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Push Notification Using the Websocket in the Application of *Sistem Informasi Uji Kompetensi Online (Situk)* Version 2

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ABSTRACT

SITUK-V2 is an application of the second version of the online competency test integrated system, which is used in the competency test at the LSP (Lembaga Sertifikasi Profesi) UPN "Veteran" Jawa Timur, with the signing up or registration process up to a statement of competence. At the time of registration, both from the session of the asesi and the asesor and the statement of graduation by the asesor, the asesi will receive a notification in the registered email, this notification uses push notification technology. Push notification technology is a technology that allows a device (client) to get information in the form of notifications sent by the information provider (server) automatically. In general, the mechanism for sending notifications from the server to the client uses a stand-alone push service (broker) and uses the Hypertext Transfer Protocol (HTTP) protocol. but in sending notifications there is often a delay to the client. In this study, a notification delivery mechanism with push notifications was developed which will be implemented using the WebSocket protocol in the SITUK-V2 application where the result is that there is a difference in delay time between the registration process and the competency statement process that is sent via user email, this is due to the influence of the size of the data, bandwidth, and device used.

Keywords: Push Notifications, WebSocket, SITUK

Introduction

Lembaga Sertifikasi Profesi (LSP) University of Pembangunan Nasional "Veteran" Jawa Timur is an institution that conducts competency assessments and competency certification for students according to professional skills that have been licensed by the Badan Nasional Sertifikasi Profesi (BNSP). Competency Certification is the process of providing competency certificates that are carried out systematically and objectively through competency exams that refer to the certification scheme that has been made by LSP and approved by BNSP. The processes that occur in LSP are quite numerous and require good data processing. The processes that occur at LSP are carried out manually, which causes these activities to run slowly and the recorded data is not automatically connected to other parts, and data related to the assessment is not stored neatly. With these problems, it is necessary to change the LSP data processing method from manual to computerized and automatic LSP data processing method. Where it can carry out the participant registration process, independent assessment by asesi, data maintenance by admin or LSP employees, and the process of determining graduation become systemized and integrated.

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The competency test process begins with registration, both collectively and independently by visiting the LSP of the University of Pembangunan Nasional "Veteran" Jawa Timur. This registration will later provide information that will be submitted to the asesor (the asesor is a team of examiners in the competency exam) or admin, which will then be notified to the asesi (the asesi is a competency test participant) if approved to take the competency test, where the implementation of the professional certification competency test consists of several stages, namely written, verbal, practice, interview, simulation, and others. If after the competency test, and the asesi is declared competent, the asesi will receive a certification that is recognized by the Badan Nasional Sertifikasi Profesi (BNSP).

When an asesi or asesor (all of them are users) performs the registration process, either by the asesor or by the asesi and a statement of competence by the asesor, the asesi and asesor will receive a notification feature to be able to receive information quickly and periodically without having to open the site or application first. This notification feature is sent from the server using push notification technology. Push notification is a technology for sending information in the form of notifications from an information provider (server) to a device (client) automatically (Hansen et al., 2012). The notification received by the client is in the form of a successful registration notification and a statement of competence. The working system of this technology sends notifications by directly sending notifications from the server to the client without having to be asked by the client first (Brüstel & Preuss, 2012). This notification delivery mechanism is arranged in a service called a push service. By using this technology, device users do not need to visit sites or applications periodically to get information or notification results. If there is the latest information from the site or application, the device user will immediately get a notification that there is the latest information from the site or application. Examples of this push technology are SMS notifications, Email notifications, and others. By using this technology, device users do not need to visit sites or applications periodically to get information or notification results. If there is the latest information from the site or application, the device user will immediately get a notification that there is the latest information from the site or application. Examples of this push technology are SMS notifications, Email notifications, and others. By using this technology, device users do not need to visit sites or applications periodically to get information or notification results. If there is the latest information from the site or application, the device user will immediately get a notification that there is the latest information from the site or application. Examples of this push technology are SMS notifications, Email notifications, and others.

Several studies related to push notifications, among others, were conducted by Elliot Estep (Estep, 2013). One aspect that Elliot Estep wants to achieve is to know the performance of the protocol being tested on the client-side. The parameter used is resource usage on the client-side. Likewise, research conducted by Muhammad et al. 2018) compared the Performance of the WebSocket Protocol with the SSE Protocol on Push Notification Technology, where both protocols will be implemented and tested based on 3 scenarios, namely 1 client, 3 clients, and 6 clients. The results obtained are the average delay and CPU usage on the SSE protocol is smaller than the WebSocket protocol. Yudianto et al. (2017) developed a notification delivery mechanism with push notifications that will be implemented using the WebSocket protocol and broker implementation into the server. The results of the development in this study have a maximum number of clients that can connect to the server as many as 1015 clients and the average delay obtained from testing the sending of notifications in bulk, sending notifications of different sizes, and sending notifications using different bandwidths.

Based on the case study above, the research that will be carried out is to see or find out the performance of the WebSocket protocol in the application of Sistem Terintegrasi Uji Kompetensi Online (SITUK) with push notification technology. The research will be conducted using the flutter framework with Dart language and javascript, the Socket.IO library, on the scope of the internet network via the https://situk-web.igsindonesia.org/ server and for clients using laptops or PCs and smartphones with operating systems Android and iOS. The test will be carried out using the

delay parameter, the results obtained will be analyzed to determine the performance of the WebSocket protocol related to the delivery method based on the test parameters.

Literature Review

Push Notifications

Push notification is included in the category of internet communication model, based on how to publish/subscribe the client does not have to approve or request from a central server to get information. Unlike the traditional scenario (pull) where the client has to request every time it wants to get information from the system. In general, push notifications are sent via Push Notification Service (PNS) specific to each platform: such as Apple Push Notification Service (APNs) for Apple, Google Cloud Message (GCM) for Android, and Microsoft Push Notification Service (PNS) for Windows Phone. However, some of the algorithms for each civil servant are the same (Laysha, 2015), namely, the three technologies use the Hypertext Transfer Protocol (HTTP) protocol. HTTP is a standard protocol that functions to regulate the delivery of information in a network. On the other hand, smartphone users must register their smartphone ID first with each push technology before receiving information regularly. This is needed so that the sending of notifications from the server to the client is not misdirected. The general notification delivery mechanism for the three push technologies can be seen in Figure 1.

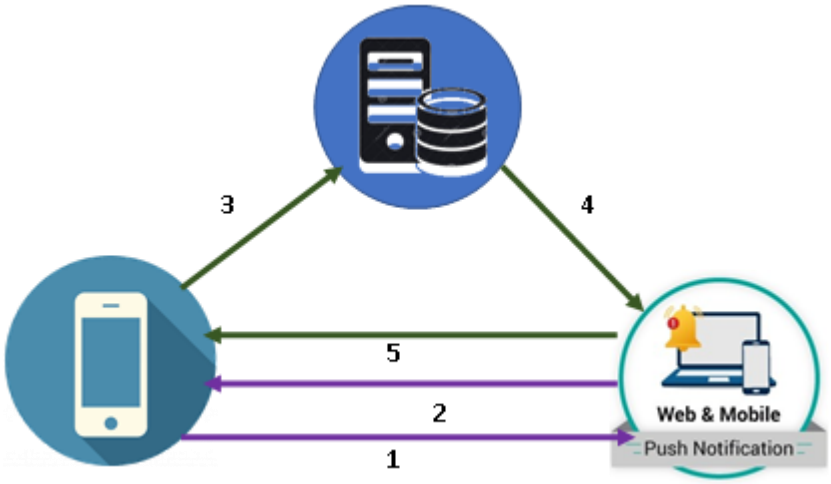

Figure 1. Push notification working mechanism

Figure 1 describes pushing notification technology using a push notification service (PNS) as a broker on the web or android based smartphone. The working system of push notifications is as follows:

1. Client registered with PNS as a broker,
2. Once registered, the broker provides an identification (token) to the client. Token functions so that notifications are sent right to the token owner.
3. After the token is obtained from the broker, the client will send the token to the application server.
4. The Token obtained from the client will be saved to the database.
5. The mechanism for sending notifications from the server to the client is:
6. Servers send a notification to the broker.
7. The broker receives notifications from the server and sent to the client according to the token stored in the application server database.

WebSocket

WebSocket is an event-driven, full-duplex asynchronous communication channel for web applications. WebSocket can provide real-time updates that previously used the long polling method. The main advantage of using WebSocket is that it reduces resource requirements on both the client and server-side. WebSocket uses HTTP as a transport mechanism, communication does not end immediately after the response is received by the client, but as long as the connection is still open the client and server can send messages to each other asynchronously (Estep, 2013).

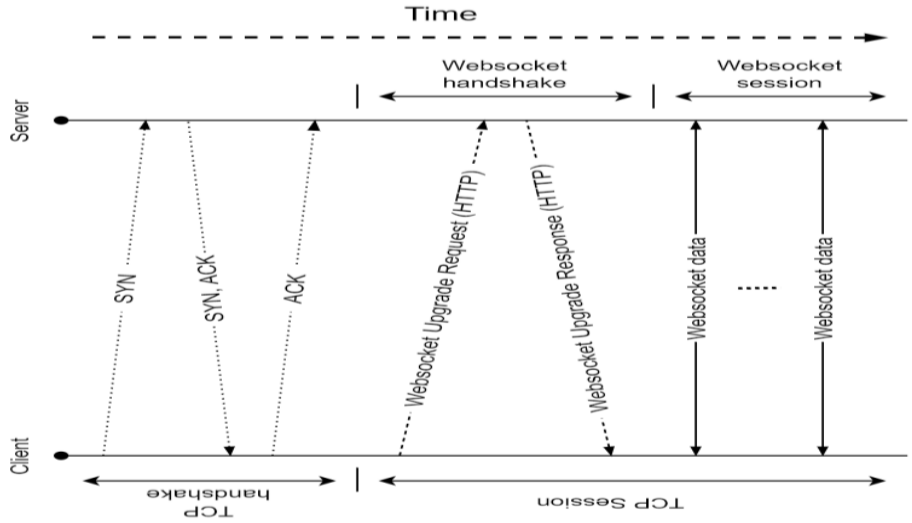

Figure 2. WebSocket protocol working diagram

Figure 2 shows the handshake process between the client and the server on the WebSocket protocol. First, the client will request a WebSocket connection on the server. Then the server will respond to the connection request from the client. After the handshake process is formed, the WebSocket protocol can send and receive data in a dual-channel model or different paths at the same time (Ludovici & Calveras, 2015). The server will actively send data in the form of notifications to the client. The process of sending notifications will continue to run until the command is given to disconnect on the server-side. In this study, the WebSocket push server also acts as a broker so that delivery is directly from the server to the client. When the client connection with the server is lost, there is a notification on the server-side.

Website

The website can be interpreted as a collection of pages that can be used to display information in the form of text, images, animation, sound, and combinations that are static or dynamic depending on the value of data or parameters sent by the user to the webserver (Jader et al., 2016) stored on the internet or called a webserver (Tasneem & Ammar, 2018). Research that has been carried out is related to Sistem Terintegrasi Uji Kompetensi Online (SITUK) which applies web push notification technology (Reyes et al. 2019), to conduct competency tests at the UPN "Veteran" Jawa Timur LSP which results in web-based applications running well as expected (Wijaya, 2017). Previous research that has been done also aims to make the system more efficient. Implementing web notification technology, it is hoped that it can help asesor and asesi to get notifications when a notification comes in. Web Push Notification is a method that sends data to a browser or mobile device in real-time, which this web push notification can provide user convenience in the form of information (Sulastri et al., 2016; Praba & Hariyanto, 2020). Information needed by users to use the application, how the system works, such as short messages or short messages when messages come in, a notification will appear to notify about data or messages that have been sent or when

the user's screen is run even if the user opens the web or not (Isikligil et al., 2017; Sulastri, et al., 2016).

Web Push Notification is a method that sends data to a browser or mobile device in real-time, which this web push notification can provide user convenience in the form of information (Bidargaddi, et al. 2018; Sulastri et al., 2016). Information needed by users to use the application, how the system works, such as short messages or short messages when messages come in, a notification will appear to notify about data or messages that have been sent or when the user's screen is run even if the user opens the web or not (Isikligil et al., 2017; Sulastri et al., 2016). Web Push Notification is a method that sends data to a browser or mobile device in real-time, which this web push notification can provide user convenience in the form of information (Reyes et al., 2019; Paronen, 2015). Information needed by users to use the application, how the system works, such as short messages or short messages when messages come in, a notification will appear to notify about data or messages that have been sent or when the user's screen is run even if the user opens the web or not (Isikligil et al., 2017; Sulastri, et al. 2016).

SITUK Application (Integrated System for Online Competency Test)

The competency test process begins with registration, both collectively and independently by visiting the LSP of the University of Pembangunan Nasional "Veteran" Jawa Timur. This registration will later provide information that will be submitted to the asesor or admin, who will then be notified to the asesi if approved to take the competency test. This registration uses the APL 1 form, the APL 1 form contains the data for the applicant or assessment and data on the certification scheme to be followed along with the required evidence. After APL 1 is approved by the admin or asesor, the asesi can continue to fill out the APL 2 form which contains data on the independent assessment according to the selected scheme, which is to interpret themselves according to the material to be tested. When working on APL 2, the asesi answered one of the materials incompetently, then the asesi has been declared not to have passed the certification and it is advisable to take part in training and debriefing before re-taking professional certification. If the results of the competent assessment answers are all in APL 2, then the assessment is considered eligible and can carry out a competency test (Masdiyasa, et al. 2020).

The implementation of the professional certification competency test consists of several stages, namely written, verbal, practical, interviews, simulations, and others. If after the competency test, and the asesi is declared competent, the asesi will receive a certification that is recognized by the Badan Nasional Sertifikasi Profesi (BNSP). The process carried out starting from registration to determining the results of the competency test still uses a manual system. A large number of existing schemes also makes the process of grouping and distributing questions based on schemes still not, organized and neatly stored. Asesi registration data is still manually inputted by the admin which also makes this process take longer.

Material and Methods

This research was carried out at LSP UPN "Veteran" Jawa Timur, the determination of the research location was based on considerations of data access, the data as the research had not been processed much so the latest information was still scant. In this study, the method (Putri & Wulandari, 2016) uses the waterfall model, which is a method with a linear sequence model or a classical lifeline that approaches the plot sequentially. The stages of the method applied in this research include analysis, design, coding, testing, and up to the support stage.

However, referring to the title of the research, this paper will discuss push notifications on the SITUK application, where the device that acts as a server is the SITUK website at the domain address and hosting: https://situk-web.igsindonesia.org/ with the operating system (Masdiyasa et al. 2020). While the devices that act as clients are laptops or PCs and some smartphones only as a comparison, of course with the Android operating system and laptops with the Windows operating system or other operating systems on the asesi side. Implementation of notification

delivery mechanism (push service) using WebSocket on the server-side using a web-based programming language. In addition, the implementation of push services on the server is supported by using the Flask framework and the Socket.IO library. While on the client-side, several devices have different needs. Client push notification implementation using WebSocket on Android device using Flutter framework. While the implementation of the client on a laptop device uses a web-based programming language as shown in Table 1. And Figure 3 is a block diagram of the push notification test on the SITUK application.

Business process analysis Online Competency Test System (SITUK) Version 2

From the results of interviews conducted, several user requirements for the API (Masdiyasa, et al. 2020) will be built, which are as follows:

1. Asesi candidates are required to register with the system before registering for the competency test.
2. The admin will determine the schedule for the competency test registration limit.
3. To register for the competency test scheme, asesi must register according to the schedule provided by the admin on the system and must complete APL 1.
4. After the asesi registers for the competency certification test, the admin or asesor will verify the APL 1 data and the attached requirements.
5. After the registration data has been verified, the admin will select an asesor for each session.
6. The next step is to fill out the APL 2 form, which is an independent assessment.
7. The asesor will check on APL 2, if there are results that are not yet competent then the asesi is declared incompetent.
8. The asesor determines the date of the competency test on the participants being tested.
9. When the asesor conducts the competency test, the asesor does not need to write the results of the verbal assessment, etc. to the system.
10. Asesor is required to fill in the form of observation checklist, portfolio evaluation checklist, and competency assessment records.
11. The asesor decides whether the asesi is competent or not yet competent on the competency assessment record form which the system will recheck the results of the competency test.
12. Admin can manage schema data, competency units, elements, and performance criteria on the system.
13. The admin can manage the data for the competency test place.

Design and implementation push notification SITUK version 2

The simulation designed in this study is a simulation of the working mechanism of sending notifications sent by the server to the client. In this study, the SSE protocol was used to be able to compare the results between the two protocols according to the purpose of this study, but it would be more directed to the use of WebSocket in the SITUK application (Masdiyasa et al. 2020), thus this discussion is divided into two parts, namely the implementation of the WebSocket protocol and the SSE protocol into the delivery mechanism on push notification on the same local network (WLAN) as well as on the internet network, but more focused on the implementation of WebSocket on the internet network through the domain situk-web.igsindonesia.org

As shown in Table 1, the device that acts as a server is the situk-web.igsindonesia.org domain. The implementation of sending notifications using WebSocket on the server-side uses a web-based programming language, namely javascript. It also uses the Flask framework and the Socket.IO library. The Flask framework is used to design servers that are supported by the Socket.IO library. For devices that act as clients are smartphones using the Android operating system. The programming language used is javascript. Javascript serves to design web pages that will be accessed by clients through a browser.

In the process of sending notifications on a per-client or broadcast basis, the user fills in the register account column to be used as the value of the push notification variable and the link

variable. The data input variable in the notification process will have a value according to the registration data. After the user enters the required notification data, the server will process the data. The first process is to enter the value of the registration variable into the database. After the process is successful, the next process is to send the notification to the connected client or user, as shown in the flowchart of Figure 4, which is the order in which the notification is sent from the server to the client.

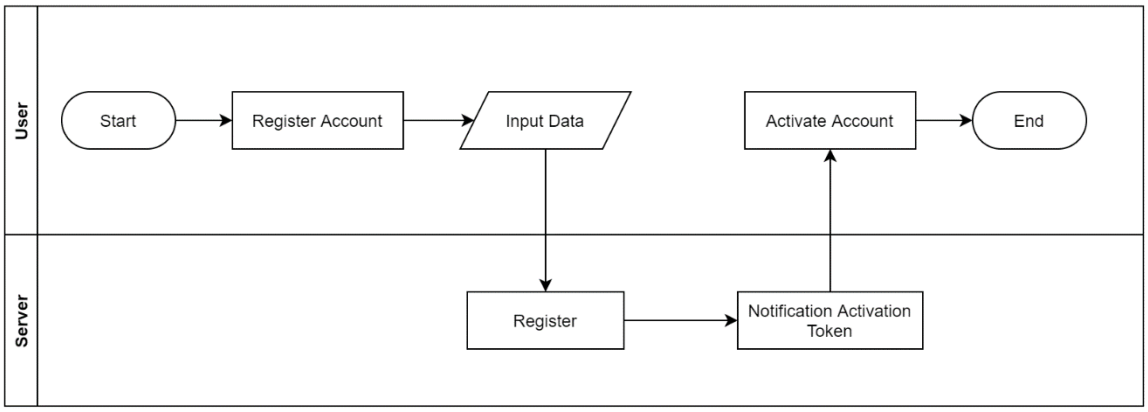

Figure 4. The order of the process of sending notifications from the server to the client

In the SITUK-V2 business process, push notifications are carried out when asesi conducts the registration process and is informed that asesi has passed the certification so that the push notification process is carried out automatically by entering registration data and when the asesor declares that the asesi has passed the competency test and a statement that the notification is sent to the certain client to the server (Ma'rufi et al., 2020). Next, the server will add notification data into the database. Then the notification will be sent to the client registered in the SITUK V2 database, as shown in Figure 5, which is an example of a notification made by the server to the client (asesi) when registering (Sampurno et a., 2020).

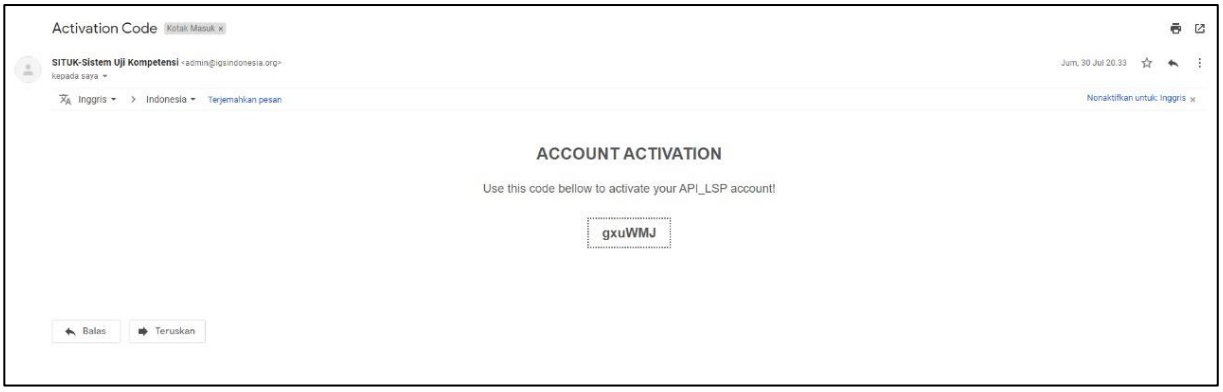

Figure 5. Example of sending notifications made by server to client (asesi) when registering

Results and Discussion

Testing

Tests in this study include testing the maximum number of clients that can connect to the server and testing the notification delivery time (delay) from the server to the client. The notification delivery delay test is divided into 3 delivery conditions, including repeating notification delivery, sending notifications with different packet sizes, and sending notifications with different bandwidths. To be able to do the test, it takes a server and several clients to get varied and more valid results. Table 2 is the hardware specifications used in this study as many as

362 clients, but only 102 clients who use PC or laptop computers and 15 clients who use mobile devices can confirm.

Notification delivery repeat test based on package size and bandwidth

This test is carried out to prove that the WebSocket protocol can provide fast delivery services when sending notifications in large quantities. All devices experienced consistent drops in each scenario. However, the quality factor of the internet network and wireless devices in each device affects sending a notification. Likewise, the Packet size test is carried out to determine the effect of the delay in sending notifications from the server to all devices. And the notification delivery test with a bandwidth of 1024 Kbps has a smaller average delay than the average notification delivery test delay with a bandwidth of 512 Kbps.

Test result

This test is carried out by sending notifications to clients who carry out the registration process and process graduation statements or statements of competence on 102 assessments (clients) which are grouped into three (3) categories, namely asesi or asesor who use laptops or PC, use Android mobiles and iOS mobiles. The results obtained from the test scenario will be analyzed to get the average delay for each notification. The delay is obtained by using a timer script and the average calculation operation on the client-side so there is no need to calculate the average delay value for each scenario when processing data, as shown in Figure 6.

Table 2. Client hardware

Device Code	Device Type and Type		Operating system
	PC-Laptop	Mobile	
L-PC-001	Laptop Asus A43E		Windows 8 Professional 32 bit
L-PC-002	Laptop Asus FX-505DD		Windows 10 Home 64 bit
L-PC-003	Laptop Asus ROG GL553VD		Windows 10 Professional 64 bit
L-PC-004	Laptop Dell Latitude		Windows 10 Professional 64 bit
L-PC-005	Laptop Asus FX-505DT		Windows 10 Home 64 bit
L-PC-006	PC Ryzen 5 3600		Windows 10 Professional 64 bit
L-PC-007	Laptop HP 1000		Windows 10 Professional 32 bit
L-PC-008	Laptop Lenovo 330		Windows 10 Home 64 bit
L-PC-009	Laptop Asus X507UF		Windows 11 Home 64 bit
L-PC-010	Laptop MSI GL63 8RD		Windows 10 Home 64 bit
L-PC-011	Laptop Asus X441N		Windows 10 Home 64 bit
MB-A-001		Smartphone Lenovo A6000	Android 8.1.0 (Oreo)
MB-A-002		Xiaomi Redmi 5 Plus Smartphone	Android 8.1.0 (Oreo)
MB-A-003		Vivo Y71 Smartphone	Android 8.1.0 (Oreo)
MB-A-004		Smartphone Oppo A7	Android 8.1.0 (Oreo)
MB-A-005		Asus Zenfone Max Pro M1 Smartphone	Android 9 (Pie)
MB-I -001		iPhone XR	iOS 14.7.1

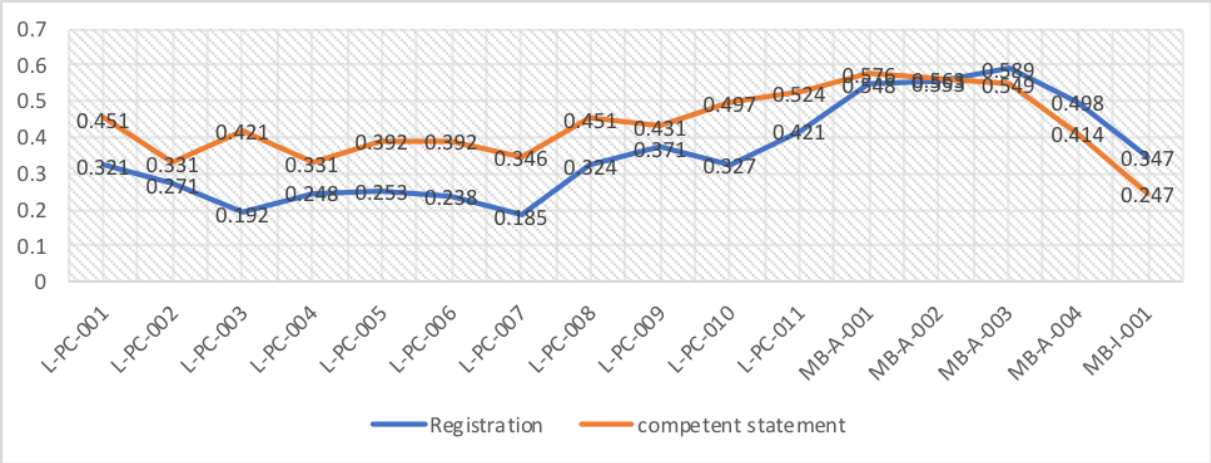

Figure 6. The result of sending notifications made by the server to the client (asesi) when registering and a statement of competence

Figure 4 is a graph of the average delay in testing the 102 test clients, who registered and declared competent on the SITUK-V2 application. Based on the graph in Figure 6, it can be seen that there is a difference in delay between sending using WebSocket on a laptop or PC (on device codes L-PC-001 to L-PC-011 and mobile devices (MB-A-001 to MB). -A-005 and MB-I-001), where L-PC-xxx is the code for laptop and PCs, while MB-A-xxx and MB-I-xxx are the code for mobile devices (Android and iOS). The delay between devices is 0.107s, while in terms of the package size sent via notification during the registration process and the competency statement process, the delay difference is 0.131s.

Conclusion

The implementation of the WebSocket protocol on push notifications in this study uses a server https://situk-web.igsindonesia.org/, which also acts as a broker. The client is implemented on two operating systems, namely Android, iOS, and Windows operating systems. The Android operating system is implemented on smartphone devices by creating a web-based application and Windows is implemented on laptop devices by creating a website page. On the server side, it can be concluded that there are 102 clients connected to the server from the asesi and the asesor session. Sending notifications in the registration process and competency statement process causes delays in sending notifications based on the size of the package and the device used. This is evidenced by the average delay in sending notifications on device usage of 0.107s. This is because network traffic on smartphone devices is denser than network traffic on laptop devices. While the average delay in sending notifications based on package size is 0.131s. The packet size factor of a notification affects the delay in sending a notification.

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