

Software for Fintech Optimization and Financial Inclusion

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SnT

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> WHO ARE WE?

> Software Researchers

- One born in France, one in Burkina Faso
- Both got an engineering degree from “Grandes Ecoles” in France
- Both got a PhD degree in Software Engineering
- Working now at the University of Luxembourg, in the SnT center.

> Interdisciplinary Centre for Security, Reliability and Trust



securityandtrust.lu

- **Aim:** to establish Luxembourg as a European centre of excellence and innovation for secure, reliable & trustworthy ICT
- Founded 2009, current size 2017: 260+ people
- Director: Prof. Bjorn Ottersten
- Vice Director: Prof. Lionel Briand



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SnT Goals & Strategy

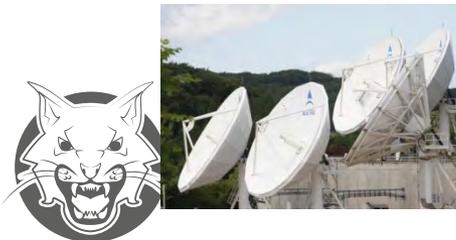
- Centre of excellence in research and innovations in *Security, Reliability and Trust*
- Impact well beyond the academic community



Increase R&D investments to Luxembourg



- Highest quality research in areas with a relevance to Luxembourg
- Strategic partnerships
- International cooperation and attract European research funding and ensure competitiveness
- Interdisciplinary approach with application area focus



> SERVAL RESEARCH GROUP

> Serval: Software Believers



conducts research on **Software Engineering** &
Software Security

=> with a focus on data intensive solutions, mobile platforms and complex systems

> Three Main Pillars

- **Mobile Security**
 - Data Leaks, Malware Detection, Piggybacking Detection
- **Software Engineering**
 - Patch Recommendation, Automated Program Repair
 - Bug Detection, code search
 - Automated Document Processing
- **Data Analytics, Information Mining**
 - Information Retrieval, Web Crawling (Augmented data)
 - Natural Language Processing, Sentiment Analysis
 - Time Series Pattern Recognition
 - Machine learning



Application Domains: Android, Fintech, Smart Home, etc.

> Current and Past partnerships



- Smart meters/smart grid modelling and monitoring
- Analytics: Predict elec. load



- Smart Building
- Machine learning



a SIX Company

- *Decrease the cost and time-to-market for testing their product-line*



- *Android malware detection*
- *Large-scale analysis of mobile apps.*
- *Machine learning*



- IoT and Smart Home
- Big Data for Smart Home
- Model-driven and middleware



BNP PARIBAS

Weicker Foundation

- Wealth Management
- Software Testing



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=> Very close to sign new Fintech partnerships in the coming weeks

> LET'S NOW PLAY WITH SOME WORD CLOUDS

> What is FinTech about?



CONTENT

Introduction	1	Payments	26
Steve Ellis, <i>Metia</i>	1	Gareth Lodge, <i>Celent</i>	27
		Gilles Ubaghs, <i>Ovum</i>	28
Core Banking	2	Leo Lips, <i>Lips & Lips</i>	29
Daniel Latimore, <i>Celent</i>	3	Thomas Zink, <i>IDC</i>	30
Christine Barry, <i>Aite Group</i>	4	Amy Hoke, <i>Marcator</i>	31
Daniel Mayo, <i>Ovum</i>	5		
Capital Markets	6	Retail Banking	32
David Easthope, <i>Celent</i>	7	Zivinas Bareisis, <i>Celent</i>	33
Sang Lee, <i>Aite Group</i>	8	Stephen Greer, <i>Celent</i>	33
		Tim Walker, <i>Deloitte UK</i>	34
Cryptocurrency	9	Lucian Morris, <i>Deloitte UK</i>	34
David Birch, <i>Consult Hyperion</i>	10	Richard Samuel, <i>Deloitte UK</i>	34
Scott Dueseweke, <i>Booz Allen Hamilton</i>	12		
Zennon Kapron, <i>KapronAsia</i>	13	Risk Management	36
Julie Conroy, <i>Aite Group</i>	14	Peyman Mestchian, <i>Charis Research</i>	37
Gilles Ubaghs, <i>Ovum</i>	15	Medy Agami, <i>Celent</i>	38
Enterprise Data Management	16	Trade Execution	39
Virginie O'Shea, <i>Aite Group</i>	17	Kevin McPartland, <i>Greenwich</i>	40
Ben Keeler, <i>Citisoft</i>	18	David B. Weiss, <i>Aite Group</i>	41
Bank Marketing	19	Outsourcing	42
Jaroslav Knapik, <i>Ovum</i>	20	Eike Biebar, <i>PAC</i>	43
Michael Araneta, <i>IDC</i>	21	Peter Bendor-Samuel, <i>Everest</i>	44
		Jimit Arora, <i>Everest</i>	45
Insurance	22	How we chose our key influencers	46
Craig Weber, <i>Celent</i>	23	Sally Yates, <i>Metia</i>	46
Donald Light, <i>Celent</i>	24		
Pat Speer, <i>Aite Group</i>	25		

> What is FinTech about?

Global Fintech Report 2016

Blurred lines: How FinTech is shaping Financial Services



Global FinTech Report
March 2016



20%

*More than 20% of
FS business is at risk
to FinTechs by 2020*

57%

*are unsure about or
unlikely to respond to
blockchain technology*

> What is **FinTech** about?

Global Fintech Report 2017

Redrawing the lines:
FinTech's growing influence
on Financial Services

82%

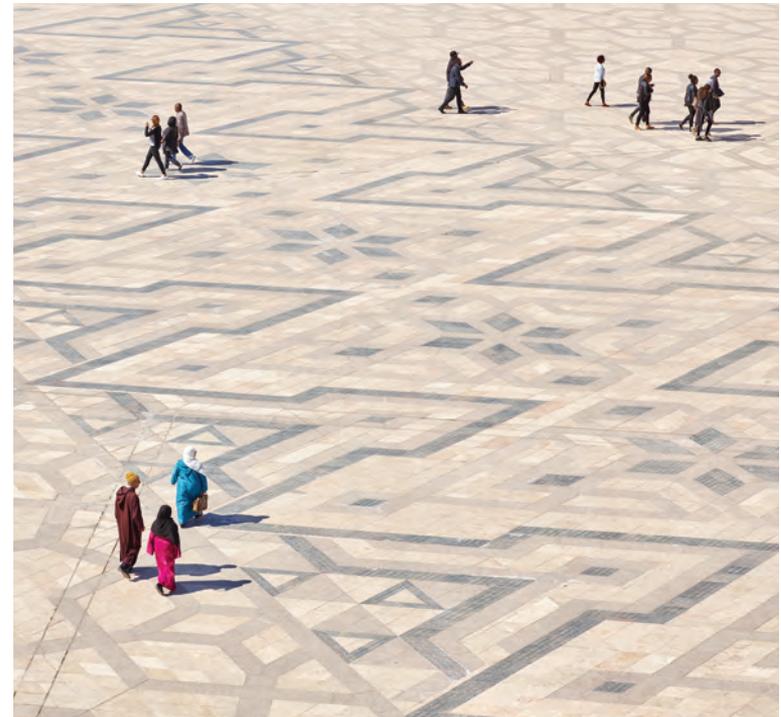
of incumbents expect to increase
FinTech partnerships in the next
three to five years

77%

expect to adopt blockchain as
part of an in production system or
process by 2020

20%

expected annual ROI on FinTech
related projects



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pwc.com/fintechreport

> We are Software Engineers

- We are surprised to realize that

SOFTWARE IS MISSING!!!

- 0 occurrence in the 2017 PwC Report
- 3 occurrences in the 2016 PwC Report
 - “Open development and **software**-as-a-service (SaaS) solutions have been central to giving banks the ability to streamline operational capabilities.”
 - “by providing **software** that helps clients to better navigate the investment world”
 - “Just as Enterprise Resource Planning (ERP) **software** allowed functions and entities within... »



> Software is **Ubiquitous** in FinTech

Core Business Software



Monitoring & Analytics Software



Customer Software
(Mobile Payment, ...)





PART 1: FINTECH = OPTIMIZATION

> FINTECH Definition (1)

*“Fintech is usually defined as an industry leveraging **new technology and innovation** with **available resources** in order to **compete** in the marketplace of traditional financial institutions”*
(Wikipedia)

> FINTECH Definition (specific to this part)

- “Do **better** what you are currently doing”
- Better = Cheaper,
Quicker, More Efficient
With less Errors/Bugs
More Scalable
Etc.

> FINTECH OPTIMIZATION

- FINTECH is **less** about changing the essence of **what** you are doing but more in changing **HOW** you are doing your tasks
- **HOW** = Automation = Software

FINTECH is about Optimization via Automation with the support of Software

> Examples of FINTECH for OPTIMIZATION

- Robo-Advisor for Investment:
 - Cheaper operational cost (less manual intervention, can be distributed and paralyzed),
Expect better investment score,
- Automated Document Processing:
 - Much less manual and human intervention
 - Less errors
 - Much faster
- More Data and Data with better quality:
 - Transform unstructured data into structured, semantically rich data
 - Augment your own data



> **LET'S GO MORE IN DEPTH**

> **AUTOMATED DOCUMENT PROCESSING**

**In Collaboration with a
Big Luxembourgish Player**

> Financial Institutions process a lot of documents

GOAL: devise automated techniques for:

- automated document classification,
- smart document processing and
- ability to extract value-added intelligence from data stored

Automated Document classification, data extraction, diff computation, auto-completion, etc.



> Main challenges

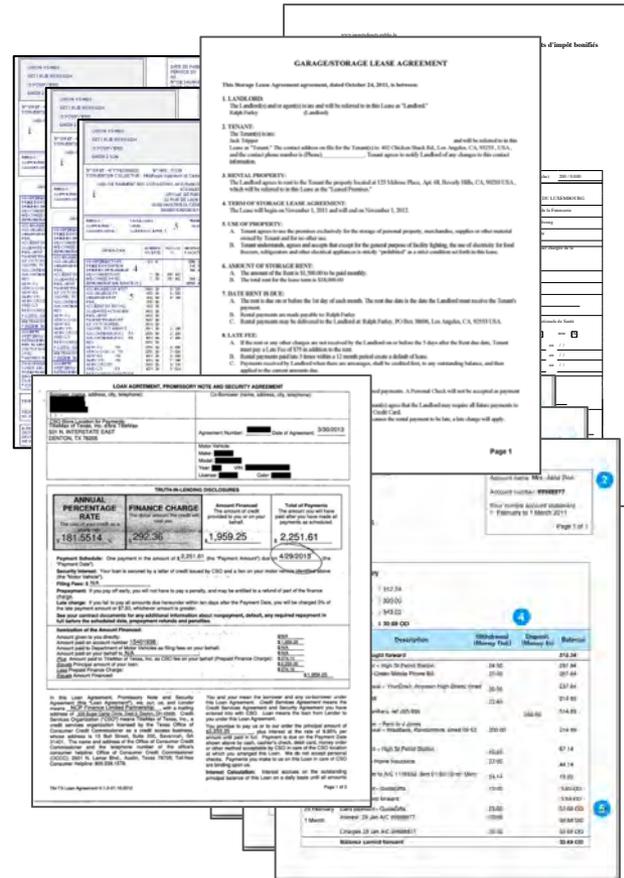
“Automated” document “comprehension” could lead to several huge benefits, but (among others):

- Most relevant documents are unstructured!
- How does a computer understand a text?
- Tower of Babel Problem (Andrew Haldane, Bank of England), no pivot language in the financial domain.

> Concrete Use Case: Automated > Loan Document Processing

- Imagine you are a bank offering an online service for loan.
 - Customer simply sends the required documents
 - Automated checks
- => Simpler for both the User and the Bank

> Concrete Use Case: Automated Loan Document Processing



GARAGE STORAGE LEASE AGREEMENT

The Storage Lease Agreement agreement, dated October 24, 2015, is between:

1. LANDLORD
The Landlord is and is acting in and will be referred to in this Lease as "Landlord"
or another.

2. TENANT
The Tenant is: [Redacted] and will be referred to in this Lease as "Tenant" or another.

3. RENTAL PROPERTY
The Landlord agrees to lease to the Tenant the property located at 1234 Main St., Apt. 40, Beverly Hills, CA, 90210, USA, which is referred to in this Lease as the "Rental Property".

4. TERM OF STORAGE LEASE AGREEMENT
This Lease will begin on November 1, 2015, and will end on November 1, 2017.

5. USE OF PROPERTY
A. Tenant agrees to use the premises exclusively for the storage of personal property, merchandise, supplies or other material owned by Tenant and her affiliates.
B. Tenant understands, agrees and accepts that except for the general purpose of storing property, the use of electricity for food storage, refrigeration and other mechanical appliances is strictly prohibited on or under premises under this lease.

6. AMOUNT OF MONTHLY RENT
A. The amount of the Rent is \$1,000.00 per month.
B. The Rent will be paid in advance.

7. STATEMENT OF RENT
A. Tenant shall pay the Rent on the 1st day of each month. The Rent due date is the date the Landlord receives the Tenant's payment.
B. Rent payments are made payable to Ralph Foster.
C. Rent payments may be addressed to the Landlord at Ralph Foster, 30000 Wilshire Blvd., Los Angeles, CA, 90048 USA.

8. LATE FEE
A. If the rent or any other charge due to Landlord is not received by the Landlord on or before the 15th day after the Rent due date, Tenant agrees to pay a late fee of 5% of the amount due to Landlord.
B. Rent payments made 15 days within a 12 month period make a default of Rent.
C. Payments made by a Landlord after three consecutive late payments will be considered late, notwithstanding balance, and then the Tenant shall be liable for the late fee.

LEASE STATEMENT, PROMISSORY NOTE AND SECURITY AGREEMENT
12/20/2015, 10:00 AM, 10/20/2015, 10:00 AM, 10/20/2015, 10:00 AM

Account Number: 33000013

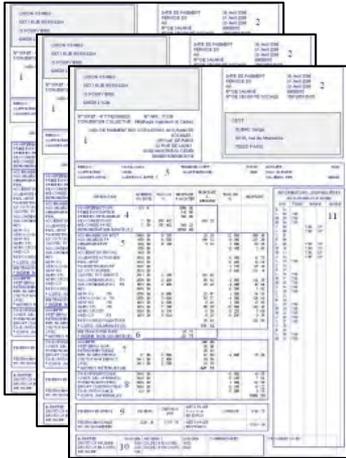
Account Holder: [Redacted]

FINANCE CHARGE

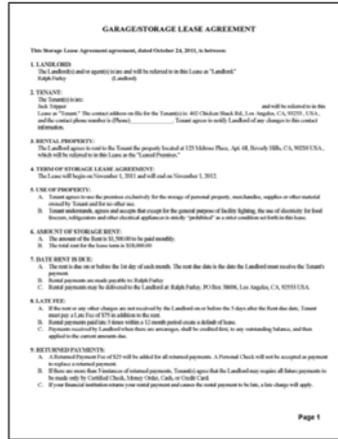
ANNUAL PERCENTAGE RATE	FINANCE CHARGE	Amount Financed	Total of Payments
181.5514	292.36	1,959.25	2,251.61

Description	Withdrawal (Money Out)	Deposit (Money In)	Balance
Initial Deposit		2,251.61	2,251.61
1 - High To Payroll Deduction	18.00		2,071.61
Green Mobile Phone Bill	21.00		2,050.61
Bank of America Payment High Interest Credit		22.00	2,072.61
Bank of America Ref 1001000		100.00	2,172.61
1 - Rent for 1st month	1,000.00		1,172.61
1 - High To Payroll Deduction	18.00		1,154.61
Home Insurance	22.00		1,132.61
1 - High To Payroll Deduction	18.00		1,114.61
1 - Home Insurance	22.00		1,092.61
1 - Home Insurance	22.00		1,070.61
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1 - Home Insurance	22.00		718.61
1 - Home Insurance	22.00		696.61
1 - Home Insurance	22.00		674.61
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1 - Home Insurance	22.00		586.61
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1 - Home Insurance	22.00		542.61
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1 - Home Insurance	22.00		476.61
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1 - Home Insurance	22.00		432.61
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1 - Home Insurance	22.00		-30.61
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1 - Home Insurance	22.00		-888.61
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1 - Home Insurance	22.00		-1064.61
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1 - Home Insurance	22.00		-4936.61
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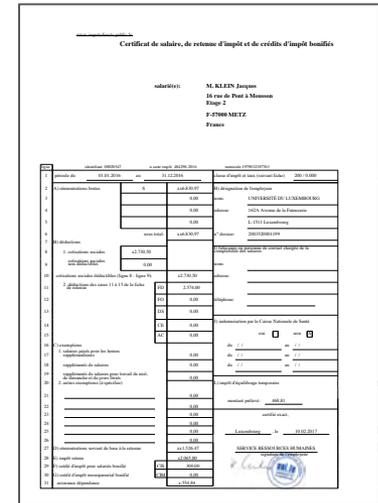
> Step 1: Document Classification



Salary Sheets



Leasing Contract



Certificat de renumeration



Other Loan



Bank Statements



> How to combine semantics and syntactical features?

- **Idea 1:** Simply concatenate the features of both types, i.e.,
 - Features = Feature_{Topics} + Feature_{Structural}
 - Apply K-Means, etc...
- **Idea 2:** Use the structural features to perform first a “rule-based” classification, and then K-Means with only Feature_{Topics}

> Step 2: Information Extraction

- **Extract info for each type of document:**
 - Salary from the salary sheets and check consistency and validity thanks to the “certificat of remuneration”
 - Leasing Duration and leasing cost from the leasing contract
 - From Bank statement, compute the overall spending, confirm the salary and leasing cost, etc.

=> Relevant extraction only if the type of the documents are known



> ANALYTICS

The exception that proves the rule?

> Data more important than Software?

- We almost all have access to the same analytics algorithms
 - Google makes publicly available TensorFlow
- ⇒ We will not compete on these tools, software and algorithms.
- ⇒ We will compete on the DATA

> **SUCCESS PREDICTION**

Harvesting Web Data to Accelerate FinTech Businesses

In Collaboration with a VC Company

> Data IS NOT Information!

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</abstract>

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STRUCTURED

Association, in view of abuses and lack of consistency in published reports, has asserted that the all-inclusive income statement, containing all income items recognized as determinants of net income, is the answer to these questions.2 The Securities and Exchange Commission has also strongly favored this solution.3 On the I Committee on Accounting Procedure, American Institute of Accountants, "Income and Earned Surplus Accounting Research Bulletin No. 22 (December 1947). 2 (1) "A Tentative Statement of Accounting Principles Affecting Corporate Reports," THE ACCOUNTING REVEW, June, 1936, pp. 187-191; (2) Accounting

UNSTRUCTURED

“80% of business-relevant information originates in unstructured form, primarily text.” Seth Grimes – Alta Plana

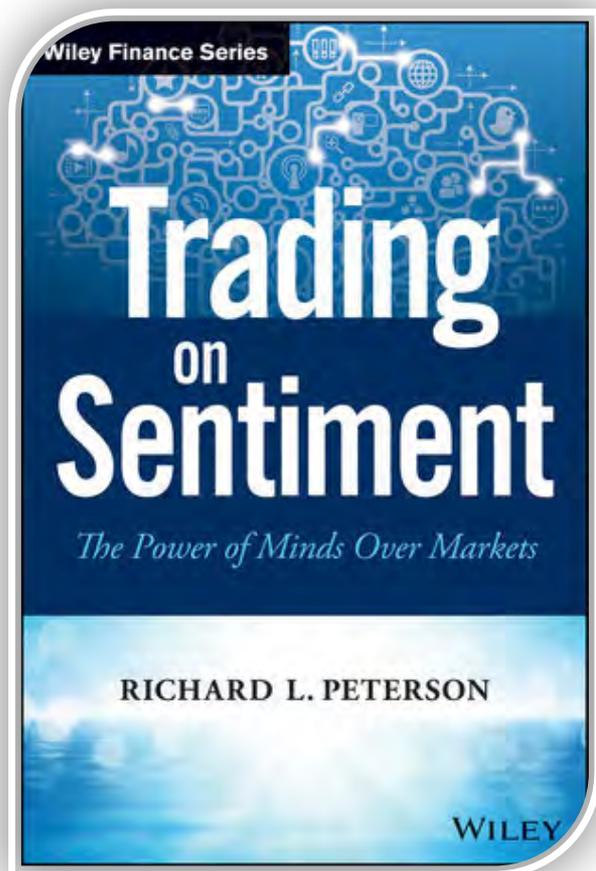


> Used Techniques

- Web Crawling (javascript-based)
- Information Retrieval
- Natural Language Processing
 - The art of extracting the meaning of text
- Machine Learning
 - CLUSTERING, CLASSIFICATION, ...



> Hot example: Sentiment-Driven Trading...



TOPICS / BELIEFS / EMOTIONS



→ market-neutral **social media**-based **hedge fund** that **beat the S&P 500** by more than **24%**—through the 2008 financial crisis

> Concrete Use Case: How to get the budget of all cities in France?

- [City Accounts](#): we can access a lot of financial information from all French cities over the web.
- Would be interesting to crawl and store all this information to perform analytics or simply augment your data
- Not so simple to automate the crawling...
 - Need to understand the structure of each web page, automatically click on good links, etc.



> Concrete Use Case: Build a network

- If LinkedIn is not enough, you can create your own network by crawling some web site.
- Let's consider paperjam.lu and the page “carriere”.

> Concrete Use Case: Build a network

The screenshot shows a career page on paperjam.lu with a grid of 15 professional profiles. Each profile includes a circular headshot, a title, a company name, and a date. The profiles are arranged in a 5x3 grid. At the bottom of the grid, there is a pagination bar with numbers 1 through 9, where '2' is highlighted.

Profile	Title	Company	Date
Isabelle Liépin	ASSOCIATE	RSM AUDIT LUXEMBOURG / DIRECTOR	11.05.2017
Jaufre Lafage	DIRECTEUR COMMERCIAL	OGIER LUXEMBOURG / TEAM SECRETARY	11.05.2017
Audrey Fleurot	INTERTRUST / DIRECTRICE CAPITAL MARKETS	OGIER LUXEMBOURG / TEAM SECRETARY	10.05.2017
Benjamin Devouassoux	SERVICES	OGIER / ASSOCIATE	09.05.2017
Xavier Guzman	SERVICES	DLA PIPER / ASSOCIÉ	08.05.2017
Karla Gutierrez	COMMUNICATION	LUDWIG / SENIOR ACCOUNT MANAGER	08.05.2017
Irina Marinescu	ENTREPRISES	ADVITEK / PROJECT MANAGER ASSISTANT	02.05.2017
Guillaume Houba	INDUSTRIE	NO-NAIL BOXES / CONSEILLER TECHNIQUE	02.05.2017
Michaël Damasio	RH	MYJOBEST / GENERAL MANAGER	02.05.2017
Amélie Thevenart	SERVICES	BONN & SCHMITT / COUNSEL	27.04.2017
Laurent Henneresse	JUSTICE	BONN & SCHMITT / COUNSEL	25.04.2017
Nicolas Widung	JUSTICE	BONN & SCHMITT / COUNSEL	25.04.2017
Thomas Sarpcan	JUSTICE	BONN & SCHMITT / SENIOR ASSOCIATE	23.04.2017
Frank de Wit	SERVICES	INTERTRUST LUXEMBOURG / BUSINESS UNIT MANAGER CORPORATE & LEGAL	19.04.2017
Harald Thul	SERVICES	INTERTRUST LUXEMBOURG / DIRECTOR ALTERNATIVE INVESTMENT SERVICES	19.04.2017

> Concrete Use Case: Build a network

- Use good NLP techniques to extract information from this text.

JUSTICE

BONN & SCHMITT - COUNSEL

Laurent Henneresse

25 AVRIL 2017 · 10:47

f t in g+ e

Laurent Henneresse a été nommé counsel au sein de l'étude **Bonn & Schmitt** pour laquelle il travaille depuis 2010. Il est inscrit comme avocat à la Cour auprès du Barreau de Luxembourg.

Laurent Henneresse est titulaire d'une licence en droit délivrée par l'Université Catholique de Louvain (Belgique) en 2008 et d'un LL.M. en International Business Law obtenu en 2009 auprès du University College London (Royaume-Uni).

Il est spécialisé en droit bancaire et financier, en gestion des investissements, ainsi qu'en droit des procédures d'insolvabilité. Laurent Henneresse conseille une clientèle internationale dans des opérations de financement transfrontalière et est également actif dans le domaine du regulatory et de l'arbitrage international. ♦

Laurent Henneresse Université catholique de Louvain
University College London Bonn & Schmitt

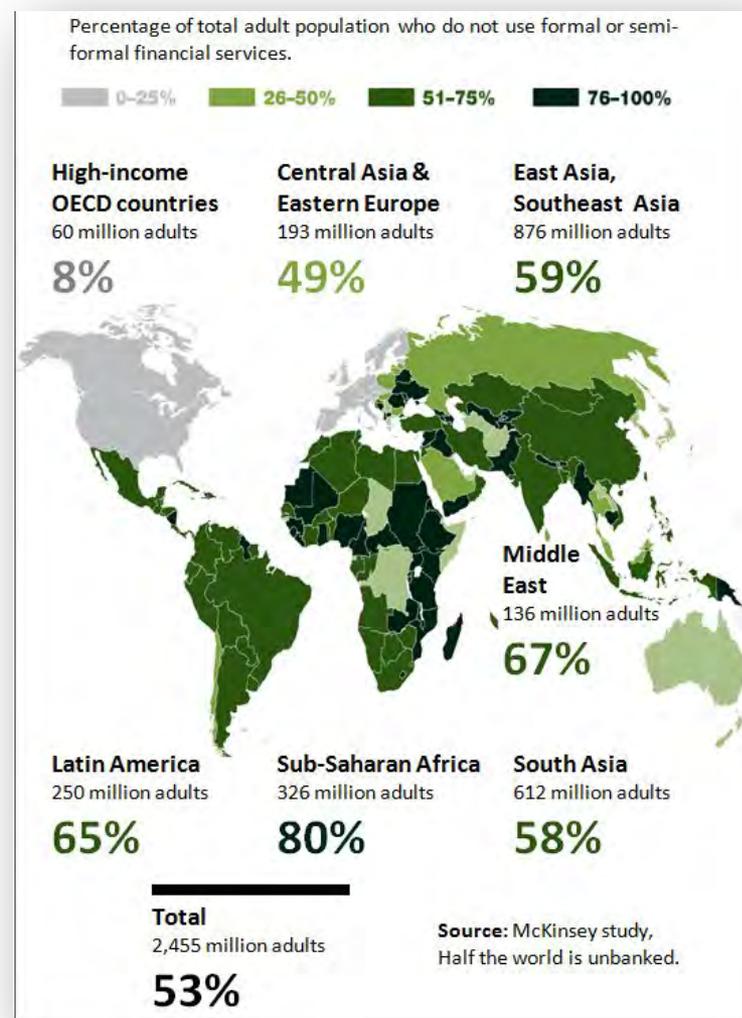


PART 2: FINTECH **FOR** THE POOR

> Counting the World's Unbanked

What is the percentage of total adult population who do not use formal financial services?

- Half of the world population do not have a bank account
- Up to 80% in developing countries are underserved



> Who are the unbanked?



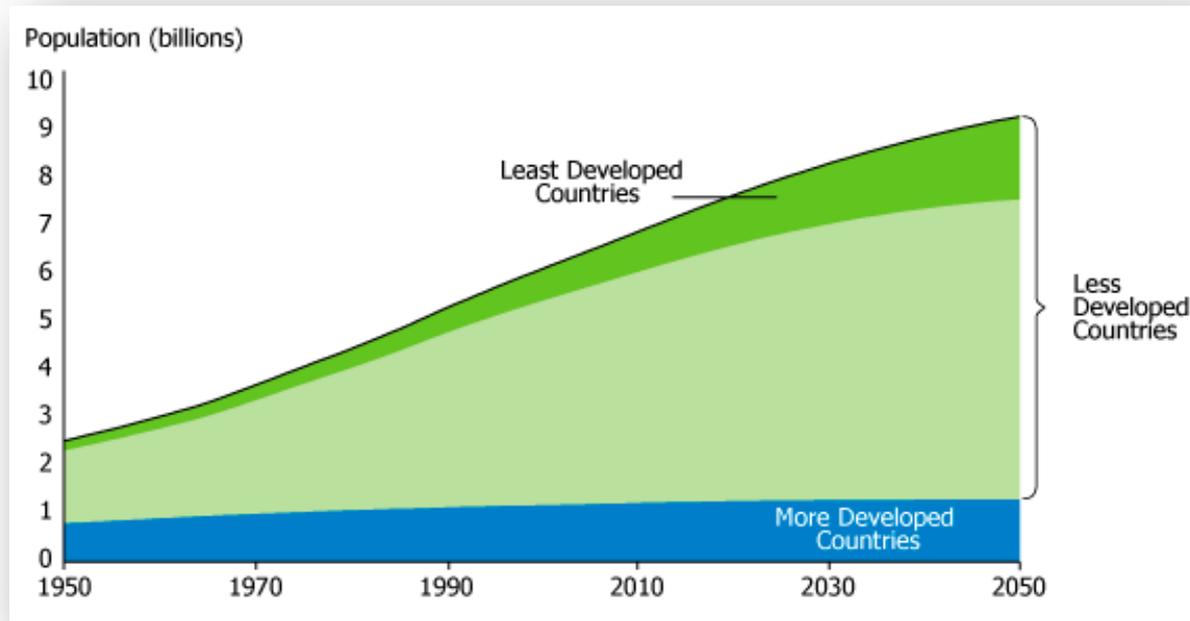
> Who are the unbanked?

	Literacy rate
 Senegal	55.7%
 Gambia	55.5%
 Mauritania	52.1%
 Ethiopia	49.1%
 Sierra Leone	48.1%
 Liberia	47.6%
 Côte d'Ivoire	43.1%
 Chad	40.2%
 Mali	38.7%
 Benin	38.4%
 Afghanistan	38.2%
 Central African Republic	36.8%
 Burkina Faso	36%
 South Sudan	31.9%
 Guinea	30.4%
 Niger	19.1%



© Wikipedia, 2017

> And tomorrow?



There is a huge potential to boost

dividends



> FINTECH ENABLING FINANCIAL INCLUSION



“The unbanked DO NOT need a bank account... Yet!”
Technology is enough!

> Mobile Phone Penetration

Sub-Saharan Africa's mobile market by the numbers

Mobile cellular subscriptions per 100 people



1 billion

Expected total number of mobile cellular subscriptions in Africa by 2015. Mobile cellular subscriptions in 2005 totalled 90.3 million and in 2010 that figure stood at 384 million.

Number of countries with at least one mHealth app



Sources: World Bank, GSMA, Informa Telecoms & Media



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securityandtrust.lu

As of January 2017, Africa is at **81%** Subscription rates (GSMA report)

> Mobile Money **is king**



A new **CURRENCY** – Cell phone minutes

> Mobile Money

- Money Transfers (Remittances)



RURAL EXODUS IMPACT

- Your phone = Your **wallet**
- **Telcos** are the fastest growing FSP
- Only **domestic** transfers



> Mobile Money

• Money Transfers (Remittances)



RURAL EXODUS IMPACT

- Your phone = Your **wallet**
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© World Bank



International Transfers
The Next Opportunity?

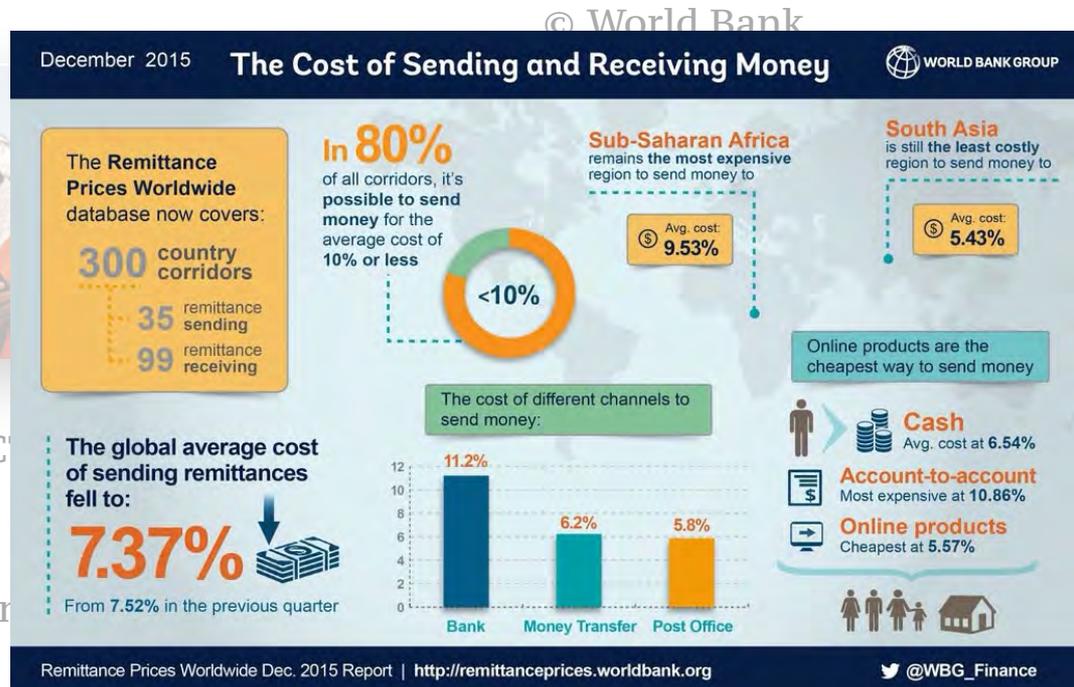
> Mobile Money

• Money Transfers (Remittances)



RURAL EXODUS IMPACT

- Your phone = Your **wallet**
- Only **domestic** transfers
- **Telcos** are the fastest growing



> Mobile Money

- Money Transfers (Remittances)

250 Send money home

Helping 700+ MILLION families make ends meet

36 MILLION EMIGRATING PEAS

Putting \$60+ BILLION in migrants' pockets

Source: Remittance Prices Worldwide, June 2015
Migration and Development Brief, April 2015

http://www.bank.org/paymenttoextrem and http://remittanceprices.worldbank.org

International Transfers
The Next Opportunity?

- Your phone = Your wallet
- Only domestic transfers
- Telcos are the fastest growing FSP



BTW, Have you heard of **Orange bank**? We will come back on this one...

> Mobile Money

- Money Transfers (Remittances)
- Cashless payments
- Microfinance & Deferred payments
- Credit history



> They are eyeing this opportunity...



- *“The future will be built in Africa”* - **Zuckerberg** in Kenya, 2016
- *“In the next 15 years, digital banking will give the poor more control over their assets and help them transform their lives.”* – **Gates** (Bill & Melinda Gates report 2015)

> M-Pesa: The African Success Story

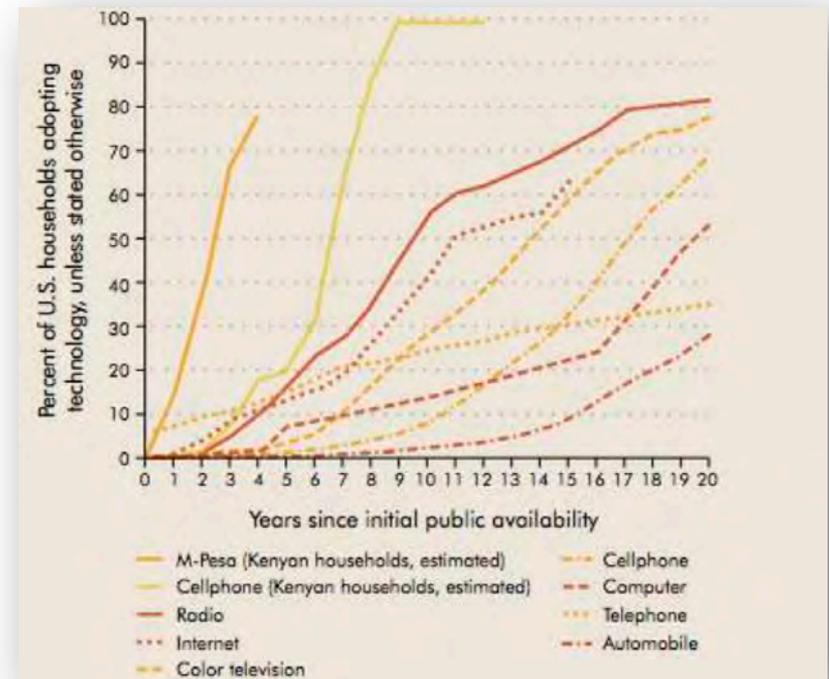
M-Pesa reached 80% of households in Kenya within 4 years



44% of
Kenya GDP



© World Development Report 2015



> M-Pesa: The African Success Story

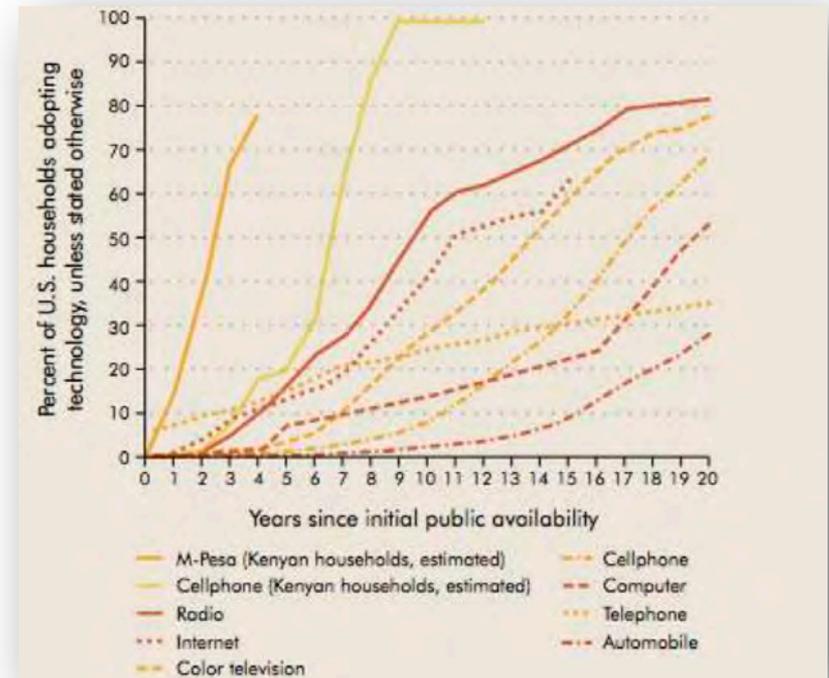
M-Pesa reached 80% of households in Kenya within 4 years



44% of
Kenya GDP



© World Development Report 2015



Only in 1 out of 55 countries

- Only 26% in Tanzania
- 17% in South Africa
- 11% in Senegal



In Kenya, there was:

- A supportive Regulatory framework
- A monopoly of Safaricom
- ...

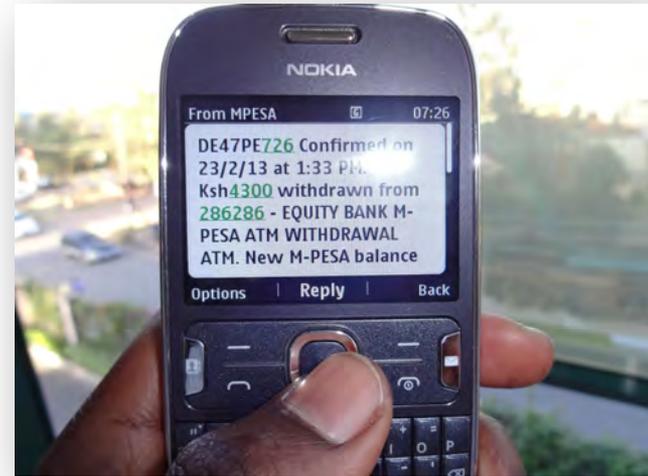
> THERE IS ROOM TO INNOVATE

Trough **SOFTWARE ENGINEERING** for FinTech



> What are the (Technical) challenges?

- Most users are **ILLITERATE**

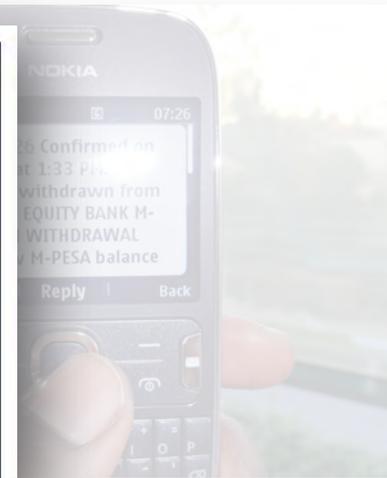
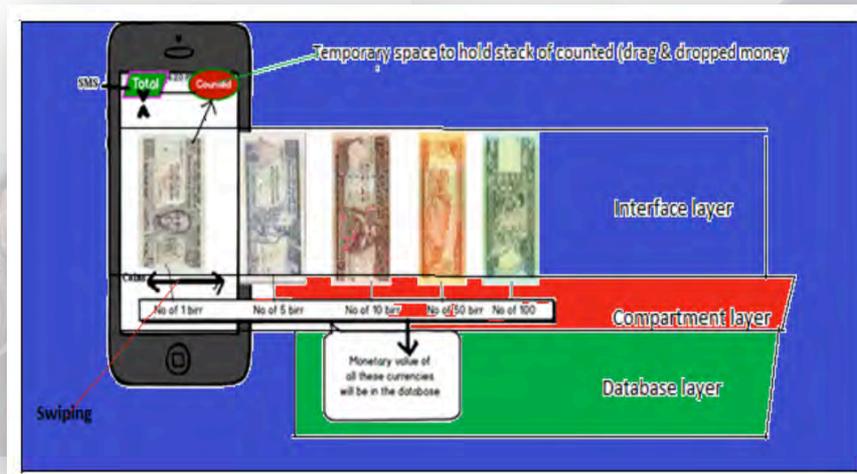


**Graphical User Interface
design problem**

> What are the (Technical) challenges?

- Most users are **ILLITERATE**

© HCII 2014 – International Conference on Human-Computer Interaction
From Brunel University



**Graphical User Interface
design problem**

> What are the (Technical) challenges?

- Most users are **ILLITERATE**
- The technology used is outdated, hence **INSECURE**



Short Message Service (SMS)

Unstructured Supplementary Service Data (USSD)

- Data transfers in plain text in mobile networks
- Massive frauds with fake SMS / fake transactions

37% of M-Pesa Transactions are **fraudulent**
(Central bank of Kenya, 2015 Report)

Software and Security
Testing problems

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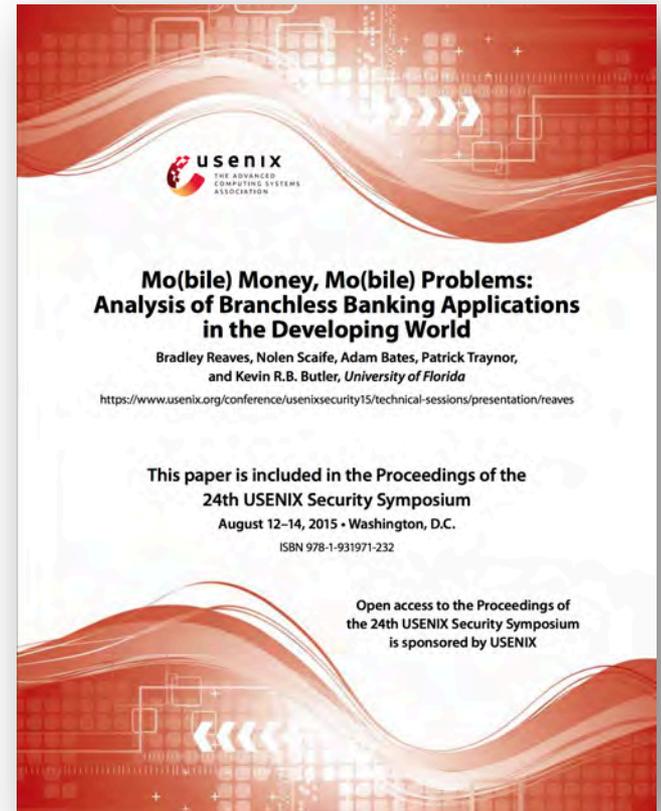


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37% of M-Pesa Transactions are **fraudulent**
(Central bank of Kenya, 2015 Report)

- Pervasive security **vulnerabilities**
- Botched **certification** validation
- Do-it-yourself **cryptography**
- Information **leakage**



> What are the (Technical) challenges?

- Most users are **ILLITERATE**
- The technology used is outdated, hence **INSECURE**
- Operators do not **INTEROPERATE**, limiting innovation



Lack of **API** / clear architecture

> What are the (Technical) challenges?

- Most users are **ILLITERATE**
- The technology used is outdated, hence **INSECURE**
- Operators do not **INTEROPERATE**, limiting innovation
- Transactions are not yet **GLOBAL** (e.g., no cross-border tx)



Software for **tracking data**,
keeping **integrity**,
implementing **transparency**

> WHAT ARE WE DOING @SnT

> Demonstration of Technology



Pilot Implementation of a Framework for
Secure, **I**nteroperable and **G**lobal **M**obile **M**oney in Sub-Saharan **A**frica



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securityandtrust.lu



Call ICT-39-2016-2017:
*International partnership
building in low and middle
income countries*

> The consortium

- in Sub-Saharan Africa



Senegal

- **UCAD** (Université Cheick Anta Diop)
- **Suricate** (Suricate Solutions Sarl)
- **CTI.SN** (Centre de Traitement Informatisé du Sénégal)

Burkina Faso

- **MDENP** (Ministère du Développement de l'Economie Numérique et des Postes)
- **ANPTIC** (Agence Nationale de Promotion des TICs)
- **UPB** (Université Polytechnique de Bobo Dioulasso)

Cote d'Ivoire

- **UAOB** (Université Alassane Ouattara de Bouaké)

- with EU Partners

Netherlands

- **U.Leiden** (Universiteit Leiden)

Luxembourg

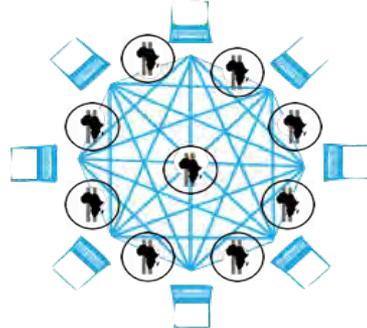
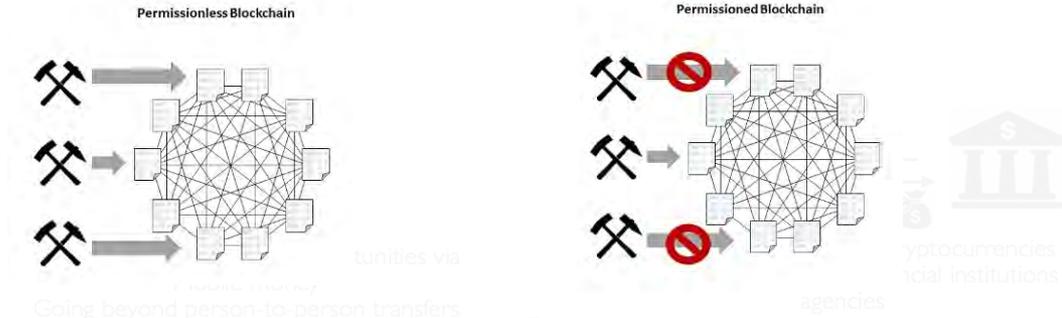
- **Uni.lu** (University of Luxembourg /SnT)
- **SnapSwap** (Snapswap International SA)

Poland

- **Nethone**



> The big picture in SIGMMA



A Permissioned Blockchain Architecture for *Cryptocurrency-based Mobile Money*

- Secure << Transparent distributed ledger
- Interoperable << Public open API
- Intuitive << Transactions logic hidden behind app GUI
- Global << Possibility of interconnecting with other cryptocurrencies worldwide

Real-world, large-scale testing of Cryptocurrencies

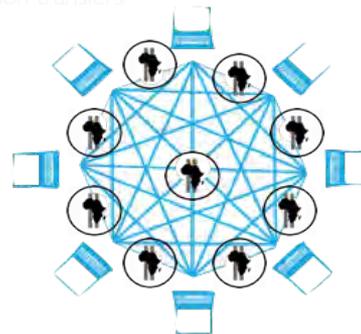
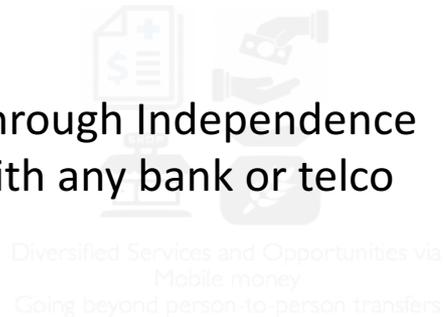
– opportunity for contributions from

- Not any entity is allowed to verify transactions (*security*)
- No need for majority to agree on the validity transaction (*latency*)
- Transparent ledger for Central Banks (*possibility of cross-border*)

Innovation in FinTech
Sustainable take-up via training businesses

> The big picture in SIGMMA

- Interoperability through Independence
- No specific ties with any bank or telco



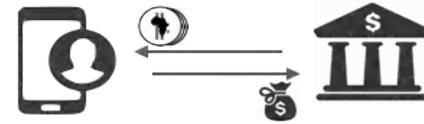
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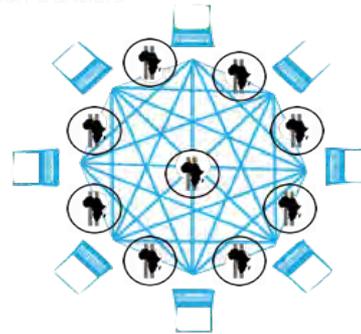
Diversified Services and Opportunities via Mobile money
Going beyond person-to-person transfers



Users can buy/exchange cryptocurrencies at traditional bank and financial institutions agencies



Interconnection with and for existing mobile money systems



A Permissioned Blockchain Architecture for *Cryptocurrency-based Mobile Money*



SIGMMA will develop an Application Programming Interface to interact with the backend of the solution



Real-world, large-scale testing of Cryptocurrencies
- opportunity for exposing constraints, limitations
- contributions for formulating regulation

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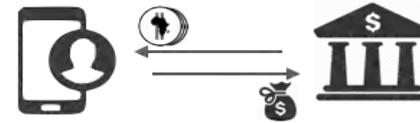
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Growth in businesses



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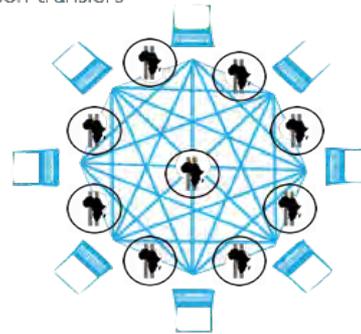
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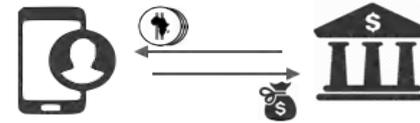
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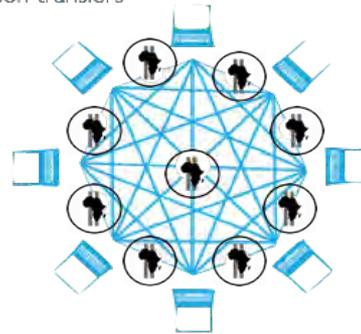
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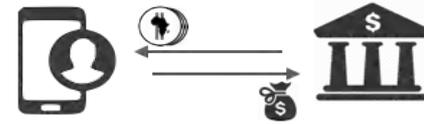
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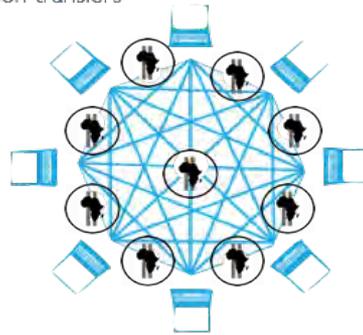
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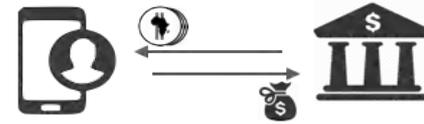
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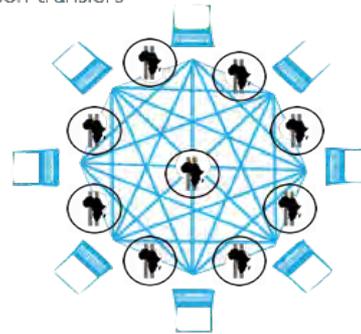
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ONE LAST CHALLENGE...

> Customer Identity



- Keep known **criminals** out of the loop.
- Identify **high risk** customers as early as during onboarding

> Summary

- Examples highlighting that Software can be used for both:
 - Already advanced users and institution in order to OPTIMIZE existing financial services
 - Novice users such as unbanked people in order to ONBOARD them into the financial market

> Thanks!

- We are open for collaboration!

> We are Software Engineers

- We are surprised to realize that

SOFTWARE IS MISSING!!!

- 0 occurrence in the 2017 PwC Report
- 3 occurrences in the 2016 PwC Report
 - “Open development and **software**-as-a-service (SaaS) solutions have been central to giving banks the ability to streamline operational capabilities.”
 - “by providing **software** that helps clients to better navigate the investment world”
 - “Just as Enterprise Resource Planning (ERP) **software** allowed functions and entities within... »



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> Step 1: Document Classification



SNT securityandtrust.lu

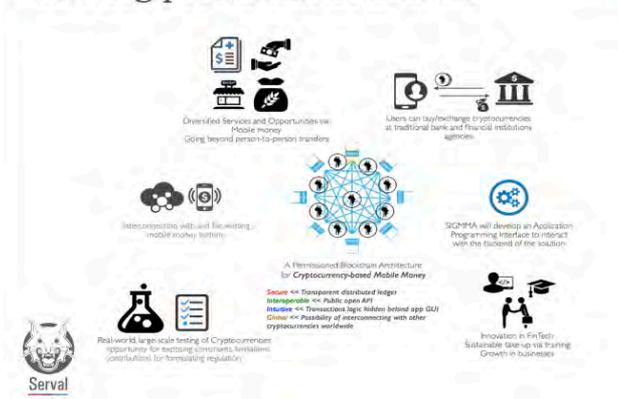
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