important element of the information content on the media sites and official websites of the authorities. Comments on news or events reflect the online audience's response to this news or event, its resonance, and relevance to society. Such systems are available on all news sites and can be presented on the official sites of state authorities in the section "News". The number of comments indicates the popularity of this resource [6].

In order to leave a comment, most online communities require a pre-registration. This process was designed to collect information about the user of the online community and give it opportunities and rights for active online community activity. The registration process for all types of online communities is similar, however, it may vary in the completeness of the information provided by the user. The accuracy of the information provided is the responsibility of the user.

The credibility and completeness of the personal information of the user of the online community are very important when determining the level of trust the administration of the system for processing the appeals of citizens to this user as the author of appeals. The level of trust and activity of the online community user is important factors in creating conversations based on his posts. It is possible to authorize the user with the accounts of other online communities, such as social networks. This avoids duplication of user information as well as provides information about user activity in other online communities. However, in order to eliminate potential conflicts over user competence in various topics and different behaviors across online communities, we look at its accounts in these online communities as representations of individuals user [3, 10]. A separate case is a registration in the online communities of state authorities as one of the parties to the communication. The peculiarity of such registration is to provide complete and reliable information about the authority. In particular, the name of the authority, its coordinates and telephones, the surname and the name of the compliance officer who will represent the authority in this online community. The format of signatures in posts and the graphic image (avatar) of the account also is important. Both the online community administration and the management of the authority check whether the information is trustworthy and meets the requirements of these accounts.

Registration of users in social networks and in web forums has performed by entering the user's personal information into the corresponding web form. This information is stored in the database of the relevant resource and allows you to identify the user in the online community. Depending on the requirements for registration, a minimum and a complete set of user data for registration is distinguished.

For registration in the systems of posting comments their own means of users' registration are used and there is the possibility of authorization through social accounts.

Collaboration with online communities that do not identify users is ineffective because there is a high probability that users' posts will generated automatically to cause damage [4].

3 Features of the Presentation of Information in Online Communities, its Characteristics and Criteria

Each of the online communities has peculiarities of the organizational structure of the information presentation. Social networks consist of individual user pages and user group pages. Personal pages in the social network can have both physical and legal persons and authorities. The part of the user's social network page that has posts has called the "user wall". A feature of the social network is the ability to create thematic groups of users, which can be joined by any user of the social network. Connecting to a group based on user interests [12].

Working with posts in social networking groups is more effective and much more informative than with replies on individual "walls" of users. Working in a social network group requires some prior approvals: group sign-up and team rules [11].

Posts in groups of social networks are an example of expanding citizens' information, as opposed to posts on the official website of the authority in the social network.

The organizational structure of most web forums is tree-like and consists of thematic sections of the web forum, discussion topics and user's posts. The sections define the thematic, professional and geographic purpose of the web forum and create by the owners of this web forum. Each separate content has multiple images. Discussion topics created and controlled by web forum moderators, and posts can be created by all registered users of the web forum. The post's relevance to the discussion topic is determined by the user. Web forum moderators can move user posts between topics and delete them if the information in the posting does not conform to the rules of the web forum.

In the systems of posting comments, the structure of the presentation of information is similar to a web forum. You can comment on every news or event posted on the website. User posts posted with information about the relevant news or event.

3.1 Analysis of Online Community Information that Can Be Used to Create Appeals

The following information is required to create appeals from online community users' posts: user's data of the online community as the author of appeal, information about the online community as the source of the appeal, information about the topic of the problem that violated in the appeal.

Authors of appeal created on the basis posts in online communities may be social network users, web forum users, and comment authors. The information about the authors of the appeals made up of general information about the user of the online community and information about the peculiarities of the functioning online community. The general information includes surname and name, age or date of birth, sex, e-mail address, social status, etc. This information is contained in the user account of the online community. The structure of general user information for all online communities is the same. Depending on the online community, the types and characteristics of the author's information may vary.

The basic set of characteristics of an online community user to create an appeal is:

- The name of the author of appeal (if the nickname is used to identify the author of the conversion, in this case, the message of this author is processed as anonymous);
- The email address of the author request (or the contact address of the author request on the social network);
- Rating of the author of appeal in the online community (determined by the administration of the online community by expert basis on the basis of the information about the given member of the online community).

Parameters that affect the rating of the author request are:

The social network – the number of author's friends, the number of his posts and the number of preferences appeal posts;

The web forum is a user rating and its activity on a web forum;

The system for posting comments is the number of posts in the system and the author's activity in the system, as well as information from the user account.

When processing conversations created on the basis of online community reports, the source of the information on which the request is made is important, namely: the name of the online community, its type, topics, and the rating in the system of processing the requests of citizens. The most important information is about the rating of the online community. It is determined based on the characteristics of the online community by the expert way at the stage of concluding an agreement on cooperation with the authority.

4 Methods and Discussions

4.1 Formal Model of the Author of Appeal

The author of appeal (the applicant, citizen, declarant), as an active participant in the creation of appeals, plays an important role in the process of functioning of the processing of applications. Information about the author of appeal is important for further processing of his appeals.

The author of appeal ($Declarant_i$) – the user of the system processing the appeals of citizens, which forms the appeal and has the ability to control the state of execution of this appeal. The set of all authors of conversations write as follows:

$$Declarant = \{Declarant_i\}_{i=1}^{N^{Declarant}}, \quad (1)$$

where $N^{Declarant}$ – the number of authors' appeals.

In general, $Declarant_i$ described as a triple:

$History_i$ – The set of appeals submitted by the author of the application

$SysInfoD_i$ – The system information about the author of the appeal.

The input of personal data carried out at the registration of the user in the system of processing of the appeals of citizens. This is provided by standard user registration procedures. The registration can be completed, all the necessary information entered for the notification of the status of official appeal and anonymous is for entering only

the text of the message. Accordingly, an appeal created by a user with full registration will have priority and will require a mandatory response to her, informing the author of the request for the outcome of the review. Appeals made by an anonymous user will be considered, but the results of the review will be used for internal review of the results of the work of the authority. The author's personal information write as follows:

$$PersonalData_i = \langle Name_i, DateofBirth_i, Profession_i, Address_i \rangle, \quad (2)$$

where $Name_i$ - Surname, name of the author of the application;

$DateofBirth_i$ - Date of birth of the author of appeal;

$Profession_i$ - Occupation of the author of appeal;

$Address_i$ - Address of residence of the author of appeal;

In some cases, $PersonalData_i$ you can add information about the author's passport number, telephone number, email address, taxpayer identification number.

In order to monitor the activity of the author of the appeal, it is necessary to have complete information about all appeals created by him.

In the formal model, all appeals created by the author of the appeal described as the appeal history of the i author appeal. The history of appeals by the i author appeal described as:

$$History_i = \{Claim_{ij}\}_{j=1}^{N^{History_i}}, \quad (3)$$

where $N^{History_i}$ – the number of appeals submitted by the i author of the appeal.

$Claim_{ij}$ – j appeal of the i author appeal.

The set of all appeals in the system for processing the appeals of citizens is the union of the stories of the appeals of all the authors of the applications.

$$Claim = \bigcup_{i=1}^{N^{History}} History_i \quad (4)$$

System information about the author of the appeal described by the tuple:

$$SysInfoD_i = \langle CreatorID_i, TechInfoD_i, Trust_i \rangle \quad (5)$$

where $CreatorID_i$ - identifier of the i author appeal.

$TechInfoD_i$ - the technical information about the author of appeal.

$Trust_i$ - the level of trust of the administration of the system of processing the appeals of citizens to the author of appeal.

The parameter $TechInfoD_i$ assigned to the author of the conversion as a result of generation of the unique identifier of the author of the application when it registered in the system for processing the appeals of citizens. It is used to identify the user of the system for processing the appeals of citizens and further analysis of its activities. All identifiers of authors of conversions form a plural.

$$CreatorID = \{CreatorID_i\}_{i=1}^{N^{CreatorID}}, \quad (6)$$

where $N^{CreatorID}$ is this is the number of authors appeals.

The parameter is responsible for storing the technical information about the author of the appeal, in particular: the IP address, login and the geographical location of the computer from which the access to the processing system of the citizens' access is made.

$$TechInfoD_i = \langle IP_i, Login_i, Region_i \rangle, \quad (7)$$

where IP_i is the IP address of the author of the technical device (computer, phone and tablet) used to access the system for processing the requests of citizens.

$Login_i$ – an alphanumeric character set that identifies the user and is used with the password to log in and determine access rights to the resources of the referral processing system.

The author himself from an arbitrary set of alphanumeric characters or automatically from his registration data can create Username of the author entry.

In order to create a login request of the author offered to use personal data such as this may be: name and surname; passport number; phone number; E-mail address.

This will correctly identify the author of the appeal and reduce the risk of errors.

$Region_i$ (the location of the author of appeal) is the service information about the location of the author's computer. One of the ways to get this information is to use specialized databases developed by companies working in the field of GeoIR technologies. Access to these databases can be done either by special requests or through the web interface of this resource.

Taking into account the specifics of the use the system for processing citizens' appeals, it has been investigated that the smaller the area of the use of the system, the more accurate the information about the author of appeal should be.

4.2 Methods of Determining the Level of Trust to the Author of Appeal

One of the most important indicators of the author of appeal is the level of trust of the administration of the system to the i author of appeal - $Trust_i$. This level is important in creating rating lists of appeals for execution. The analysis shows that the level of trust is determined by the basic methods shown in the diagram (fig. 1).

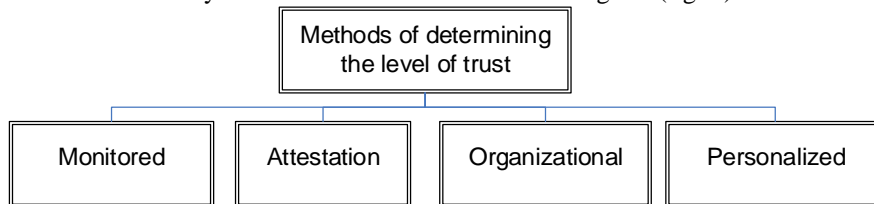


Fig. 1. Scheme of methods for determining the level of trust

For the level of trust, there are natural constraints $0 \leq Trust_i \leq 1$. The same level of confidence in the author of appeal in the general case is calculated as a linear convolution of the basic methods.

$$Trust_i = TrustM_i * C_m + TrustA_i * C_a + TrustO_i * C_o + TrustP_i * C_p, \quad (8)$$

where $TrustM_i$ - the level of trust to the i author of appeal in accordance with the monitoring method, $0 \leq TrustM_i \leq 1$;

$TrustA_i$ - the level of trust to the i author of appeal in accordance with the attestation method, $0 \leq TrustM_i \leq 1$;

$TrustO_i$ - the level of trust to the i author of appeal according to the organizational method, $0 \leq TrustM_i \leq 1$;

$TrustP_i$ - the level of trust to the i author of appeal in accordance with the personified method, $0 \leq TrustM_i \leq 1$;

C_m, C_a, C_o, C_p - the weight ratios for each of the methods that depend on the domain of the application of the system.

For weighting ratios, the following conditions are fulfilled:

$$C_m + C_a + C_o + C_p = 1 \quad (9)$$

$$0 \leq C_i \leq 1, i \in \{m, a, o, p\}$$

In this case, there may be situations in which the level of confidence of certain methods will not take into account. Thus, in the systems of e-commerce only personalized and monitoring methods and ratios will apply $C_a = C_o = 0$. Because such systems are very important information about the credibility and completeness of the user's personal data, as well as information about the user's activity in e-commerce systems, in particular the number of transactions he has made and their rating on a particular system.

In systems that provide communication within the corporation, only the organizational method is important in determining the level of confidence of the author of conversion, therefore, the coefficients $C_m = C_a = C_p = 0$, and the coefficient $C_o = 1$. In such systems, the status of the author of appeal in the structure of the organization and its influence on decision-making is important.

4.3 The Monitoring Method

The criteria of this method are the activity of the author of appeal and the correctness of his work in the system of processing the appeals of citizens. In this method, the level of trust is determined on the basis of positive and negative indicators of the activity of the author of appeal.

The indicators that increase the level of trust are:

- The total number of target appeals $N(Claim)$ - this is the number of appeals received from the author of the appeal and worked out in the system of processing the appeals of citizens;
- The average number of appeals for the period $AVG(Claim)$ - this is the proportion of processed requests by the author of the appeal in the system of elaboration appeals of citizens to the number of days in the period of time.

Indicators whose values reduce confidence level include:

- The number of appeals that found to be incorrect when verified $N_{lie}(Claim)$. These include the appeal, the content of which contains advertising information (spam), does not correspond to the sphere of activity of the authority or does not bear the content load;
- The number of appeals that violate the rules of using the system for handling citizens' requests $N_{bad}(Claim)$ - appeals that contain obscene words, provocative information, and may harm the system of processing citizens' appeals.

The confidence level in accordance with the monitoring method defined as a monotonically increasing function with an increase in the average number of appeals, and monotonously decreases with an increase in the number of appeals that were found to be false and in violation of the rules governing the use of the referral processing system.

The level of trust in the monitoring method calculated according to the formula

$$TrustM_i = K_Q * Q_i + K_C * C_i, \quad (10)$$

where Q_i – the indicator of activity of the i author of appeal;

C_i – the indicator of correctness of the i author of appeal;

K_Q – the coefficient of importance of the activity of the author of appeal;

K_C – the coefficient of importance of correctness of the author of appeal.

The coefficients K_Q and K_C are determined expertly and their values may vary depending on the requirements that will be addressed to the authors of appeals, as well as on the specifics of the use and scope of the system for processing the appeals of citizens. If the number of author's entries is important to the system of processing the appeals of citizens, then K_Q will increase, but K_C – decrease.

Conversely, if the information processing of the treatment and the correctness of its writing is important for the system of handling the appeals of the citizens, then K_Q will decrease and K_C increase – moreover $K_C + K_Q = 1$.

The formula is use to determine the activity indicator of the conversion i author (11):

$$Q_i = \begin{cases} \frac{N_i^{(Claim)}}{CN}, & N(Claim) \leq CN, \\ 1, & N(Claim) > CN, \end{cases} \quad (11)$$

where $N(Claim)$ - total number of target appeals;

CN – the index of the typical writer's signature is determined expertly on the basis of information on the number of authors of appeals and the number of appeals themselves in the process of processing appeals. By default, the tenth of all appeals created in the system of processing grains of citizens for a certain period.

The rate of correctness of the author of the appeal is determined based on information about reviews of the appeal of this author. Depending on their values, the indicator of correctness of the author of appeal by the formula is determined (12).

$$C_i = \frac{Cl_i - (Cp_i - CK * Cb_i)}{Cl_i} \quad (12)$$

where Cl_i – the number of reviews on the i author's posts;

Cp_i – the number of positive reviews on the i author's post;
 Cb_i – the number of negative reviews on the i author's post;
 CK – the coefficient of incorrectness is determined expert way depending on the requirements and rules of use of the system of processing citizens' appeals.
 In calculating the level of trust in accordance with the monitoring method, the condition must be fulfilled:

$$TrustM_i = \begin{cases} TrustM_i, TrustM_i > 0. \\ 0, TrustM_i \leq 0. \end{cases}$$

When calculating the level of trust to the author of the appeal, we take into account the date of registration of the first treatment, and not the registration of the author of the user's treatment of the processing of citizens'. Because the information on the treatment, its number, frequency, and the presence of positive and negative responses are important for determining the level of trust to the author of the application in the monitoring approach.

The level of trust in accordance with the monitoring method is update with a certain periodicity, which is determine by the administrator of the system for processing citizens' appeals.

4.4 The Attestation Method

In order to implement the attestation method it is expedient to use the method of constructing a professionogram with certain modifications and changes, taking into account the specifics of the use of the system for handling conversations. In particular, use only the professional and personal characteristics of the author of appeal for evaluation. Professional characteristics are assessed through distance learning systems, and personal – based on the information that is available in the referral system or in the online community. To assess the professional characteristics of the author of appeal, relevant online tests are provided that relate both to the activities of the government, as well as to social and public life. An assessment of the personality characteristics of the author of appeal may base on expert opinions and on the correspondence of the author's personal information to the reference values of the user of the system. The results of passing the tests and compliance with the reference values form the level of trust to the author of appeal in accordance with the attestation method:

$$TrustA_i = Kt * Test_i + Kr * Standart_i \quad (13)$$

Where Kt та Kr - the coefficients of the professional and personal characteristics of the author of appeal, and, and are determined by the experts and depend on the features of the scope of the system;

$Test_i$ - the result of the correlation of the correct answers of the author to the test tasks to the number of test tasks;

$Standart_i$ - the result of the correlation of the author's data to the reference values.

4.5 The Organizational Method

Organizational method of determining the level of trust to the author of appeal is used to rank the users of the system processing appeals. This method is used to provide certain groups of users with system rating points in accordance with their functional responsibilities in the system. The number of points awarded is determined according to the following criteria:

- the position occupied by the author in the organizational structure of the authority (leader, performer, controller, POPs, citizen, etc.) – O_1 ;
- the public weight of the author of the appeal – O_2 ;
- the responsibility of the author of the appeal – O_3 ;
- the honors, rewards, and encourages of the author of the appeal – O_4 .

Each of the criteria has its own range of values, which is determined by the administration of the system of processing citizens' appeals.

The condition to be fulfilled in the organizational method of determining the level of trust to the author of the appeal is as follows:

$$TrustO_i = \begin{cases} TrustO_i^*, TrustO_i^* < 1. \\ 1, TrustO_i^* \geq 1. \end{cases} \quad (14)$$

The level of trust in the author of appeal when determining it using the organizational method is calculated by the formula:

$$TrustO_i^* = \frac{O_1+O_2+O_3+O_4}{100} \quad (15)$$

4.6 The Personification Method

With this method, verification of the registration data of the author of the application with his personal data, provided to him by the administration of the system in the form of official documents (passport, identification code, diploma, a certificate from the workplace) is carried out.

This method uniquely determines the authenticity of the received from the author of the treatment of personal data.

To implement this method, the means of feedback with the author of appeal are used and verification of his data is carried out in publicly accessible databases for the storage of personal information. The completeness of the information about the author of appeal affects the level of trust in him from the administration of the processing system of appeals. The value of confidence level belongs $TrustP_i$ to the interval $[0,1]$ and is determined expertly for each author of the appeal.

5 Results

The use of informational content of online communities for making appeals of citizens, describing the properties of online communities and the peculiarities of the or-

ganizational structure of information presentation are considered. An analysis of online content filling of online communities that can use for generating citizens' requests is conducted. The overall level of trust is equal to the sum of the results of calculating the confidence levels each of the methods.

Table 1. The application of methods for determining the level of trust of system.

System	Monitoring	Attestation	Organizational	Personified
E-commerce systems	X			X
Electronic money				X
Social networks	X			X
Distance learning systems		X		X
Development of free software		X		
Electronic Governance	X		X	X
Web forums	X			
Online games	X	X		
Corporate Business Systems			X	

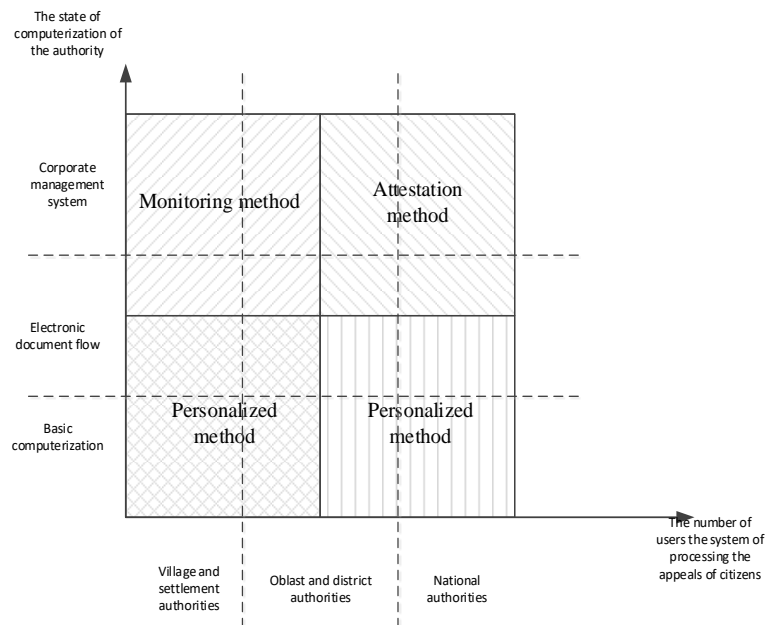


Fig. 2. Scheme of methods for determining the level of trust to the author of appeal.

The application of methods for determining the level of trust of the administration the system for processing the requests of citizens to the author of appeal is determined based on information on the state of computerization of the authority and number of users the system.

The proposed methods differ in how to determine the level of trust to the author of appeal. Consider each of the methods separately.

6 Conclusion

The use of informational content of online communities for making appeals of citizens, describing the properties of online communities and the peculiarities of the organizational structure of information presentation are considered. An analysis of online content filling of online communities that can use for generating citizens' requests is conducted.

A formal model of the author of appeal is constructed and methods of determining the level of trust of the administration to him are proposed. The peculiarities of determining the level of trust to the author of appeal in different spheres of the application of the treatment of the circles are investigated and the corresponding indicators for each of the methods are introduced.

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