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Using Web Service for Generating Permanent Voter Cards (PVCs) for Nigerian Citizens

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Abstract: ***A permanent voter card (PVC) is an identification card that empowers an eligible voter to participate in voting during general elections. In Nigeria, the Independent National Electoral Commission (INEC) embarks on a continuous voter Registration (CVR) exercise on daily basis in order to ensure that every eligible voter in the country is registered and issued with PVC. This method is however too costly and time consuming to embark on. The federal government of Nigeria spends billions of naira for the provision of resources and man-power needed for its effective implementation, and this project has been on-going since April 2017, and would span till few months before the next general elections in 2019. Again, the system is prone to falsification of ages and/or people's identities due to the manual method of authenticating birth certificates and other similar documents being presented by the masses at registration centres to enable their Biodata to be captured for the issuance of their PVCs. This work therefore shows how the use of web service can drastically cut-down government expenditure on voter card registration and production of PVCs as well as providing a good beginning towards credible elections by automatically authenticating and determining eligible voters that are devoid of any age falsification or personal identity.***

Keywords: Permanent Voter Card (PVC), Nigeria, Independent National Electoral Commission (INEC), continuous voter Registration (CVR), birth certificate, web service, credible election

1. Introduction

A web service is a functionality possessed by the application program of a host computer (such as a web server) over the Internet, and which can be accessed through remote method calls by a client application from any part of the globe in order to do further processing on the retrieved data. A web service is therefore an "application-to-application" based protocol instead of an "application-to-web browser" based protocol that is common to other web applications.

According to [1], one of the major functions of the National Population Commission (NPC) of Nigeria is "to establish and maintain a machinery for continuous and universal registration of births and deaths throughout the federation". Regrettably, this obligatory duty of NPC is not carried out to the letters due to certain militating factors such as, limited number of registration centres, limited financial resources, lack of effective sensitization (especially in the rural areas), etc [2]. It is therefore not surprising that "about 70% of the 5 million children born annually in Nigeria are not being registered at birth", as reported by [3]. Thus, NPC does not have a comprehensive and updated database of birth and death records of Nigerian citizens. This explains why INEC is embarking on the continuous voter registration (CVR) exercise to physically determine the eligible voters with any of the following official documents presented by them at registration centres: baptism card, age affidavit, national ID card, international passport, etc that proves that such individual is a Nigerian and 18 years of age or above. Such exercise is undoubtedly a huge capital expenditure on the purse of the federal government. It is also prone to falsification of ages and identities of people.

Happily, the house-to-house birth registration exercise which was conducted in Bauchi state of Nigeria in July 16th, 2017 by a joint team of European Union (EU), UNICEF, NPC and the state ministry of health, as reported by [4], is a right step in the right direction towards ensuring a more comprehensive birth registration of Nigeria citizens for good national planning.

This is where this work becomes very relevant because if the database of NPC contains a comprehensive and well-updated information about every 'birth' and 'death' of citizens in the country, such information will be of immense help to other establishments like INEC, National Identity management commission (NIMC), Federal Road Safety Commission (FRSC), etc to develop their respective client applications to consume or make use of the information contained on the NPC web server for various services. For instance, INEC can develop a client application to retrieve information from the NPC web server about the birth Biodata of every Nigeria citizen, and then process the data automatically in order to determine the actual population of citizens that are eligible to vote (that is, those that are 18 years of age or above). This is what web service is all about! The eligible voters can then be contacted through phone cells, text messages, or emails to report at designated registration centres at certain dates and time for 'data capture' in lieu of collection of their PVCs.

In this manner, the voter registration costs and time are reduced to the barest minimum. It also provides credibility in the registration process in terms of age and personal identity.

2. Literature Review

The lack of synergy through the use of web services amongst the various government agencies like NPC, INEC, NIMC, FRSC, and a host of others is costing the federal government of Nigeria billions of naira on regular basis. An agency such as INEC whose primary source of data for the provision of PVCs is the Biodata of electorates- such as name, nationality, gender, date of birth, place of birth, etc – is not supposed to embark on the manual method of the "continuous voter registration" exercise to carry-out any of the following tasks:-

1) Determining those that have attained 18 years of age, and who were not previously registered.
2) Determining those that have acquired nigeria citizenship.

3) Determining the deceased persons
4) Changing the registration details of some previous voters such as, misspelt names, wrong names, change of names for the married females, etc

All these tasks can easily be done by a computer program deployed on INEC website to consume certain services such as the Biodata of every Nigerian citizen which are already available at NPC's database, and then process those data automatically to obtain the desired results.

The duplication of tasks by INEC in obtaining people's Biodata physically which have already been done by NPC during birth registration is an economic waste! What the federal government of Nigeria needs to do is to provide more resources and man-power for NPC to enable the agency embark on grassroot or house-house birth registration of every Nigerian citizen (both young and old) so that there will be a comprehensive database of people's Biodata, and the database subsequently updated on regular basis from the various NPC "help desk offices" all over the country. In this way, other government agencies like INEC, NIMC, FRSC, Immigration, etc can easily source the needed information from the database.

According to [6], "the National Population Commission (NPC) has identified poor coverage, low level of awareness, and inadequate registration centres, as challenges facing vital registration of births in the country". This explains why [3] reported that,

> In Nigeria, about 70% of the 5 million children born annually are not being registered at birth. They have no birth certificate and in legal terms, they do not exist. Their right to an identity, name, and nationality is denied, and their access to basic services is threatened.

The federal government of Nigeria should therefore work assiduously to tackle these problems since the benefits of having good birth statistics are immeasurable. For in instance, a birth certificate is a requirement for enrolment in school, for the issuance of travel documents, for the issuance of national identity card, for the issuance of PVCs for elections, for the issuance of driving license, etc [2].

3. Methodology

According to [7], "the Methodology of a research paper shows the 'work plan' or blueprint used by a researcher for solving a research problem. The work-plan bothers on the method of data collection and analysis".

The methodology for this research is structured as follows:-

1) Research method
2) Selection of participants
3) Data collection, and
4) Data analysis

3.1.1 Research Method

Research method refers to the technique used for data collection. The research method used in this work is "secondary data" (or Documentary data) obtained online from NPC, UNICEF, and INEC with respect to birth registration as well as voter card registration.

3.1.2 Selection of participants

This refers to the key-players for the research.
Here, the following factors were considered:-

Description of participants: this include the following:-

1) The NPC admin at various help desk offices nationwide that will upload birth and death registration information of Nigerian citizens to the NPC database server.
2) The INEC admin that will use the establishment's client application to retrieve the Biodata of Nigerian citizens stored on NPC's database server for processing.

- **Selection criteria:** the eligible voters that will be selected by the INEC's client application are all Nigerian citizens that are 18 years of age and above (as at the time for the next general elections).
- **Target population:** This includes every living Nigerian citizen in the country.
- **Sampling method used:** the entire population of 'N' Nigerian citizens that are eligible to vote would be selected.

3.1.3 Data Collection

The data that would be collected by the INEC's client application from the NPC's database server include the following:- person's name, gender, date of birth, place of birth, birth certificate number, name of parents, state of origin, LGA, nationality, phone number, residential address, and email address.

3.1.4 Data Analysis

Data Analysis gives a detailed account of the technique used in storing and arranging data for processing as well as the technique used in processing the data in order to obtain a result (or finding). Fig 3.1 shows the architecture of the web service that will be used for generating permanent voter cards (PVC) for Nigerian citizens

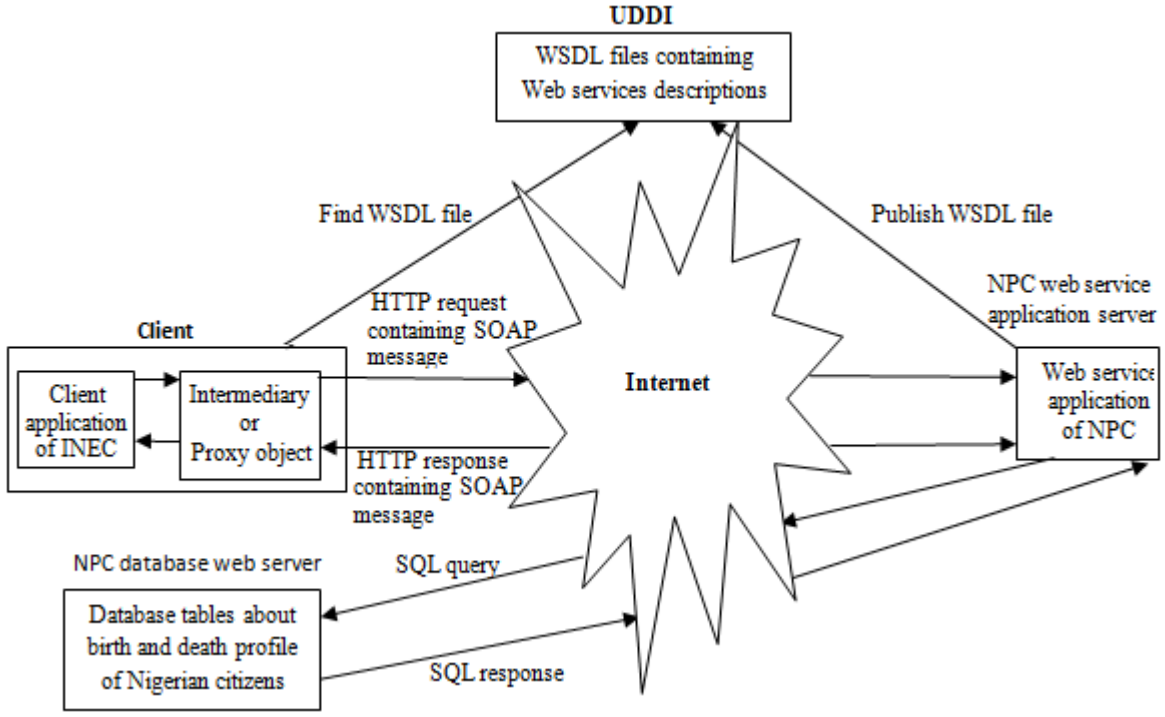

Figure 3.1: The architecture of the web service for the proposed system

The above Fig 3.1 shows the various technologies used in a web service. These are:-

1) HTTP
2) XML
3) SOAP
4) WSDL
5) UDDI

- **HTTP** stands for "Hypertext Transfer protocol". It is a communications standard that enables electronic devices send and receive data over a network.
- **XML** stands for "Extensible markup language". It is a text file having the extension name **.xml** that contains mark-ups (or notations) for describing data in a well-structured formal so that the data can be well-read by a computer and transported properly to another computer regardless of the differences in technology between the two computer systems. Virtually any type of data such as text, picture, sound and video can be described with xml [9]. The example below shows a simple xml document that describes the information about a published book.

```
<?xml version = "1.0"?>
<book>
<title> Systems Analysis and Design </title>
      <edition> sixth edition </edition>
      <authors>
          <name1> Gary B. Shelly </names1>
          <name2> > Thomas J. Cashman </name2>
          <name3> Harry J. Rosenblatt </name3>
 </authors>
 <publisher>  Thompson  Course  Technology
</publisher>
  <year> 2006 </year>
  </book>
```

On the contrary, an **HTML** document is a text file that contains mark-ups for displaying data by a **web browser.** For instance, if we want the message: "Systems Analysis and Design" to be displayed **bold** and **underlined,** then we write the HTML code as follows:

```
<HTML>
   <head>
      <title> display message in bold and underlined
</title>
      </head>
      <body>
      <b> <u> Systems Analysis and Design </u </b>
      </body>
      </HTML>
```

SOAP stands for "Simple Object Access Protocol". It is an **xmL** – based document that describes the format for sending and receiving messages between a client and web service application regardless of the differences in technologies between the two applications. This interoperability is because every object oriented programming language has **APIs** (Application programming Interface) for reading XMLs.

Structure of a SOAP message

According to [8], a SOAP message is structured as follows:-

```
<?xml   version = "1.0"?
<soap: Envelope
    definitions of xml – soap message>
      <soap: Header>
        Header definitions
      </soap: Header>
      <soap: Body>
        Body definitions
      </soap: fault>
        Fault definitions for the actual soap message
            </soap: Body>
      </soap: Envelope>
```

Figure 3.2: A skeleton SOAP message

source: https://www.w3schools.com/xml/xml_soap.asp

- The **Envelope** element in fig 3.2 identifies the xml document as a SOAP message. It uses a beginning and ending tag to encapsulate all the details in the SOAP message.
- The **Header** element may contain the following information: (i) authentication particulars used by the client application, (ii) complex data types used in the SOAP message, etc.
- The **Body** element contains the actual data that needs to be sent between the web service and the client application.
- The **Fault** element is used to report an error message from a web service whenever the web service is not properly called by the client code.
- *It is important to note that a SOAP message is generated automatically by a web service whenever any of the methods of a web service is being called by a client application.*
- **WSDL** stands for "web service description language". It is an xml document file used for describing a web service so that a client application will know how to invoke or call any of the web service methods for an appropriate service. A WSDL document, for instance, provides information about all the available methods in a web service such as, method name, its return data type, the number of parameters in the method, and the data type of each parameter.

Structure of a WSDL document

`ccording to [10], a WSDL document has the following structure:-

<definition
header *definitions*
Target Namespace *definition*
Types *definitions>*
<message>
method definitions and their input/output parameters
</message>
<port Type>
definitions of the input and output operations of each method
</port Type>
<binding>
Definition of the port name used in carrying out all the method operations
</binding>
<service>
Definition of the web service name and its URL location
</service>
</definition>

Figure 3.3: Structure of WSDL document
Source: https://www.guru99.com/wsdl-web-services-description-langauge.html

- The **definition** section defines the web service and its entire SOAP message structure.
- The **message** section is used to describe all the web service methods, their input parameters, and the type of output they will return.
- **Port Type** section: every web service method receives input and produces an output. "Port Type" is a functionality of the web service method that is used to encapsulate these two main operations of a web service method.
- The **binding** section is used to bind all the method operations of a web service to a particular port so that when a client application references the relevant port type, all the web service methods will be accessible to the client.
- The **service** section contains the name of the web service itself as well as its URL location.

A **WSDL** file is automatically created whenever a web service is implemented with any object-oriented programming language like Java, Python, C++, C#, Visual Basic.Net, etc.

UDDI stands for "Universal Description, Discovery and Integration". It is a directory service where businesses worldwide can register and search for web services on the Internet. It is therefore a directory for storing information about web services which are described by WSDL so that it can easily be located online by a client before a client application can be written to access the web service.

After an establishment has finished developing a web service application, she has to register it into the UDDL directory (just like a telephone directory contains the list of all registered customers). A stakeholder can then visit the UDDI directory online to search for the web service of his/her choice, and subsequently develop the required client application to use the web service. The UDDI directory is maintained by well-known companies like Dell, HP, IBM, Microsoft, Intel, Oracle, Sun, etc.

3.2 How INEC can make use of the web service of fig 3.1 to generate PVCs

Step 1: The web service provider – that is, the National Population Commission (NPC)- writes the required web service application (using any of the following programming languages: Java, Python, C++, C#, Visual Basic.Net, etc) and hosts it on a web application server. The web service application will contain a method called **bioData()** that will retrieve the biodata of all living Nigerian citizens from the NPC database. The format of the **bioData()** method is shown below.

String bioData (string username, string password)

The method will require a *username* and *password* from the **client** (such as INEC) which will be authenticated before the biodata information can be retrieved from the database server. The information that will be retrieved from the server include the following: *name, gender, date of birth, place of birth, birth certificate number, name of parents, state of origin, LGA, nationality, phone number, residential address, email address, etc.*

Step 2: The web service provider (NPC) registers (that is, publishes) her web service application with the **UDDI,** and also provides a link on her website to the UDDI registry, or about the **WSDL** file of her web service to enable any client locate the web service with ease.

Step 3: A client (such as INEC) searches the UDDI registry with a search engine such as **Google** to locate the WSDL file of NPC's web service, or uses the web service link provided by NPC on her website to locate the WSDL file.

Step 4: The client makes use of the information available in the WSDL file to write the required client application that will consume (or make use of) the web service.

The client application will have the following 'input form' shown in fig. 3.4 for submitting the *username* and *password* of the INEC's admin to the web service method for authentication.

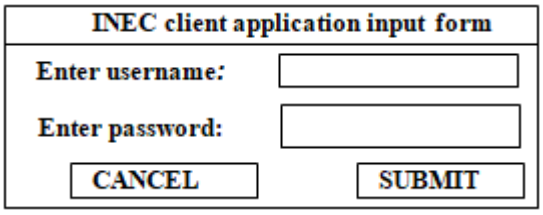

Figure 3.4: The input-form for submitting the user's particulars for possible Biodata response from the web service

Step 5: The submitted request is received by an "intermediary or proxy object" of the client application which then converts the request to a **SOAP** message, and sends it through **HTTP** protocol over the Internet to the web service application server. The application server interprets the **XML** tags contained in the SOAP message in order to determine the actual method of its web service to be executed.

Step 6: The web service method uses the arguments in its parameters to query the appropriate table in the database server for legitimacy. If the values are invalid, an error message will be returned to the client. On the other hand, if the values are valid, the Biodata of Nigerian citizens will be retrieved from the appropriate table and sent back to the client as **SOAP response.**

Step 7: The proxy object of the client application interprets the xml tags in the SOAP response into plain text and submits the result to the client application for processing. The client application stores the result on its database table and then processes the table in order to determine the eligible voters – that is, Nigerian citizens that are 18 years of age and above.

The algorithm below shows how the eligible voters can be determined.

1. Enter the **year** for the next general election, **Yn**
2. Determine the **nationality** and **age** of an individual from the database table thus:-
   2.1 SELECT * from **biodata** table WHERE nationality = "Nigeria"
   While record.next ()
   {
   age = Yn – date of birth
   if (age > = 18)
   {
   store the individual's biodata record in another database table
   called **processedBiodata**
   }
   }
3. End

Step 8: The list of eligible voters generated by the client application will be used by INEC to contact the individuals through their respective phone numbers to report at various INEC registration centres very close to them at given dates and time for data capture of their finger prints, current passports and other biodata changes about them since birth, and the changes then uploaded to the database.

Step 9: INEC uses the updated information to produce the required PVCs which would be collected by the individuals at specified dates and time at the respective registration centres.

Figure 3.5 shows the Workflow diagram of the interaction between the INEC's client application and the web service application of NPC for the exchange of data.

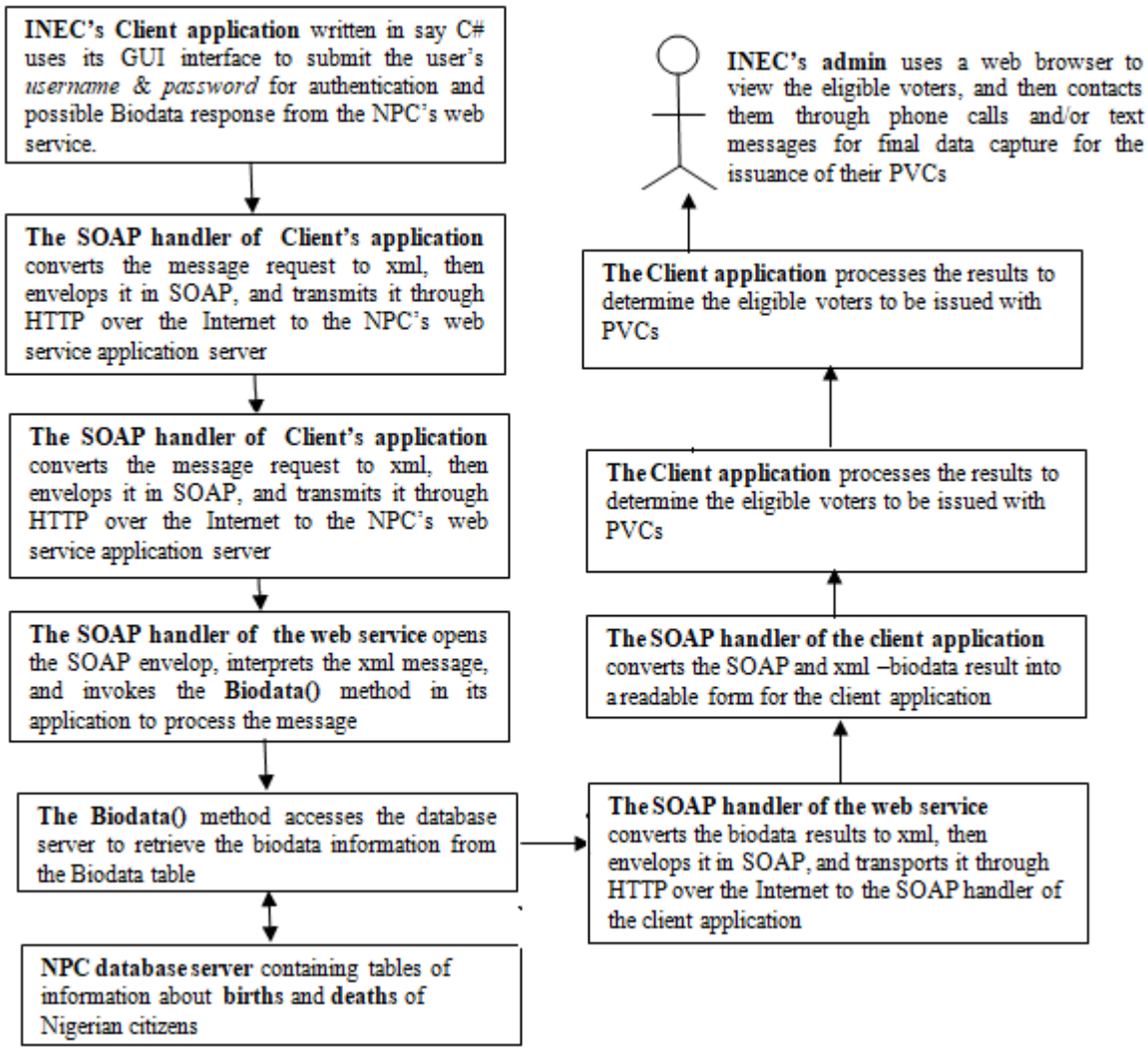

Figure 3.5: The Workflow diagram of the interaction between the INEC's client application and the web service application of NPC for data exchange

Note: The following database tables should be maintained by INEC to actualize this objective:-

1) rawBioData table
2) processedBioData table
3) OldPVC table
4) dormantPVC table
5) State table

- **rawBioData table:** This table contains the biodata of Nigerian citizens that was retrieved from the web service
- **processedBioData table:** This table contains the biodata of Nigerian citizens that are eligible to vote, and to be given PVCs after their nationality and date of births have been processed and found credible.
- **OldPVC table:** This table contains information about those that have been issued with PVCs.
- **dormantPVC table:** this table contains information about those that have not collected their PVCs
- **state table:** This table contains the following information: all the states in Nigeria, all the LGAs in each state, and all the registration/polling units n each LGA.

Fig. 3.6 shows the format of the PVC that can be issued to eligible voters.

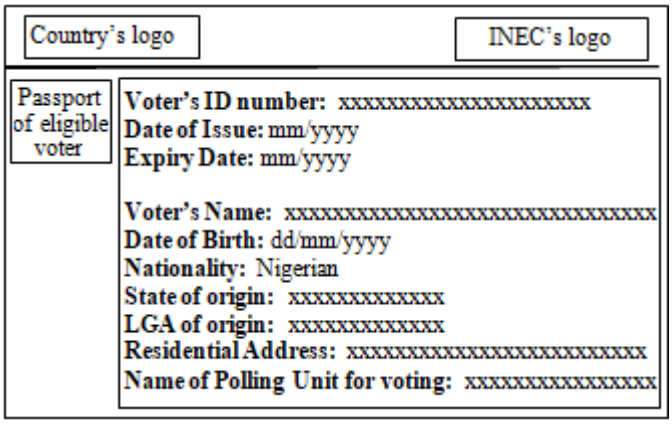

Figure 3.6: A PVC format that can be issued to an eligible voter

4. Summary and Conclusion

The use of web service in generating PVCs for eligible voters is the bedrock to credible elections in Nigeria. This is because the system generates a list of legitimate voters from the database which is devoid of any age falsification and personal identity. Again, the system reduces PVC production costs to the barest minimum. Contrast this to the usual scenario whereby every Tom, Dick, and Harry goes to

various registration centres for verification and possible data capture which is enshrouded with age falsifications and fake identities that are antecedents to election violence or non-credible election.

The federal government of Nigeria should therefore expedite action in implementing the web service proposed in this work for an improvement in the production of PVCs and for a safer and credible future election.

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