# Usability and Accessibility Evaluation of Nigerian Mobile Network Operators' Websites

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*Abstract*— **Usability and accessibility of websites have been a subject of great importance to human computer interaction researchers. Hence, this paper carries out the usability and accessibility evaluation of the four main Nigeria mobile network operators' websites. The websites tested are: www.mtnonline.com, www.gloworld.com, www.ng.airtel.com, and www.9mobile.com.ng. Four online automated tools were used which are: Mobile SEO, WAVE, TAW and Achecker. User testing was also conducted in a controlled environment with forty participants who were given five tasks to perform on the websites. The activities of the participants were recorded using Camtasia studio to get the total time taken to complete the task. Questionnaire for Interaction Satisfaction (QUIS) was used to get users feedback on the tested websites. The QUIS was designed based on five categories with each category dealing with an aspect of usability. The results show that the overall usability level of MTN was the best among the four. This was followed by GLO, 9mobile and Airtel respectively. From the results obtained, it is recommended that the web designers of the mobile network operators compare their website design with web content accessibility guideline (WCAG 2.0) to make sure the different categories of subscribers are satisfied with the features and services provided by the websites.**

**Keywords— Accessibility, Usability, Websites, mobile network operator,**

## I. INTRODUCTION

Since the introduction of internet technologies, a new communication channel has been opened for citizens, business organisation and government. This has subsequently paved way for effective and efficient way of access to information and services [1]. Among emerging business organisation, telecommunication sector with focus on mobile services have emerged with a formidable and conspicuous online platform via websites. Through this platform, a lot of services are made available to various subscribers. This unparallel uptake of mobile services in Nigeria and Africa as a whole has no doubt had sizeable direct and indirect impact on the local economies [2].The importance of websites has been increasing with leaps and bounds over the years. Hence, it has penetrated every aspect of life and many business organisation have embraced its usage in dissemination of timely, accurate and up to date information to users.

This is to ensure seamless communication between subscribers and mobile network operators (MNO). In addition to this they intimate subscribers and website users with the avalanche of available products, offers, promos, callers tune, data plan, Frequently Asked Questions (FAQ), customer's feedback among others. So, a great level of interaction is expected between the users and the MNOs. This implies that the websites should not only be accessible but must also be usable.

For websites to be usable, the twin's quality of usability and accessibility must be met. It has been proved over the years that these elements are very crucial to the successful deployment of any website by any organization. Hence, tremendous research efforts have been channeled into evaluation websites based on usability and accessibility [3]–[5].

In Nigeria there are four major MNO which are MTN Nigeria communication Limited (MTN), Globacom limited (GLO), Airtel Nigeria (Airtel), and EMTS Limited (now 9mobile but formerly known as Etisalat). All these MNO use GSM and HSDPA technology. As at December, 2018 MTN has 67,133,009 million subscribers, GLO has 45,255,297million subscribers, Airtel has 44,180,484 million subscribers and 9mobile has 15,917,015 million subscribers [6]. So, these amount to over 172 million mobile subscribers as at 2018. Expectedly, some of these subscribers will have one reason or the other to carry out some tasks on the MNO websites. Hence, there is need for good usability and accessibility.

These MNO all have an online platform to provide services to their subscribers at any particular point in time. Thus, it provides easy means of accessing their services to their subscriber's. Presently the mobile network operator websites are being underutilized because most subscribers prefer to call customer care than to go online to solve their problem and not all their subscribers have access to the internet. MNO in Nigeria have websites so that their subscribers to get update of their services online, but they still make use of short message services (SMS) to send messages for their tariff plans updates, caller tunes among other services. The reason according to some subscribers is that the websites are not effective, efficiency and satisfactory enough. More so, they are not up to standard, most of the feature are not functional, and they are not well structured. Since, various services are being provided

by these MNO on the websites which users interact with them always. Hence the need arises to investigate the usability and accessibility levels of these websites.

There have been previous studies conducted in evaluating the usability as well as accessibility of different genre of websites like educational websites [7]-[8], e-government websites [9]–[11], e-commerce websites [12]-[13], e-learning websites [14], airline websites [15], hotel websites [16] and so on to mention a few. Till date there is no known previous study conducted to evaluate the usability and accessibility of Mobile network operators' websites. Hence, this paper tends to fill that gap with a view of showing the status of these important websites.

## II. LITERATURE REVIEW

Usability has been described as a quality attribute which evaluates the ease with which user interface interfaces are used by different people. It refers to procedure to improve ease-of-use during the process of design [17]. The recent International Organization for Standardization (ISO) 9241-11 [18] defines usability as "usability can be defined as "the extent to which a product, service or system can be used by specified users to achieve a specified goals with effectiveness, efficiency, and satisfaction in a specified context of use"". Usability can also be seen as a capability to communicate, learn and use a service or product to accomplish the goal that it is meant to facilitate [19].

Web accessibility is concerned with the ability to design websites that can be used by different categories of people irrespective of their disability. It implies that people with disability can easily observe, comprehend, navigate and interact with websites and tools [20]. Accessibility involves a wide range of disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities. It is based on Web Content Accessibility Guidelines (WCAG) which is an internationally accepted standard that consists of fourteen guidelines that with provision to specify on how accessible website can be developed. Web Accessibility Initiative (WAI) which was founded by the World Wide Web Consortium (W3C) to promote the accessibility of the Web further defines web accessibility as a means by which people with disabilities can use the Web [19]. Both attributes are very important for websites to be effective.

Different attributes of usability have been viewed from various disciplines. Booth [21] listed four usability aspects namely usefulness, effectiveness, learnability, and attitude. Shackel [22] identified four usability evaluation criteria which focus on how users accomplish their tasks while using the system. These are learnability, flexibility, effectiveness, and user attitude. Jacob and Thomas [23] further proposed five attributes of usability as learnability, efficiency, memorability, low error rate (easy error recovery), and subjective satisfaction [19]. Brinck, Darren and Wood [24] definition of usability includes functionally correct, efficient to use, easy to learn and remember, error tolerant, and subjectivity. Jackob Nielsen, a famous usability expert, defined usability as comprises five components of learnability, efficiency, memorability, minimization of errors, and satisfaction [25].

According to Rinder [26] usability tests typically involves having a user performing a task in order to test the ease and efficiency of task completion. In addition to this, the user's successive satisfaction with their performance or the product is observed.

Ways by which usability can be conducted include the use of expert evaluators. These experts review a system based on a set of usability principles otherwise known as heuristics. This is done in order to check the conformance level with the heuristics and to identify potential usability problems [27].

According to Garcia and Diaz [28] usability and accessibility have become important to enable satisfactory online brand communication. Web navigation will facilitate the usability and accessibility of websites which improves the company's image and will favour loyalty towards the brand. Petrie and Kheir [29] are of the opinion that accessibility and usability are well confirmed concepts for user interfaces and websites. It is believed that accessibility and usability problems can be seen as two over lapping sets which can be classified into three. These are pure accessibility problems, pure usability problems and universal usability problems.

Some related studies in the field of usability and accessibility of websites are reviewed as follows. Mentes and Turan [30] assessed the usability of the website of university in Turkey based on attractiveness, controllability, helpfulness, efficiency and learnability. The study discovered that there exists a positive relationship between attractiveness, helpfulness, learnability, efficiency and usability perception of website but a negative relationship with controllability.

Sixteen e-commerce websites in Pakistan were evaluated based on usability and accessibility by [31].The study was based on conformance of these websites with Nielsen's guidelines principle as well as WCAG. Adepoju and Shehu [7] conducted a study on usability evaluation of academic websites in Nigeria using automated tools which focused on accessibility. Three Automated Tools were used namely Web Accessibility Checker, HERA and WAVE were used in the study. The automated tools inspected the conformity of the website with the WCAG standard. Results obtained from the study shows that there are lot of accessibility errors with the websites used in the study. Hence, they are not in total compliance with WCAG standard. Adepoju, Shehu and Bake [9] also carried out a study to know the level of accessibility conformance of e-Government websites in Nigeria, two online Automated tools were used to analyze the e-Governments websites. The results obtained further shows that there is non-conformity with WCAG 2.0 standard by the websites used in the study.

Another study was carried out in Malaysia which involves the use of three automated tools of website optimization, Axandra, and EvalAcess 2.0 by [32] . It was reported at the end of the study that there are numerous issues in Malaysia e-government websites usability and accessibility. Further study by Awlad and Yavuz[1] focused on Libya e-government websites evaluation based on usability and accessibility. The accessibility testing was done using two automated tools and it was reported that none of them passed the accessibility test. Thirty-two

| OPERATOR | JUN 2018 (Q1.Q2) | SEP 2018 (Q2.Q3) | DEC 2018 (Q2.Q3) |
|---|---|---|---|
| MTN | 66,448,706 | 64,160,404 | 67,133,009 |
| GLO | 40,108,508 | 40,856,649 | 45,255,297 |
| AIRTEL | 39,898,448 | 41,313,633 | 44,180,484 |
| 9MOBILE | 15,811,684 | 15,355,061 | 15,917,015 |
| *TOTAL* | *162,307,346* | *161,685,747* | *172,485,805* |

evaluators were involved in the usability testing and about one hundred and sixty-eight usability problems were discovered by them.

From the review above, various methods and approaches are been used by researchers to carry out website evaluation. While some conducted both accessibility and usability in their studies, others only focused on either of these.

### III.    MOBILE NETWORK OPERATORS

As stated earlier, in Nigeria there are four main mobile network operators which are MTN, GLO, Airtel and 9mobile.

MTN Group as a multinational mobile telecommunications company was founded in 1994. Its operation is in more than twenty-five African, European and Middle Eastern countries. MTN is from South Africa and its Headquarter is in Johannesburg. MTN have the Market Share of about 38%. It is the largest mobile network operator in Nigeria. Its website is www.mtnonline.com.

Globacom Limited (or GLO) was founded in 2003. It is a Nigerian multinational telecommunications company. GLO operates in four countries in West Africa: Nigeria, Republic of Benin, Ghana and Côte d'Ivoire. GLO network is from Nigeria and its headquarters is in Lagos. GLO have the Market Share of about 26%. Presently, it is the second largest network operator in Nigeria. Its website is www.gloworld.com

Airtel is an Indian multinational telecommunications services company. Its operation is present in twenty countries across South Asia & Africa. Airtel is from India and it headquarter is in New Delhi. Airtel has the market Share of 25.5% and the third largest mobile network in Nigeria. The website is www.airtel.ng.com.

9mobile (formerly Etisalat) is a UAE based telecommunications services provider, currently operating in fifteen countries across Asia, the Middle East and Africa. Etisalat is from United Arabs Emirates and their headquarters is in Abu Dhabi. Etisalat have the market Share 9%. The website is www.9mobile,ng.com.

Table 1 shows the quarterly data on mobile subscriber information for three quarters in 2018.

Various services are being provided by these mobile network operators on the websites and users interact with them always. Hence the need arises to investigate the usability and accessibility levels of these websites.

### IV.    METHODOLOGY

This research adopts three steps to carry out the usability and accessibility evaluation of Nigeria MNO websites. These methods which are stated below are further described in the sections following.
i.         Online automated evaluation tools
ii.        Usability testing
iii.       Questionnaire-based method

Table 1: Quarterly subscriber operator data (source; NCC)

#### D.    Automated tools

This involves the use of online automated tools to test for the conformance of the selected websites for WCAG conformance. Once the user's login into websites, the URL of the websites will be entered into the available box and then the test will be activated by pressing the enter key or search (or any available) button. Four online automated tools were used for the evaluation; Achecker, WAVE, TAW, and mobile SEO.

**Achecker:** Accessibility Checker is an open source accessibility evaluation tool developed in 2009 by the Inclusive Design Research Centre (formerly known as the Adaptive Technology Resource Centre) of the University of Toronto Canada. Users can submit a web page via this tool, or can upload its HTML file. Various guidelines which users can select for evaluation are the HTML Validator, BITV, Section 508, Stanca Act, WCAG 1.0 and WCAG 2.0.

**WAVE:** This stands for Web Accessibility and Versatile Evaluator, and it is an automated tool developed by Web Accessibility in Mind (WebAIM). It is available online as well as a Firefox add-on. The accessibility violations report is presented by annotating a copy of the evaluated page and subsequently provides recommendations on how to repair them. Instead of providing a complex technical report, WAVE discloses the original Web page with embedded icons and indicators that reveal the accessibility information within the page. WAVE carries out evaluation based on WCAG.

**TAW:** Test de Accesibilidad Web is an automatic online tool for accessibility analysis. It was developed by the CTIC Centro Tecnólogico, TAW clearly marks the accessibility violations that it discovers by providing an annotated version of the web site as well as recommendations on how to resolve them. TAW categories the result of valuation into perceivable, operable, understandable and robust, other attributes includes warning, problems and not reviewed. It is available both online and as a desktop application as well as a Firefox add-on [33]

**Mobile SEO:** mobile SEO means "mobile search engine optimization" of websites combined with ability to view it flawless on mobile devices such as smartphones and tablet.an open source for accessibility evaluation tool which checks for Mobile friendly, Mobile speed, Google access and Page redirects.

#### E.    Usability Testing

Usability testing involves carrying out a test with the real users in order to know the ease of use of the system, product or service been tested. The first part involves users being asked to complete representative tasks on the

websites. Typically, they are being observed by a moderator so as to know where problems are encountered and confusion experienced. Consequently, recommendations will be made to overcome these usability issues if many people encounter similar problems. However, it has been suggested that to get a comprehensive evaluation, automated tools should be combined with usability testing.

In the study forty users were used and the participants were asked to perform the following tasks on each of the websites.

1.      Check the websites for latest device
2.      Look for the cheapest tariff plan and data plan
3.      Report for loss of SIM card
4.      Chat with the online customer care service
5.      Check for roaming inquiry

### F.  Questionnaire-based method

The last part involves the use of questionnaire to get feedback from the users based on their interaction with websites. Questionnaire is a direct way to getting feedback from end user, hence questionnaire must be simple to understand, straight forward and carry a good meaning to the evaluation purpose. This method involves the process of recruitment of users, distribute questionnaires to the participant and perform few tasks on the websites. The questionnaire adopted for the research is divided into three sections; section A demographic information of the participant, section B Questions for the usability studies, and the section C was used for general observation of the website. This research project adopts Questionnaire for Interaction Satisfaction (QUIS).

**QUIS** was developed by the University of Maryland designed in order to evaluate satisfaction of users' subjectively when interacting with some aspects of the human-computer interface. The current version QUIS 7.0 which is an update of previously validated QUIS 5.5. It contains a demographic section, and another section which measure the overall system satisfaction along six scales. Four measures of specific interface factors: screen factors, terminology and system feedback, learning factors, system capabilities.

The overall satisfaction with facet of the interface is measure by each area. Also, the factors that make up that facet based on a 9-point scale is measured. The questionnaire can be configured according to the needs of each interface analysis by including only the sections that are of interest to the user.

### G.  Test Environment

A computer laboratory was used in conducting the test sessions with four different laptops system. Camtasia studio software was used to record the session during the test.

i. HP Compaq CQ57 with intel® dual core™ CPU @ 2.12GHz processor 4.00GB RAM 500GB hard disk and windows 10 pro.

ii. Lenovo with CPU @ 2.16GHz processor 4.00GB RAM 500GB hard disk and windows 10.

iii. HP 15 r011dx with intel® inside™ Pentium™ CPU 2.14GHz processor 4GB RAM 750GB hard disk 64 Bits and windows 10.

iv. DELL Inspiron 5447 with Intel® core™ i5 CPU @ 2.4GHz processor 8GB RAM 64 Bits 1TB hard disk windows 8.1 touch screen and fast access facial recognition.

## V.      RESULTS AND DISCUSSION

### H.  Online automated tools results

Typically, Achecker could check for a whole website, single webpage online, offline html file or html code.

Table 2 shows results obtained from Achecker with MTN recording the largest numbers of problems while Airtel records the least. Some of the common problems are img element missing alt attribute, image used as anchor is missing, valid Alt text, input element type of "text", missing an associated label and input element, type of "text" has no text in label, label text is empty.

Table 3 gives the results obtained from TAW. MTN website recorded the highest of problems, while GLO

| MNO | Known problems | Likely problems | Potential problems |
|---|---|---|---|
| MTN | 114 | 0 | 550 |
| GLO | 13 | 1 | 640 |
| Airtel | 3 | 0 | 15 |
| 9mobile | 50 | 0 | 477 |

website recorded highest numbers of warnings. The least number of problems and warning was recorded by Airtel website.

Table 4. shows the mobile SEO results all the websites perform well on mobile friendliness but GLO websites is the most mobile friendly. Also, the speed is for all the websites are not encouraging.

Table 5 shows WAVE results. Airtel returns no values as at the time the study was conducted. Some of the errors include empty link contains no text, a button is empty/, has no value text, missing form label. The alerts include heading level is skipped, non-script element is present, redundant link and missing first level heading.

Table 2: Results of Achecker

Table 3: Results of TAW

| | Attributes | MTN | GLO | Airtel | 9mobile |
|---|---|---|---|---|---|
| **Warnings** | Perceivable | 53 | 35 | 0 | 36 |
| | Operable | 67 | 14 | 2 | 43 |
| | Understandable | 12 | 6 | 0 | 12 |
| | Robust | 369 | 844 | 0 | 301 |
| | **Total** | **501** | **899** | **2** | **392** |
| | | | | | |
| **Problems** | Perceivable | 24 | 3 | 1 | 29 |
| | Operable | 27 | 10 | 1 | 17 |
| | Understandable | 3 | 2 | 1 | 2 |
| | Robust | 47 | 9 | 0 | 14 |
| | **Total** | **101** | **24** | **3** | **62** |
| **Not reviewed** | Perceivable | 4 | 4 | 4 | 4 |
| | Operable | 7 | 8 | 7 | 6 |
| | Understandable | 5 | 4 | 5 | 5 |

| Websites | Mean | Std. Deviation |
|---|---|---|
| MTN | 6.42 | 2.05 |
| GLO | 6.17 | 2.84 |
| Airtel | 5.02 | 2.878 |
| 9mobile | 6.13 | 2.23 |

| Item | Value |
|---|---|
| **Gender:** | |
| Male | 29 |
| Female | 11 |
| **Age:** | |
| 16-20 years | |
| 21-25 years | 27 |
| 26-30 years | 4 |
| 41-45 years | 1 |
| **Internet experience:** | |
| Less than 1 year | 2 |
| 2years- 4 years | 9 |
| Above 5 years | 19 |

| Items | MTN | GLO | Airtel | 9mobile |
|---|---|---|---|---|
| Errors | 55 | 19 | - | 37 |
| Alerts | 4 | 27 | - | 12 |
| Features | 19 | 12 | - | 2 |
| Robust | 0 | 0 | 1 | 0 |
| **Total** | 16 | 16 | 17 | 15 |

Table 4: Results of Mobile SEO

Table 5: Results of WAVE

Table 6: Demographic data of the participants

Table 7: Overall website performance

Fig 1:  Users' overall reaction to the website

### I.  User Testing results

The usability test was conducted at a laboratory in School of Information and Communication Technology. A total of 40 participants were recruited randomly for the study with ten users per each mobile network website. The demographic data of the participants are shown in Table 6. experience of participants based on data collected, are as follows: 2 participants (5%) with less than 1 year, 9 participants (22.5%) with 2years-4years, 6 participants (15%) with 5years and 23 participants (57.5%) with above 5 years.

Result on the overall reactions of the users to the websites is shown in fig 1. This is based on user's reaction to how wonderful, easy, satisfying, stimulating and

Fig 1 chart categories: Wonderful, Easy, Satisfying, Stimulating, Flexible — series: MTN, GLO, Airtel, 9Mobile
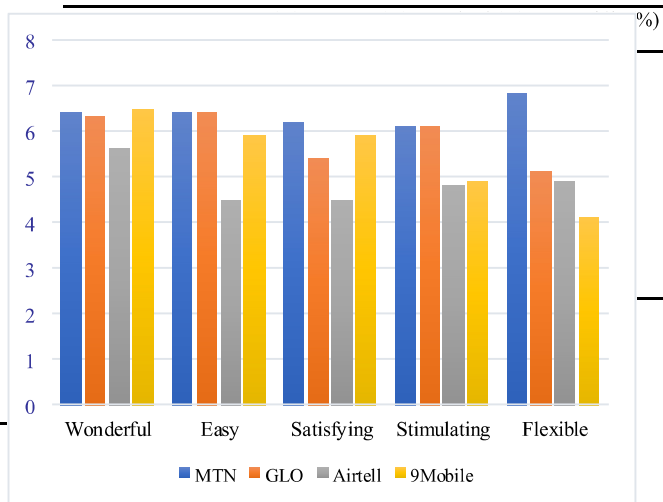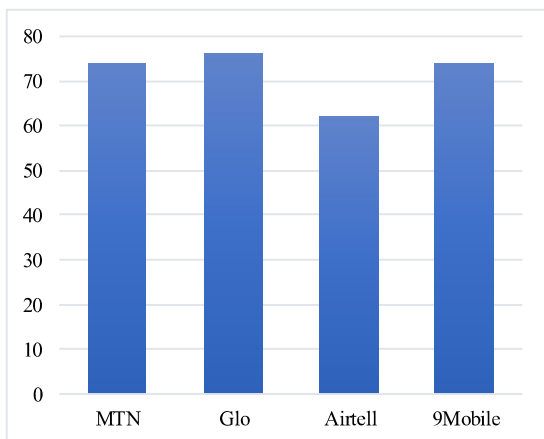
flexible the website is to them in the course of interacting with the websites. users find MTN websites most interesting in this regard and this is closely followed by GLO and 9Mobile websites. Airtel website did not provide good user satisfaction based on the results obtained.

Fig 2 shows the task completion rate in percentage. This is based on the number of tasks each participant was able to perform across the websites. In all there are a total of five tasks. But an average of three tasks were able to be accomplished by most participants.  GLO websites also take the lead in this regard with 76%. task completion rate.  MTN and 9mobile have 74 % task completion rate while Airtel task completion rate is 62%.

Table 7 show the overall performance across the websites based on the analysis of the data collected from the questionnaire.  Airtel has the lowest mean value (M = 5.02, SD = 2.87) and MTN has the highest mean value (M = 6.42, SD = 2.05). 9. GLO and 9mobile websites have an average mean and SD score of 6.17, 2.84 and 6.13, 2.23 respectively. The maximum available  score is 9. So, none of the websites perform extremely excellent.

In conclusion, from the questionnaire result, the order of performance is MTN, GLO, 9mobile and Airtel.

Fig 2: Task completion rate

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*J. Further Analysis Questionnaire Report*

According to some participants, there were complaints that Airtel website is not easily accessible, not user friendly, not flexible, not easy to navigate and difficult to access. Few others said it was easy use and accessed.

On 9mobile website, some users are of the opinion that it is user friendly and easy to operate while some said it was a bit confusing, no latest device (not available), not well organized, no comparison chat for cheapest tariff plan and data plan and roaming inquiries are not available.

As regards MTN website, a lot of participants said it was user friendly and that the Graphical User Interface (GUI) is fine.

Some users of GLO website are of the opinion that it is not user friendly and the content is not well organized while some believe otherwise

## VI  CONCLUSION AND RECOMMENDATIONS

Nigerian mobile network operators' websites are becoming more increasingly important for millions of subscribers daily. Hence, the need for the operators of these websites to develop not only usable but accessible websites which will make information easily available to people irrespective of their age, sex, ability and experience.  Thus, this study has taken an in-depth usability and accessibility evaluation of the four MNO websites in Nigeria.

The evaluation methods used are: online automated tools, user testing and questionnaire-based method. The results obtained from user testing and questionnaire-based method showed that the overall usability level of MTN was the best among the four. Further results show that none of the website satisfied completely the WCAG 2.0 guidelines. Also, the overall satisfaction with the websites put MTN ahead of others, with Airtel website coming last. All the participant cannot perform all the selected five tasks on the websites and as a result the best task completion rate was achieved by GLO website with 76% satisfaction.

This research is very relevant to the MNO management as well as to the subscribers of various MNO that are accessing  their websites. It is suggested that the MNO operators should improve their websites look and feel. This is necessary in order to provide subscribers with services which are both usable and accessible. This will further allow subscribers to have easy access to all information they need online instead of been limited to using only short message services (SMS). More so, it will also improve their relationship and enhance communication between the subscribers and the MNO.

It is therefore recommended that MNO website's designer should follow and incorporate the guidelines as stipulated in World Wide Web (WWW) and Web Content Accessibility Guidelines (WCAG) 2.0.  This will ensure a design that is usable, accessible, maintainable, user friendly and enjoyable to all users. The websites should also be updated regularly for information like latest/cheapest tariff plan, latest device and cheapest data plan.

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