approach, which underlies the Web-based information transcoding and Internet transmission, evaluates how the response time of the CMS increases when the number of the request increases. Secondly, the execution time of push-based approach, which underlies SMS Web Service and GSM communication, evaluates the increasing trend of the execution time of the CMS when the number of client device increases.

The pull-based response time contains the Web-based information transcoding time and Internet transmission time. The same experiment will be executed on the local server and GAE cloud platform, respectively. This experiment evaluated the CMS as a IoT broker that processed from 10 to 1000 requests. Figure 3 shows the average values obtained for pull-based response time. Notably, the threshold value for request number was about 500. When request number was lower than the threshold value, average response time was about 0.6 seconds. Conversely, when the number of concurrent requests increased beyond this threshold number, response time increased very rapidly because both I/O consumption and contextual information transcoding performance increased substantially. Additionally, for each dataset, execution time in local server was longer than that in the GAE cloud platform.

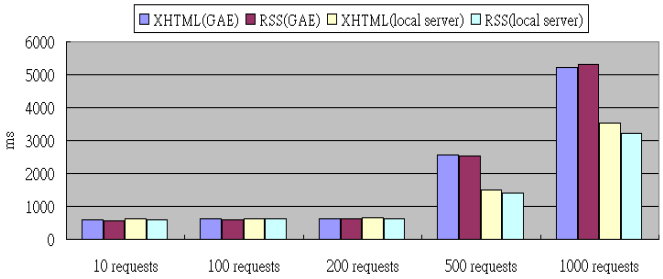

Figure 3. Results of the pull-based approach experiments

The push-based execution time contains the SMS Web service execution time and GSM communication time. Due to the limited number of mobile devices and the cost of sending SMS, the actual test of the experiment can only send SMS to 20 different mobile devices. The experience results of the push-based average execution time are shown in Figure 4. We observed that the average execution time of SMS Web service and the number of mobile device increase in equal proportion. The average time of GSM communication is about 3.1 second. Additionally, this tests show that the execution time of SMS Web Service takes a very limited percentage of the receive SMS time (about 1%). It is worth noting that a significant variation on push-based execution time result form variable GSM communication. The push-based experiment executed only on the local server. This is because the GSM modem can not be installed in the GAE cloud platform.

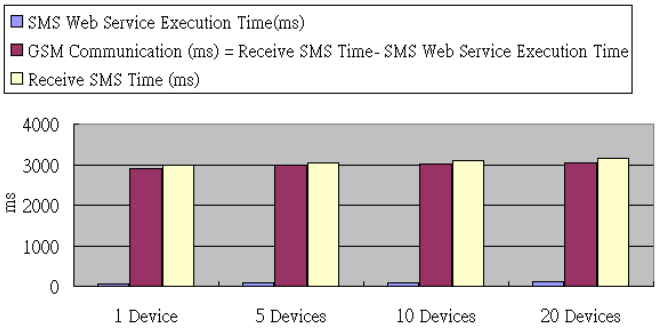

Figure 4. Results of the push-based approach experiments

IV. CONCLUSIONS

The rapid development of the wireless sensor technologies, including wireless sensors, smart objects, and communication protocols, has led to diverse devices of accessing various IoT systems. This study proposes a Multi-layer Sensor Web 2.0 Architecture (MSWA) that consists of contest sensor layer, context information layer, context service layer, context representation layer, cloud computing layer, and context-aware mobile Web 2.0 SaaS layer. The author argues to adopt Sensor Web 2.0 technologies as the backbone of IoT applications to facilitate the sharing and exchange of objects in cloud computing environment. From the Campus Monitoring System carried out in the paper, we demonstrated that Sensor Web 2.0 technologies serve as a core technology for Web 2.0 Mashups to enhance added value of traditional IoT applications. Additionally, this study also realizes how Sensor Web 2.0 technologies can be integrated into IoT applications for cloud computing environment. One future work is to investigate how to integrate Semantic Web technologies [8] into SWaaS to facilitate the development of intelligent Web Sensor 2.0 applications.

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