

## An automated server for maintaining and configuration of network elements

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**Abstract.** Network Element is a basic equipment used for the providing the necessary requirement for telecommunication service. Using a management system will help in a unified way for allowing distributed devices in a managed way. Therefore, an automated tool is developed, that is used to automate the configuration macro of the network elements in lab networks. Initially network elements had to be monitored manually including health check, configuration, backup etc. There are two major types of maintenance information which can be generated by NE and they are information related to its own internal hardware/software integrity and the quality or health of the network element. With the help of this automated tool the NE can be remotely accessed for auto-configuration, software installations, alerts, IP reachability and store logs. The automation framework is based on Spring MVC with Java Persistence API (JPA) in the backend. It runs on Tomcat Server 8.0 and uses MySQL database that runs on CentOS.

**Keywords:** Network Elements (NE) · Base Station Controller (BSC) · Network Management System (NMS)

### 1 INTRODUCTION

Today's Mobile Networks are more complex than past, such as 2G, 3G and 4G technologies. Consider 2G technology, there is a use of Base Transceiver Station (BTS), Base Station Controller (BSC) and Mobile Switching Centre (MSC) NEs for mobile communication [2]. As 3G supports both voice as well as data (Internet) with the developed NEs such as BTS, RNC etc. as the networking technology is growing, network elements features, functionality and number of NEs are also increasing rapidly.

In Mobile Telecommunication Networks, the network elements (NEs) are installed in a very large number so that it could maintain low cost in terms of deploying either software or hardware and service costs will have a dynamic

roll-out process[1]. When the NEs are being introduced in a network it causes an overhead in various things like installing the software or hardware, preparing the NEs as per the requirement and at the end commissioning it.

In future the network and its architecture becomes more complex and thereby it will be necessary to see the dynamic changes in configuration, the simplicity and rapidity of NE installation will become a more important thing. Hence, the automation of the NE will be a useful thing as it will eliminate loads of work that is being done manually. There are frameworks used for automation like python robot framework[10] but these have their own limitations as it can be used for one particular NE and need to do it separately for every NE.

Before installing any NE it has to be furnished with proper software and database. The database is divided in three different segments:

1. NE Hardware which is provided by manufacturer
2. Site which is provided by operator to decide the place where the NE must be set up, such that the NE can be easily reached and controlled from a network management system (NMS).
3. Project to which the NE belongs, provided by the operator. The proper operation and manageability of an NE can be guaranteed when it must be safeguarded only when the DB at NE and the DB in the network management system [3] (NMS) contain the exact same data and must be of the safe version.

## 2 System Overview

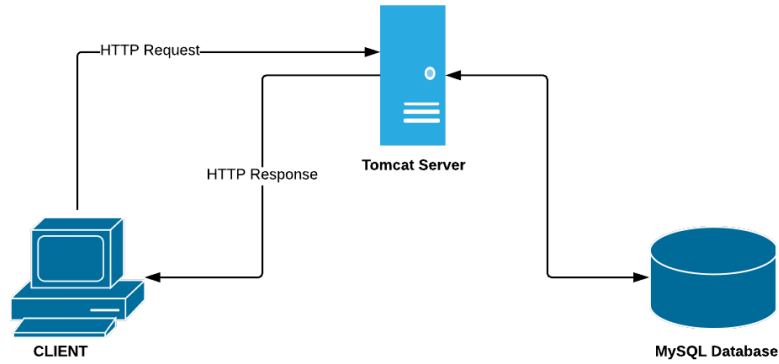
The proposal is to automate the configuration of all macro NE present. By doing such automation it helps to simplify and accelerate NE installation which helps in achieving the following things:

1. It takes lesser steps to integrate an NE in the site.
2. It helps in reducing the manual work.

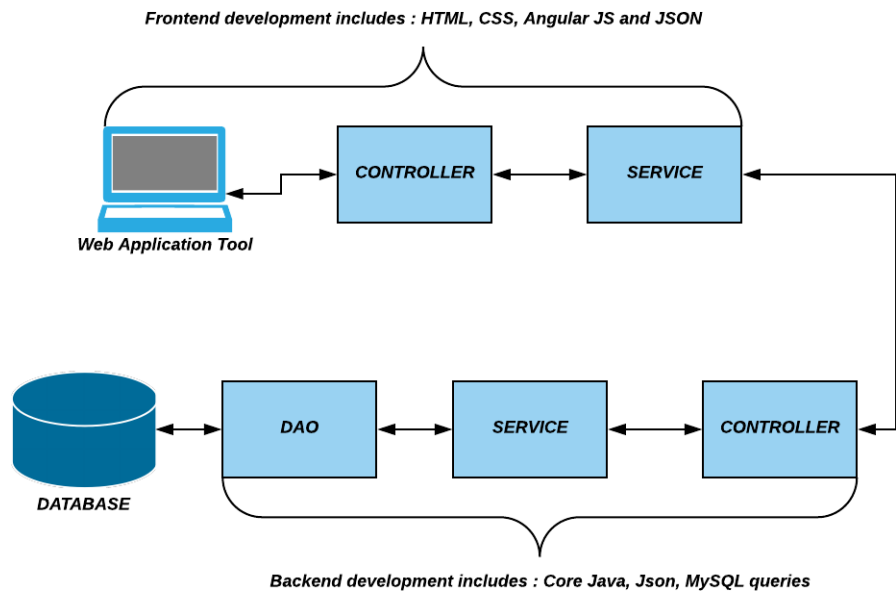
The automated transfer and installation of pre-configured data regarding the configuration of the NE is done by using the tool which is being developed and hence dynamic way of configuring the NE is not required and hence lot of time is being saved. To configure every NE the details of those should be loaded into the database.

The server used is Apache Tomcat which is a Java servlet container and implements several Java EE specifications including Java servlet, Java Server Pages (JSP), Websocket and provides a pure Java HTTP web server environment in which Java code can run. The tool developed runs on this server as it has JPA (Java Persistence API) framework. The web application tool developed has a framework used which is the Spring MVC i.e; model view controllers shown in Fig. 2.

The client is a workstation connected to the network and using to access server/services. The network Elements contain specialized software installed on the workstations. As shown in Fig. 1 these communicate to the server through HTTP Query and perform the functional operations as implemented on the server. The Client sends a HTTP request to the Tomcat server and once it receives the HTTP response the features of the tool is accessible.



**Fig. 1.** Basic system overview of the proposed project

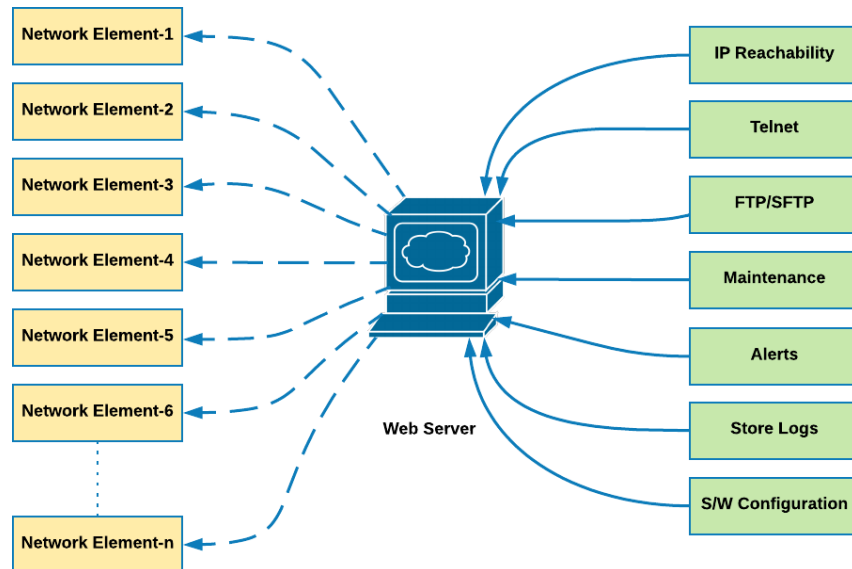


**Fig. 2.** Java Spring MVC Framework

MySQL is a relational database management system, central component of Linux Apache. It presents the data in form of rows and columns. The logs collected, changes made in the elements, back-ups, are stored in this Database which runs on a Cent Operating System. The database is connected to the server as in whenever there is data to be stored or to be accessed it just needs to send a query for the respective function.

### 3 Methodology and Features

The automated web server has the features which can do almost all the basic operations and then can be used to configure and maintain the NE at period of time as required by the user.



**Fig. 3.** Features of the tool

Fig.3 show the features in the automated tool. The web server is connected to all the network elements i.e; from 1 to n elements. And the features are included to the web server using the Javascript used. The features include:

- IP Reachability
- Telnet
- File Transfer Protocol(FTP)/ Secure File Transfer Protocol(SFTP)

- Maintenance
- Alerts
- StoreLogs
- Software configuration

The flow diagram of the software upgrade of a particular BSC is shown in Fig. 4. These are just limited features of the tool. It can be further used for many other configuration purposes.

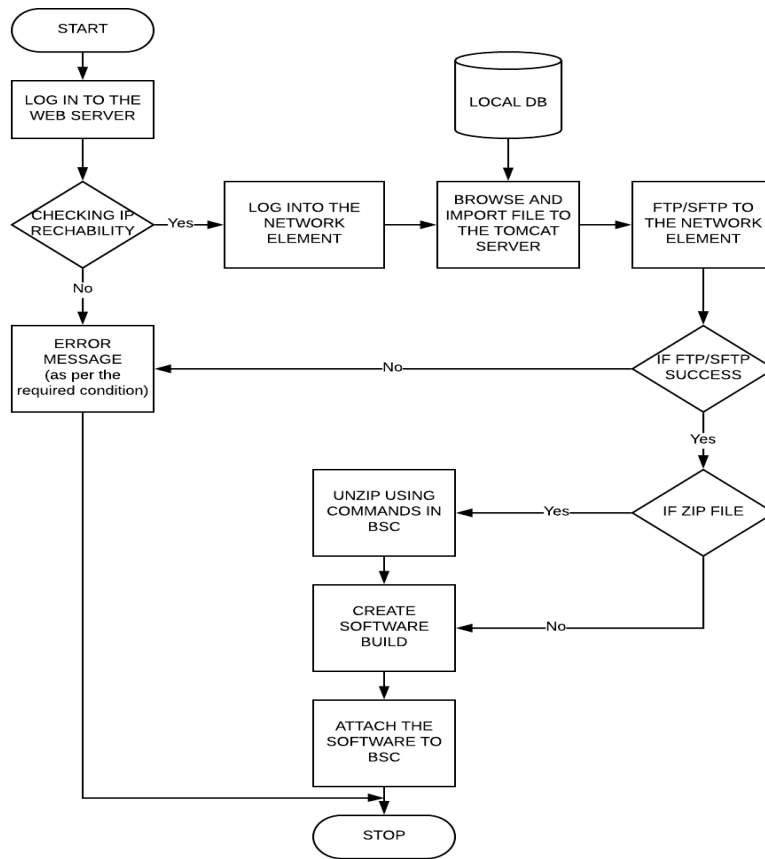


Fig. 4. Flow diagram of software upgradation of a BSC

```

public boolean telnetLoginCheck(String ip, String userName, String password) throws UnknownHostException, IOException {
    boolean status = false;
    Socket socket = null;
    try {
        socket = new Socket(ip, 23);
        PrintWriter s_out = new PrintWriter(socket.getOutputStream(), true);
        s_out.println(userName);
        s_out.flush();
        s_out.println(password);
        s_out.flush();
        BufferedReader s_in = new BufferedReader(new InputStreamReader(socket.getInputStream()));
        String response;
        while ((response = s_in.readLine()) != null) {
            if (response.contains("USER AUTHORIZATION FAILURE") || response.contains("DELAY APPLIED") || response.contains("**** DELAY OF")) {
                break;
            }
            if (response.contains("MAIN LEVEL COMMAND")) {
                status = true;
                break;
            }
        }
    } catch (Exception e) {
        e.printStackTrace();
    } finally {
        if (socket != null && socket.isConnected()) {
            socket.close();
        }
    }
    return status;
}

```

**Fig. 5.** Telnet Login Check for the NE selected

```

@RequestMapping(value = "/uploadZipToBsc.do", method = RequestMethod.POST)
public @ResponseBody Map<String, Object> uploadZipFileToBsc(parameters, HttpServletRequest request) throws Exception {
    Map<String, Object> response = new LinkedHashMap<String, Object>();
    boolean sftpStatus = false;
    Getting id of the BSC from DB
    if (id != null) {
        SFTP of zip file to BSC: sftpToBsc(parameters);
        if (sftpStatus) {
            Calling creation of Software build function: createSoftwareBuildId(parameters);
            if (buildId != null) {
                Response send to the frontend i.e, to the webpage of the tool
                response.put("SFTP is done successfully");
                response.put("SUCCESS", true);
            }
        } else {
            response.put("Problem Uploading the Zip file");
            response.put("SUCCESS", false);
        }
    }
    return response;
}

```

**Fig.6.** Function for software upgradation which includes SFTP, Software build creation and sending the response to web-page of tool

## 4 Result and Discussion

The tool is developed with all the features mentioned above and has been tested with various BSC for IP reachability, auto-configuration, alerts, software upgrading, maintenance, store log etc. The code for this is being shown in Fig. 5 & Fig. 6. The Spring MVC framework has been proved better than other frameworks as it can bind different frameworks into it. So it is better to use Java framework rather than python robot framework as it gives much bigger possibilities to access the data of NE, while python is simple but for automation we've to write script for every NE separately.

## 5 Conclusion

The purpose of automation is to reduce the human effort. And from this paper analysis it has been established that the human effort is reduced by a significant rate. The software configuration and the maintenance of the NE's is being done using the web application tool developed using Java Spring MVC framework is a much better than other frameworks as we can embed as many features into this tool and can even create a link with other frameworks like python robot framework.

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