Biometric Data Emulation and Encryption for Sport Wearable Devices (A Case Study)

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Abstract—[illegible] N SQL [illegible] W [illegible] N SQL [illegible]

I. Introduction

XCo Tech Inc. (Xco), based in Penticton BC, Canada is developing an agnostic sensor platform for enabling interconnectivity, analysis and integration of information for sports, fitness and healthcare. The company's software system collects data from multiple sensors and transmits that data to servers where the data is integrated, synchronized, and analyzed. The data and derived analytics are then transmitted to other devices or persons where an app can use the data and analytics to present valuable real-time information to the user.

Critical to the value-add proposition of the system is the ability to measure a person's location with cm level precision

In the workshop paper [3], authors present work in progress where they utilize sensor-based wellness data to benefit teenage ice-hockey players in their hobby. They created an application concept and mock-ups of wearable sensors, and conducted a service design workshop with a teenage ice-hockey team. "Numerous sports tracking applications exist for mobile phones and smart watches, bracelets and other wearable sensors are becoming increasingly popular form factors for detecting location, physical activity and biometric data" [3].

In paper [16] authors discuss a new model of using NoSQL databases as a storage systems. The tell, that the "new generation of database systems with weaker data consistency models is content with using and managing locally attached individual storage devices and providing data reliability and availability through high-level software features and protocols". They examines the behavior of several NoSQL DBs: HBase and Cassandra. In Summary they conclude, that I/O profile does not differ greatly from traditional RDBMes, but what differs most is their approach to managing data.

On the other hand, authors in [12] investigated three NoSQL database (MongoDb V2.2, Cassandra V2.0 and Riak V1.4) performances for a large, distributed healthcare organization. In their testing, a typical workload and configuration produced throughput that varied from 225 to 3200 operations per second between database products, while read operation latency varied by a factor of 5 and write latency by a factor of 4. They found, that Cassandra DBMS provided the best throughput performance, but with the highest latency.

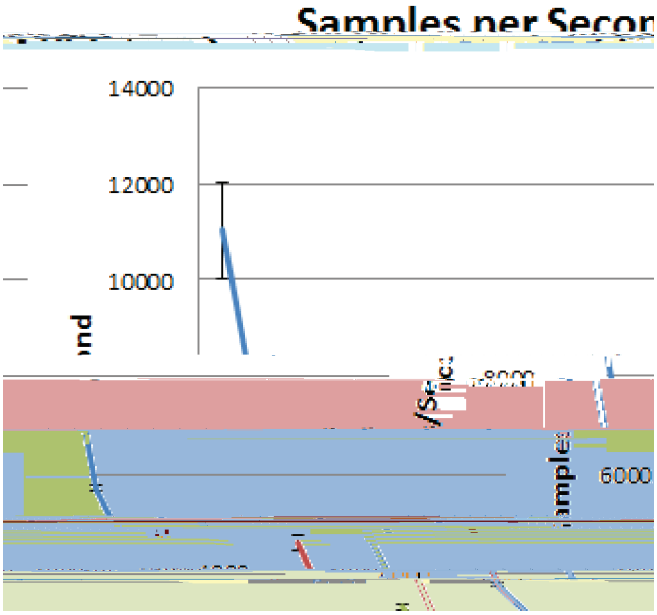
A Parallel Data Generation Framework (PDGF), a generic data generator is described in [7]. As they inform, "an extremely time and resource consuming task in the creation of new benchmarks is the development of benchmark generators, especially because benchmarks tend to become more and more complex". They presented PDGF Version 2, which contains extensions enabling the generation of update data as well.

Additionally to biometric data emulation and transmission we investigated different types of encryption algorithm for the secure data transmission and storage within a NoSQL database.

Fig. 1. Architecture of the Data Generation and Data Encryption/Decryption within NoSQL DBMS server.

Jira is a planning and collaboration tool that we used to plan our work and keep track of what needs to be done, and who is working on what. It is based around agile methodologies, and has a plug in for SCRUM which makes it a very good fit for our team.

A group of 9 students in COSC 470 Software (SW) Engineering at Okanagan College (OC) completed a 5 week spike project, in which a data generator was designed and implemented. The data generator emulates sensors data, and sends data across a network and into the database. The research goals of the spike project were to experiment with different en-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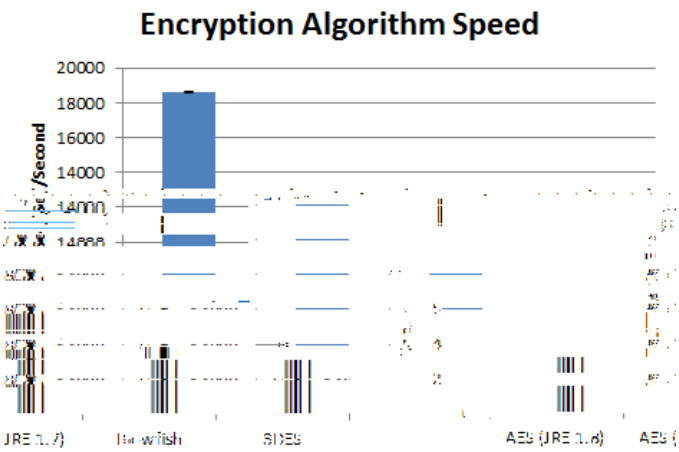

Fig. 4. Encryption Algorithm Performance

of 3DES because the DES algorithm was not designed to be used in this way, but no serious flaws have been found in its design, and it is still a widely used algorithm [8].

B. Encryption Algorithm Performance

We have implemented the previous three algorithms into the system and ran tests on them to see which one would be the best choice for us to implement in our system. In Fig. 4 we ran each encryption algorithm for a set amount of time to see how many 2491 Byte Json documents each of them could encrypt per second.

Theoretically Blowfish is a faster algorithm than AES, so we were surprised when tests were showing that AES more than twice as fast as Blowfish. The answer to this question of why AES is faster that Blowfish is optimization. In recent versions of Java there has been a lot of work done to optimize their implementation of AES and make use of Intel®'s AES-NI (AES New Instruction set); a set of instructions used to do AES encryption directly on the hardware which was introduced in 2010 [2] [19].

VI. Conclusion

In this paper we looked at how to generate data to emulate biometric sensors and investigated the effectiveness of different data encryptions for NoSQL document data bases for location and biometric data captured by sports wearable devices. Choosing an encryption method to use can be difficult, however through this research we have discovered 2 encryption methods that work well. The AES and blowfish algorithms seem to be the best choice for the system implemented. Blowfish can be implemented to be more secure than AES, however AES is faster when encrypting very large amounts of data, especially when using Intel® AES-IN. They outperform 3DES in both speed and security, 3DES is an outdated algorithm, and should not be implemented in new systems.

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