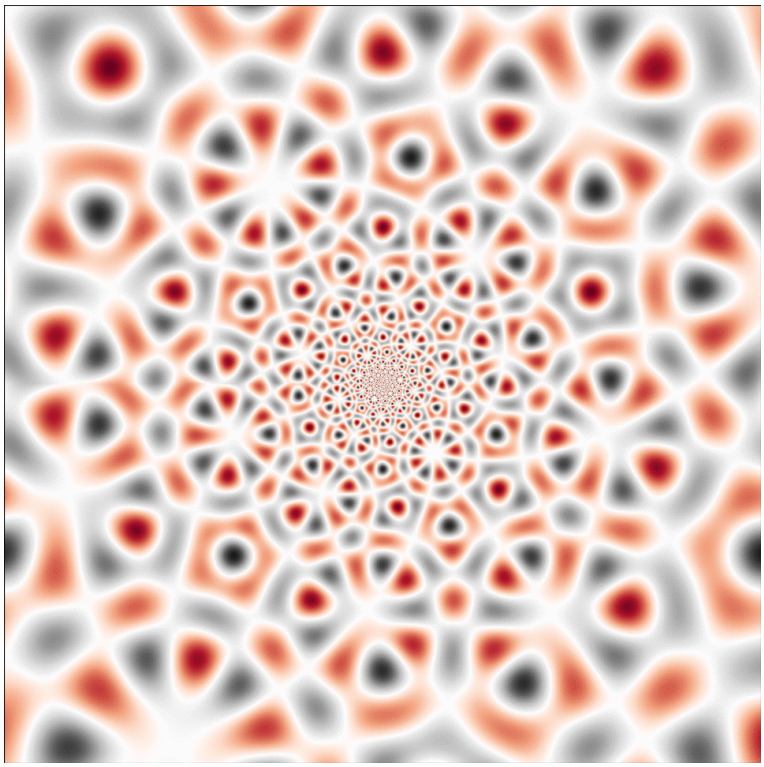
UNIVERSITY OF COPENHAGEN
FACULTY OF SCIENCE



Master thesis

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Title

Advisors: Fritz Henglin, Søren Terp

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Contents

Abstract

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Introduction

Financial inclusion is the ability to have access to basic banking which includes efficient and secure transactions, trusted ownership, execution of payments, safe storage of money, and withdrawal of cash. This has been defined by The World Bank to be an important building block for both poverty reduction and opportunities for economic growth [DKKS+18] and is one of the focal point of many international

agencies, such as the International Monetary Fund (IMF)[1] and The World Bank[2], as well as non-profit organizations (NPOs) like the Norwegian Refugee Council (NRC)[3]. By having access to these tools societies will see many benefits. In Niger, a five-month relief program swapped from a monthly payment of cash to instead use mobile money services allowing for mobile commerce (m-commerce). This change saved the recipients 20 hours on average in overall travel and wait time to obtain the payments [DKKS+18]. A similar study was performed in Kenya where the change to mobile money services allowed 185,000 women-headed households to increase their savings by more than 20 percent, reducing extreme poverty among these households by 22 percent. Additionally, the access to digital payments allow for easier storage, and a reduction in corruption in countries where trust in the government is low. [DKKS+18]

The Global Findex Database reports that 69 percent of adults in 2017 had a bank account [DKKS+18], an increase of 7 percent since 2014 and 18 percent since 2011 [DKKS+18]. 94 percent of adults in developed countries own a bank account, whereas only 63 percent of adults own an account in developing countries [DKKS+18]. Globally, approximately 1.7 billion adults still remain unbanked as can be seen on Figure 1, with half of them living in just seven developing areas: Bangladesh, China, India, Indonesia, Mexico, and Pakistan.

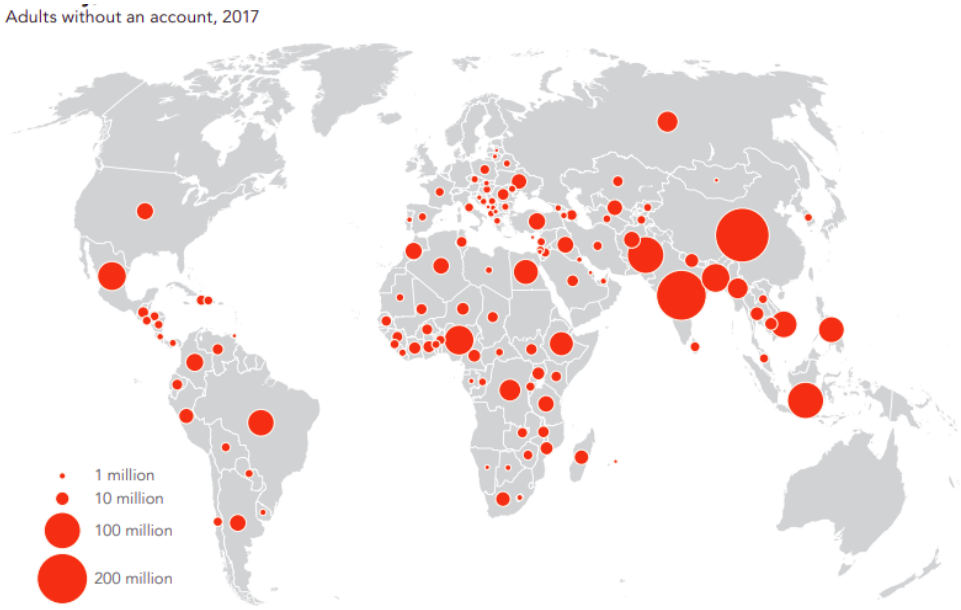

Figure 1: *The Global Findex Database*. Map of locations for unbanked adults in 2017.

[1] https://www.imf.org/en/About/Factsheets/IMF-at-a-Glance

[2] https://www.worldbank.org/en/what-we-do

[3] https://www.nrc.no/what-we-do/themes-in-the-field/cash-and-vouchers/

When looking at developing countries and financial technology (fintech) in these countries it is important to consider what is available in these areas. 1.1 billion of the financially excluded adults own a mobile phone [DKKS+18], however many developing countries have very little access to internet. Our World in Data reports that for the majority of the countries in Sub-Saharan Africa, the population with access to the internet are only between 5 and 20 percent [MROO15], however for most of these countries, the mobile phone penetration rate[4] is greater than 40 percent. [MROO15]

This paper... To be continued describing what the purpose of this thesis is and what the different sections will cover

Potential additional topics in the introduction

- An introduction and a definition of mobile payments and which types (B2B, B2C), (micro, macro)
- Some history of payment methods
- How big of a market is the mobile payment market

Background and Related Work

Analyzis of existing secure mobile payment protocols

For the following existing protocols: SET, iKP, KSL, LMPP, LPMP, MSET, SAMPP, SLMPP, MPCP, MPCP2, PCMS

- Define them and a brief introduction to how they work
- Features (Do they implement the basic e-payment requirements. Refer to [EHM14])
- Performance (A mobile phone has to perform as few operations as possible). Refer to [Puk15]

Analyzis of existing mobile payment services

Proposed architecture

Design

- Define how its supposed to work
- Reason for protocol choice
- Reason how it ensures ACID properties

[4]The mobile phone penetration rate refers to the amount of SIM cards in a certain country

- Reason its fault tolerant
- Reason that it handles eventual consistency and asynchronous transactions

Requirements

As defined by [EHM14] and how they're met.

Client requirements

- Usability
- Flexibility
- Affordability
- Reliatbility
- Speed of transactions
- Availability

Server requirements

- Confidentiality
- Data integrity
- Authentication of all the participants
- Non-repuditian

Implementation

Results

How good is this implementation? Does it execute quickly, does the utilized protocol use as few operations as possible

Findings

Comparison with other mobile payment platforms

Discussion

Conclusion

Future work

References

[DKKS+18] Asli Demirguc-Kunt, Leora Klapper, Dorothe Singer, Saniya Ansar, and Jake Hess, *The global findex database 2017: Measuring financial inclusion and the fintech revolution*, 04 2018.

[EHM14] Houssam El, Hanane Houmani, and Hicham Madroumi, *A secure electronic transaction payment protocol design and implementation*, International Journal of Advanced Computer Science and Applications **5** (2014).

[MROO15] Hannah Ritchie Max Roser and Esteban Ortiz-Ospina, *Internet*, Our World in Data (2015), https://ourworldindata.org/internet.

[Puk15] Pensri Pukk, *Review and comparison of mobile payment protocol*.