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?

- HCI
- Security
- Systems
UW DFSRG

- Research projects
- UW-Pesa demonstration lab
- Technology explorations
- Global FinTech Centers
SECURITY AND PRIVACY
# Security of Mobile Financial Applications

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<th>Application Name</th>
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MSRI, February 26, 2018
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?
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?
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
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

“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.”

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

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

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