

UW Digital Financial Services Research Group

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UW DFS Research Group

- Develop and deploy technological solutions to specific challenges that impede the introduction and wide scale deployment of DFS
- Build a global academic community focused on computing and DFS technologies



Research in Digital Financial Services

Improved access to financial services is critical for raising people out of poverty

- Technological challenges impede the introduction and adoption of digital financial services (DFS)
- Computer Scientists and Information and Computing for Development (ICTD) researchers can help address these challenges

Why improved financial services help

- Reduce the cost of being poor
- Create opportunities for financial growth
- Increase efficiency of government programs
- Protect against financial shocks
 - Limit the number of people slipping back to extreme poverty

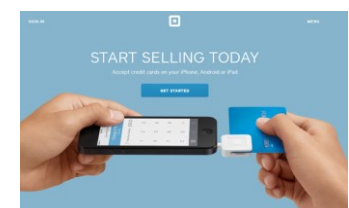
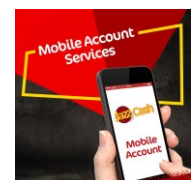
Financial Services

- Basic financial services
 - Remittances
 - Savings
 - Government payments
 - Digital payments
 - Insurance
 - Bank accounts
- Mobile money
 - Financial products linked to mobile operators
 - Commonly including Cash In, Cash Out (CICO) agents



Financial Services Landscape

- Mobile phones provide access to digital economy
 - Smart phones and basic phones
- Mobile operators and banks are both important
 - Variation across countries
 - Regulations have a big impact
- Government priority in many countries
 - Reducing role of cash
 - Link to national ID
- Fintechs have a role for innovation and market disruption



Mobile Money

Success stories

- M-Pesa in Kenya
 - Mobile money through Safaricom
 - Used by almost all Kenyans
 - Leap frog technology
 - New model
- Tanzania
 - Success in interoperability
- India
 - Aadhaar and creation of bank accounts
- East Asia
 - Very strong growth in mobile money

But, challenges abound

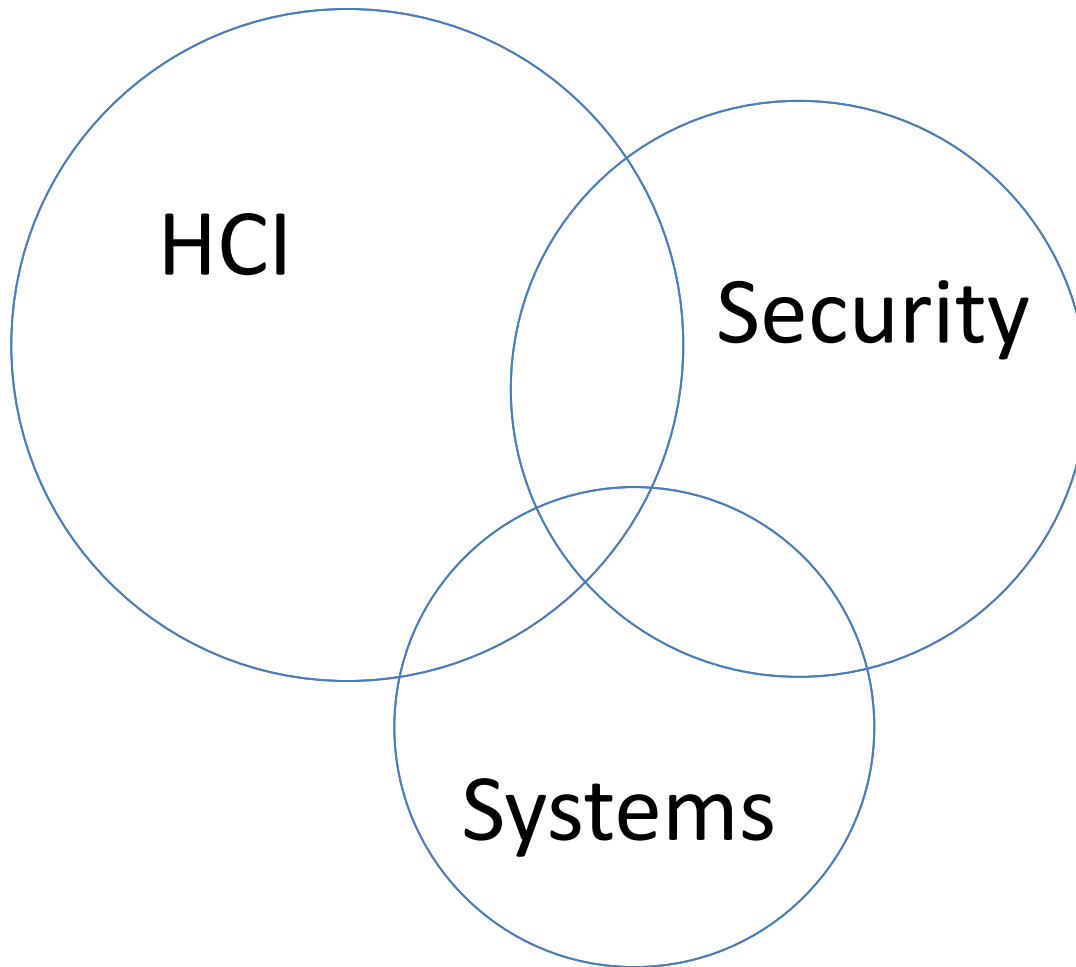
- Failure of replication of M-Pesa in many countries
 - Low adoption rates
 - Regulatory regimes
- Banking costs too high to support services in remote regions
- High transaction costs limit many digital services
- Focus on peer to peer requires cash at endpoints

Challenges to expanding the reach of financial services to the poor

- Inconsistent uptake of services
- Obstacles at consumer level
 - Usability, trust, understanding of services, available technology, appropriate services
- Obstacles at implementation level
 - Security, detecting fraud, proving and verifying identity, infrastructure failure, managing agents
- Obstacles at system level
 - Multiple carriers, regulatory regime, costs, market understanding

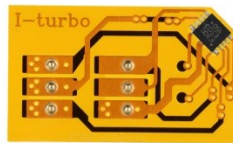
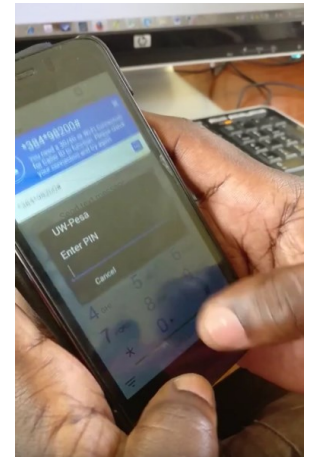
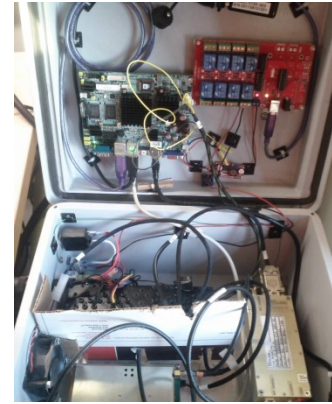


Where does Computer Science/ICTD fit in?



UW DFSRG





































- Research projects
- UW-Pesa demonstration lab
- Technology explorations
- Global FinTech Centers





SECURITY AND PRIVACY

Security of Mobile Financial Applications

 <p>Vodafone M-Pesa V Vodafone m-pesa Limit</p> <p>★★★★★ FREE</p>	 <p>m-pesa Trade Partn Vodafone m-pesa Limit</p> <p>★★★★★ FREE</p>	 <p>TumaPesa - The MF Ujuji Code Ltd</p> <p>★★★★★ FREE</p>	 <p>m-calc Dynamic Data Systems</p> <p>★★★★★ FREE</p>	 <p>pesaDroid Free MP pesaDroid Ltd</p> <p>★★★★★ FREE</p>	 <p>GoodPesa, Safaricom GoodApps Studio</p> <p>★★★★★ FREE</p>	 <p>myMpesa - Mpesa SokkoLife.com</p> <p>★★★★★ FREE</p>	 <p>MySafaricom Safaricom Limited</p> <p>★★★★★ FREE</p>	 <p>MPESA Sniffer Emmanuel Rop</p> <p>★★★★★ FREE</p>
 <p>Calc ya MPESA Ngahu</p> <p>★★★★★ FREE</p>	 <p>PesaBox Ujuji Code Ltd</p> <p>★★★★★ FREE</p>	 <p>Safaricom Airtime GOOD APPS KENYA</p> <p>★★★★★ FREE</p>	 <p>Lipa Na M-PESA m:lab East Africa Stud</p> <p>★★★★★ FREE</p>	 <p>SawaPay - Money to First Choice Global Lim</p> <p>★★★★★ FREE</p>	 <p>Clam: Instant PayPe Cafrecode IIS</p> <p>★★★★★ FREE</p>	 <p>ZEZEPAY ITFARM</p> <p>★★★★★ FREE</p>	 <p>pesaDroid MPESA pesaDroid Ltd</p> <p>★★★★★ \$2.99</p>	 <p>Safaricom M-Ledge Safaricom Limited</p> <p>★★★★★ FREE</p>
 <p>Eazzy Banking Finserve Africa</p> <p>★★★★★ FREE</p>	 <p>My SACCO Sky World Limited</p> <p>★★★★★ FREE</p>	 <p>MCOOPCASH Co-operative Bank of Ki</p> <p>★★★★★ FREE</p>	 <p>Taifa Leo Epaper Nation Media Group</p> <p>★★★★★ FREE</p>	 <p>Mwananchi Epaper Nation Media Group</p> <p>★★★★★ FREE</p>	 <p>TeksiPOA Chiraga Dodhia</p> <p>★★★★★ FREE</p>	 <p>Mula Cellulant Corporation</p> <p>★★★★★ FREE</p>	 <p>Daily Nation Epaper Nation Media Group</p> <p>★★★★★ FREE</p>	 <p>Business Daily Epaper Nation Media Group</p> <p>★★★★★ FREE</p>
 <p>Apply Now</p> <p>★★★★★ FREE</p>	 <p>ENU Craft Inventors</p> <p>★★★★★ FREE</p>	 <p>PesaSasa: Money T Sankale Shompole</p> <p>★★★★★ FREE</p>	 <p>JamboPay Web Tribe</p> <p>★★★★★ FREE</p>	 <p>Q cash QuinTell</p> <p>★★★★★ FREE</p>	 <p>Lipa Karo Homepesa Sacco Limit</p> <p>★★★★★ FREE</p>	 <p>Zeedy Paykind Inc</p> <p>★★★★★ FREE</p>	 <p>My UAP startappzke</p> <p>★★★★★ FREE</p>	 <p>The East African Epaper Nation Media Group</p> <p>★★★★★ FREE</p>

App Security Overview

- Security audits have revealed many vulnerabilities in financial applications
- Most serious vulnerability, poor implementation of SSL certificates
- Many problems could be fixed by simple steps, e.g., strict Android version requirements
- Many applications have unusual behavior
 - Pin reset to known value
 - Charge user for pin reset

Castle et al. (2016) Security analysis of 197 decompiled Android apps (automated detection of permission requests, version requirements, external libraries, and HTTPS URL usage), in depth analysis of 71 apps (assessment of KYC requirements, password reset procedures, SMS usage), interviews with seven software developers

Why are there security vulnerabilities?

- Software developer interviews in 5 countries
- Who makes these apps?
 - Professional developers
- Why do vulnerabilities arise?
 - Unclear responsibility for security
 - Conflicting specifications
 - Lack of security responsibility with vendors
- What is the big need?
 - Security validation tools for product managers



Assessment of SMS Phishing

- How prevalent is SMS based fraud in mobile money?
- Build corpus of SMS fraud messages
 - Develop mobile app for collection
 - Scrape twitter feeds
 - Interviews to understand customer reactions
 - Classify types of fraud messages
- How does SMS Phishing fit with more general fraud?

WELCOME KCB BANK, LOTTO promotions! 2016 you're the lucky winner of ksh 100,000.00 call on Mr ALEX. [0788187232](tel:0788187232) DONT PAY ANYTHING, SENDER KCB.

06:54 Safaricom

Wednesday, 23 November 2016



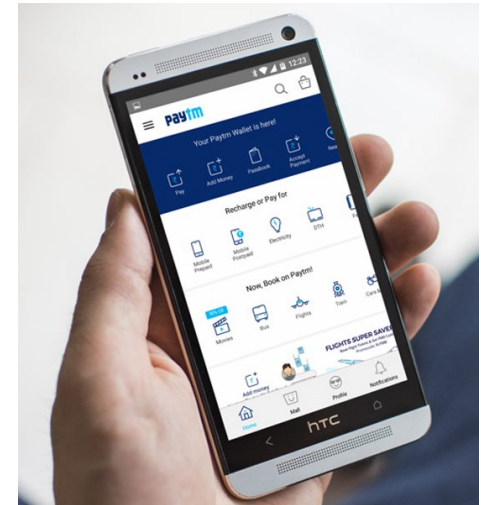
Dear safaricom Customer, KCB Mpesa soft loan now available at 5% interest @kshs 25,000/- 50,000/- 100,000/ call us or sms! [0780959000](tel:0780959000) OKOA MAISHA NA KCB.

SMS 09:35 2



M PESA KJF31UCDTGV Confirmed. You have received ksh4,530 from COLLINS ONYANGO [0797708822](tel:0797708822) on 29/10/16. New M-PESA balance ksh(LOCKED). Pay bills via Mpesa@

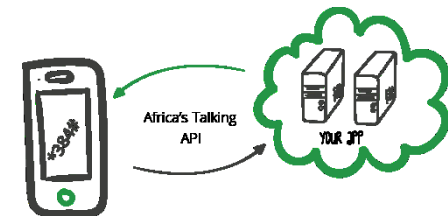
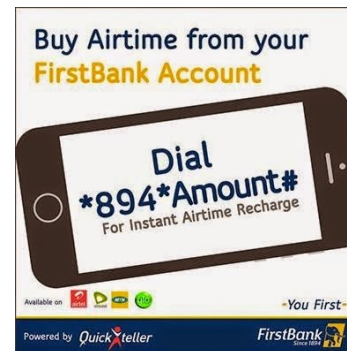
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MOBILE MONEY TECHNOLOGIES

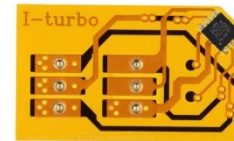
Supporting mobile money on basic mobile phones

- Unstructured Supplementary Service Data (USSD)
 - Similar to SMS, but session based and under control of mobile operators
 - Used to implement menu based applications, including mobile money
- Work on tools for implementing USSD applications and gateways to USSD services



Perrier et al. (2015) USSD : The Third Universal App

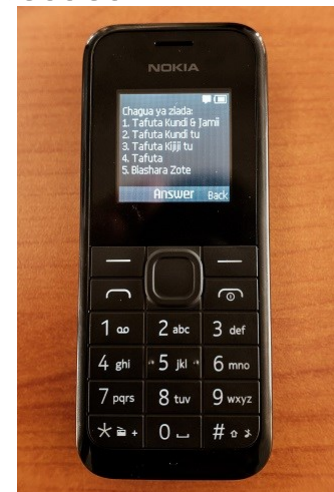
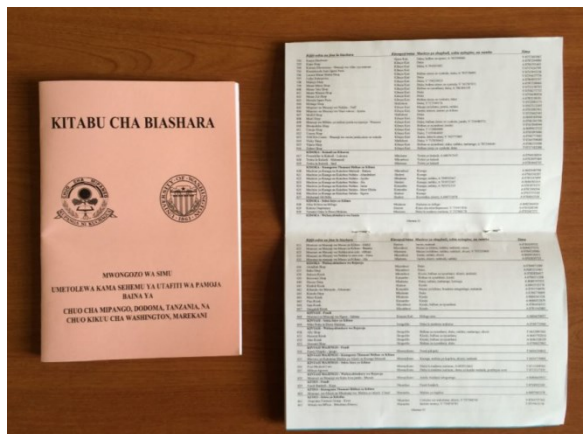
Thin Sims



- SimApp: Application embedded on sim card
- Overlay Sim
 - Allows external applications to run with a sim card
 - “Make dumb phones smart”
- Proposed for various mobile money systems
- Security issue: Man in the middle attack
 - Proof of concept on multiple vulnerabilities

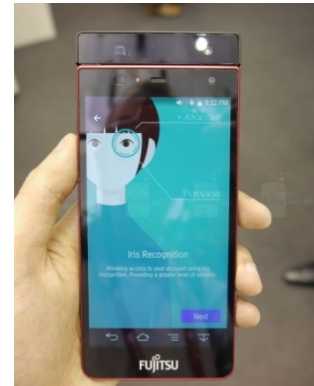
Usability of USSD Phone Directory

- Develop and deploy a scalable USSD application in Tanzania
- Implement an electronic yellow pages
 - Extending an existing paper directory
 - Promote economic development by improving service discovery
- Feasibility
 - Able to reach rural population in Dodoma region
- Usability
 - High success rate in both menu navigation and search
- Acceptability
 - Sustained usage in field trial
 - Interviews revealed use for locating businesses



The Android eco-system for DFS

- Many uses of Android devices for
 - Financial applications
 - Point of sale devices
 - Biometrics
- What are the limitations of low cost Android phones?



Home > Mobiles > Google Mobiles > Google Pixel XL Price in Pakistan SKU: 10345



Google Pixel XL

by Google
Google Pixel XL smartphone was launched in October 2016. The phone comes with a 5.5-inch touchscreen display with a resolution of 1440 pixels by 2560 pixels at a PPI of 534 pixels per inch.

105,999 PKR

[Buy Now](#)

OR

Call us: +92 311 163 4275

Item Condition: New
Shipping Info: 24 - 48 Hours
Stock Info: On Order

Home > Mobiles > GFive Mobiles > GFive President Smart 2 Price in Pakistan SKU: 12350



GFive President Smart 2

by GFive
GFive presents Smart series 2, an excellent model for those who value functionality and high quality technology and at the same time does not want to overpay for unnecessary features. GFive Smart 2 modern smartphone is designed for two SIM-cards and supports almost everything, that maximizes your chances of communication.

5,289 PKR

[Buy Now](#)

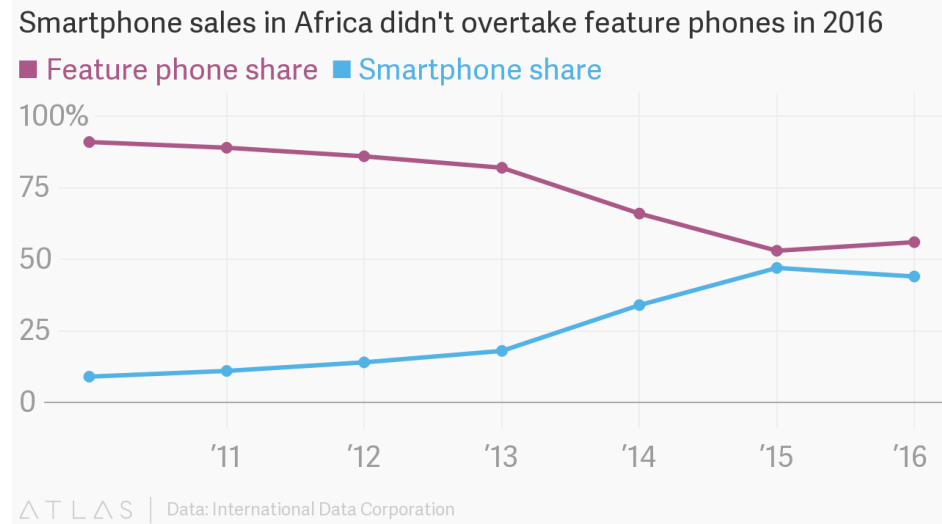
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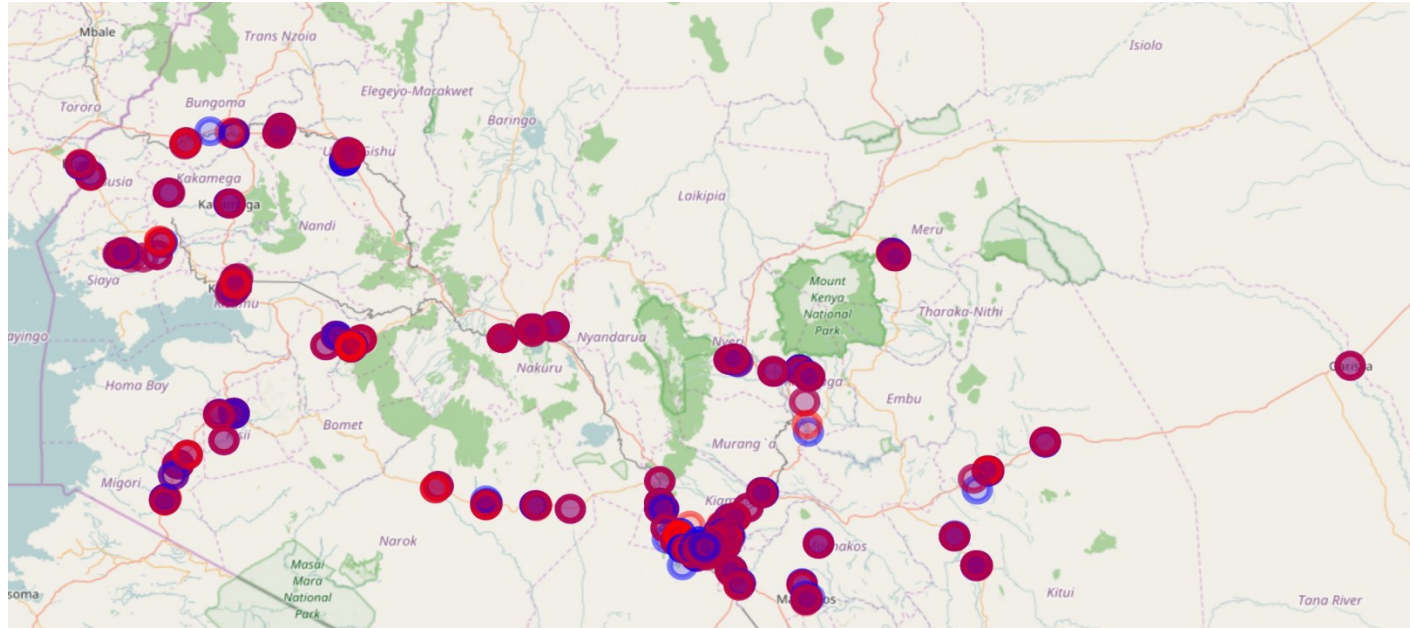
Call us: +92 311 163 4275

Item Condition: New
Shipping Info: 24 - 48 Hours
Stock Info: Available

Is there space for a smart feature phone?

- Some evidence that feature phones are making a comeback
- Distinction between smart phone and feature phone controversial
- Introduction of phones such as Jio



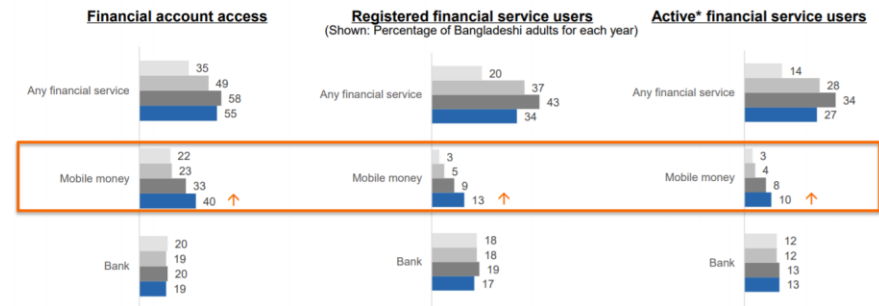
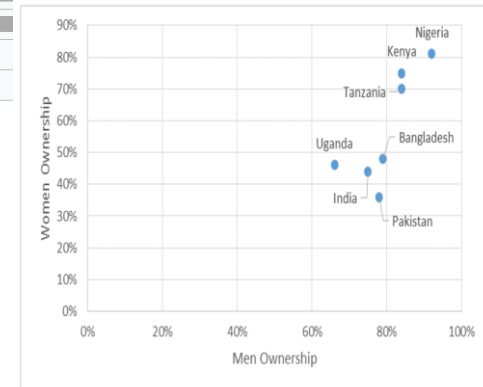


DATA ANALYTICS TO FOR MOBILE MONEY

The Challenge of Data for Financial Inclusion

- Vast amount of data being generated on financial services
- However, for financial inclusion, interested in the population not generating data
 - Data on poor often hidden by data on rich
- Combine financial inclusion surveys and large scale data sets
 - Disaggregate data for greater resolution

30	Kenya	26	
31	Peru	25	
32	Philippines	22	
33	Ghana	21	
34	Indonesia	21	
35	Senegal	19	
36	Jordan	17	
37	Burkina Faso	14	
38	Pakistan	11	
39	Tanzania	11	
40	Ethiopia	4	
41	Uganda	4	



What is the distribution of phone types in rural areas

- Debate on smart phone vs. basic phone mobile money solutions
- Who owns 2G vs 3G vs 4G phones
- Cell tower logs
 - Record of every phone connection to base station
 - Type Allocation Code (TAC) indicates model
- Track simcard and phone separately
- Analysis
 - Phones associated with the community
 - Sharing of phones
 - Upgrades and downgrades

Access to data

- Vast amount of data with Telcos
- But what if you aren't a telco?
- Analysis of community cellular logs from Philippines and Indonesia

Shah et al. (2017) An Investigation of Phone Upgrades in Remote Community Cellular Networks

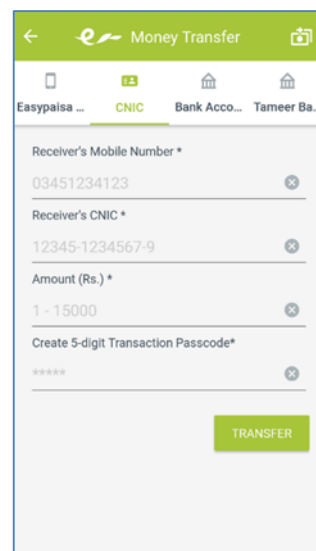


BARRIERS TO ACCESS

Usability of Mobile Wallets

- Interview / usability study in rural Pakistan with multiple App prototype
- Assessment of usability barriers
- Broader concerns
 - Lack of knowledge about existence of mobile wallets
 - People are really ready to adopt the mobile wallets if they are designed appropriately

Ibtasam et al. (2017) An Exploration of Smartphone Based Mobile Money Applications in Pakistan



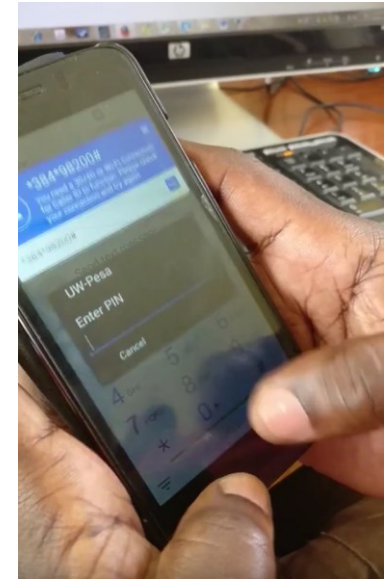
“I can transact from home and will not need to go to city after burning fuel worth 150 rupees and spending time as well. There is no mobile money agent shop in our nearby village but there is 4G internet.”



Gender and Mobile Money

- Pakistan ranks 144 out of 145 countries for gender barriers
- Interview based study in Pakistan
 - 41 Women, 10 Men
 - Urban/rural, north/south Punjab
- Complex situation relating to family, marriage, technology access, finance management, and national ID
- Opportunities
 - ROSCAs or savings groups
 - Women entrepreneurs
 - Need, control of money, independence
- Investigate ‘tipping point’ opportunities for services/financial instruments for women





UW-PESA DEMONSTRATION LAB



Mobile Money Sandbox

- “M-Pesa Complete”
- Realistic user interface
- Multiple Interfaces
 - USSD
 - Web
 - Application

Customizable

- Implement multiple mobile money systems
- Control over implementation parameters such as transaction costs and workflow
- Localization

Extensible

- Point of Sale
- Biometric
- QR Code payments
- Bill paying
- B2P, P2B, G2P, P2G

Composable

- Link multiple system
- Resolve across ledgers
- Exchange and transaction fees

Goals for UW-Pesa

- Demonstration site for mobile money technologies
 - Internal learnings
 - External education and outreach
- Sandbox for experimentation
 - Quick Prototyping
 - Usability Testing
 - Security Testing
 - Workflow Evaluation
- Not targeting high performance, scalability, strong security

Building the DFS research field

- Promoting global work in Computing and DFS
 - Increase the number of researchers working in the area
 - Develop multiple centers of expertise
- Strategy
 - Developing background and literature surveys
 - Sessions at conferences
 - Interdisciplinary linkages
 - Networking and community building
 - FinTech workshop at ICTD 2017
 - Create other DFS research centers



Fintech Center, ITU, Lahore

- Established a research center at Information Technology University, Lahore
- Director: Lubna Razaq
- Establishing projects to parallel existing UW Projects
 - Gender barriers to adoption of mobile money



Reflections on DFS and ICTD

- Plenty of scope for CS work
- Paths to impact
 - Influence industry, regulators, donors
 - Startups
- DFS arising in other ICTD Domains (Health, Agriculture)
- Country differences in DFS much greater than other ICTD Domains
- Impact goals for DFS less clear

Collaborators

MicroSave
Market-led solutions for financial services



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UNIVERSITY of WASHINGTON
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Computing and Financial Services for the Poor: The UW Digital Financial Services Research Group

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