DigiTally: Piloting Offline Payments for Phones

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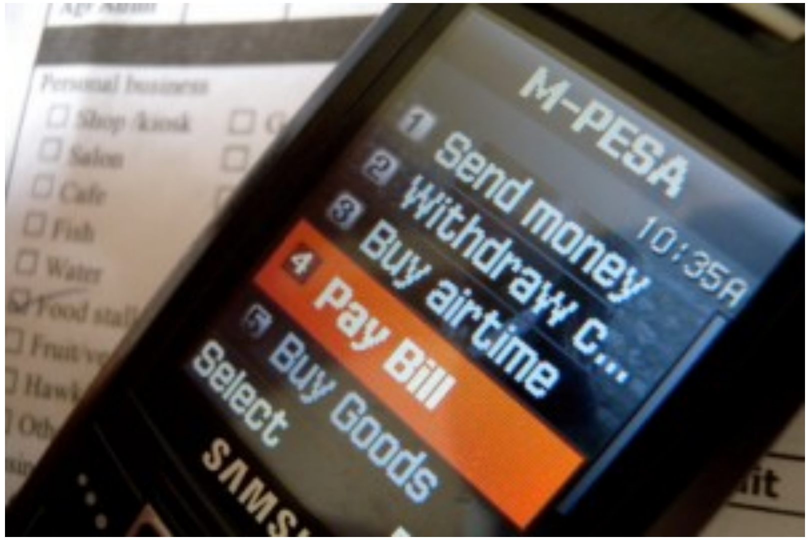
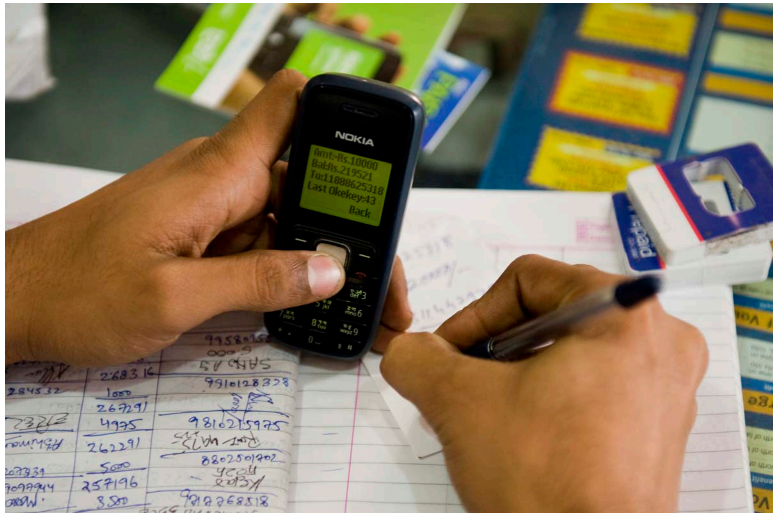
The mobile money revolution





Mobile money achievements

- Brought banking services to hundreds of millions who didn’t have them
- Built mechanisms for direct payments and remittances; store of value; personal safety; transaction history; access to credit
- Provided direct channel for government payments
- Connected lots of people to the online world

What are the remaining challenges?

- Extend payments to areas with no mobile service (mountains, deserts, islands)
- Make service still work when network service intermittent (congestion, power cuts)
- Cut network charges / transaction fees
- Establish standards and interoperability for international remittances

The DigiTally project

- The Gates Foundation asked for ideas to increase merchant use of mobile money
- We talked to operators and users in several countries: issues were network access and costs
- So: how can you do a payment between two phones when there’s no GSM signal?
- It’s easy with two smartphones, but what about basic handsets (feature phones)?

Busia (near Lake Victoria)

Busia county offices (near Lake Victoria)

DigiTally overview

- DigiTally is a prototype system we've built to do research on offline mobile payments
- Address financial inclusion challenges in developing countries
- It works by copying short authentication codes from one phone to another
- It can also be implemented in SIM toolkit or as a smartphone app

Overlay SIMs

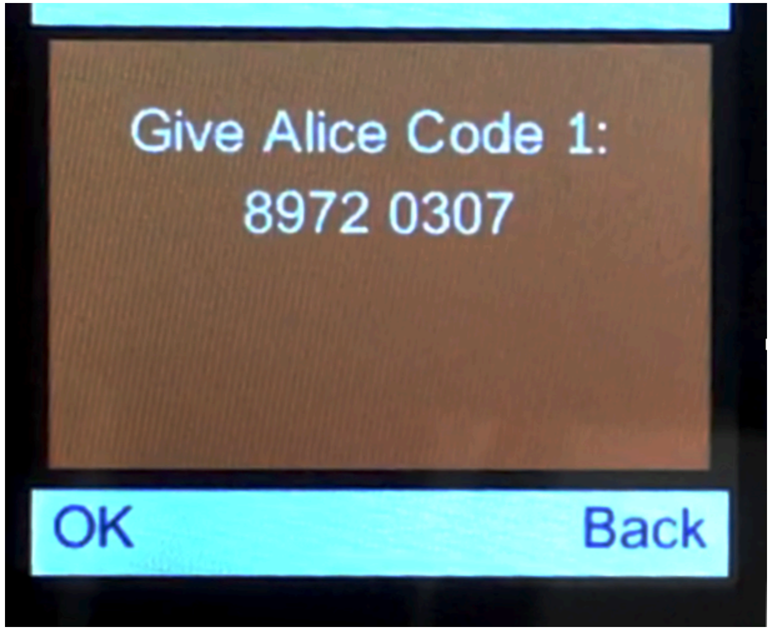
- Tamper-resistant SIM
- Sticks on top of the regular SIM
- Bypasses the mobile network operator
- Independent secure device, like SE in NFC
- Can be used to compute authorization codes, just as in EMV

DigiTally design

- Work in existing environments
- Do not require/introduce unfamiliar hardware
- Minimize assumption about constrained devices
- Focus on feature phones
- Mimic existing mobile payment systems
- Work seamlessly alongside any existing SIM card

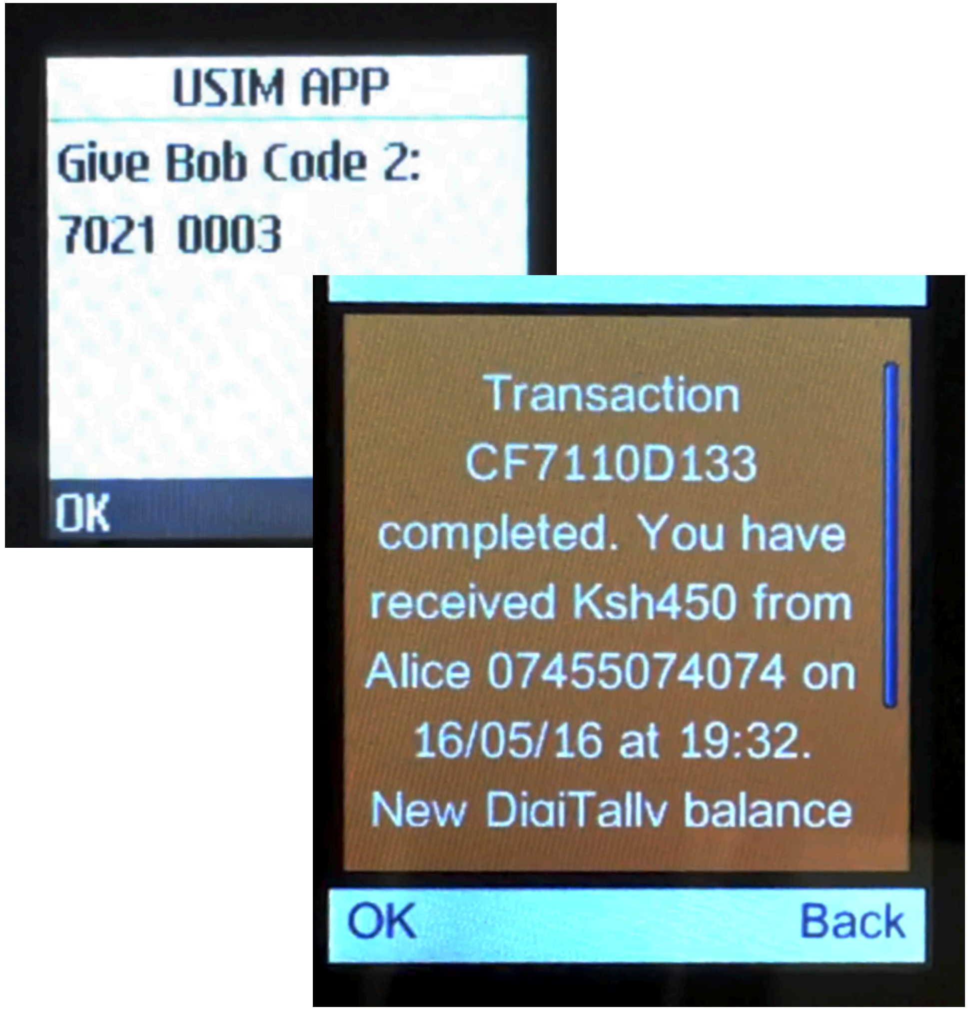
DigiTally payment (I)

- Bob enters the amount, “Ksh 450” on his phone
- It shows an 8-digit authorization request, say “8972 0307” which he reads to Alice
- She taps “Ksh 450” and “8972 0307” on her phone
- If they agree on the two phone numbers and the amount, then Alice’s phone proceeds to the next stage



DigiTally payment (II)

- Alice's phone displays an 8-digit authorization response, say "7021 0003", which she reads to Bob
- He taps in the code
- If it's correct, his phone displays "Ksh 450 received" with a log of the transaction (Alice gets a similar log)

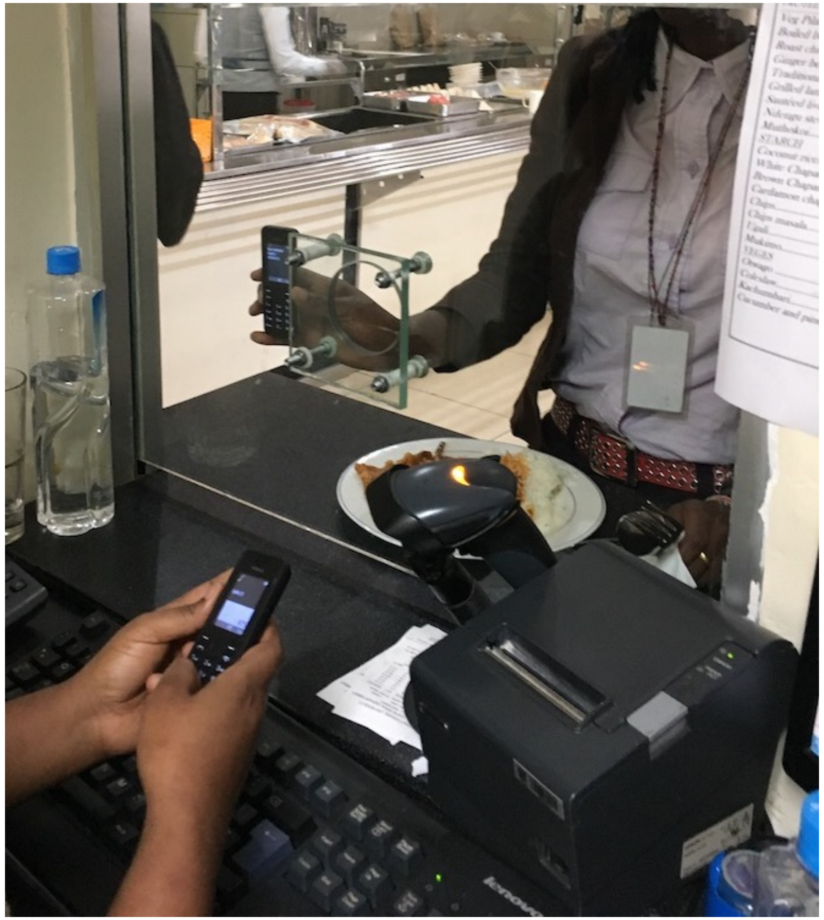


Preliminary study (I)

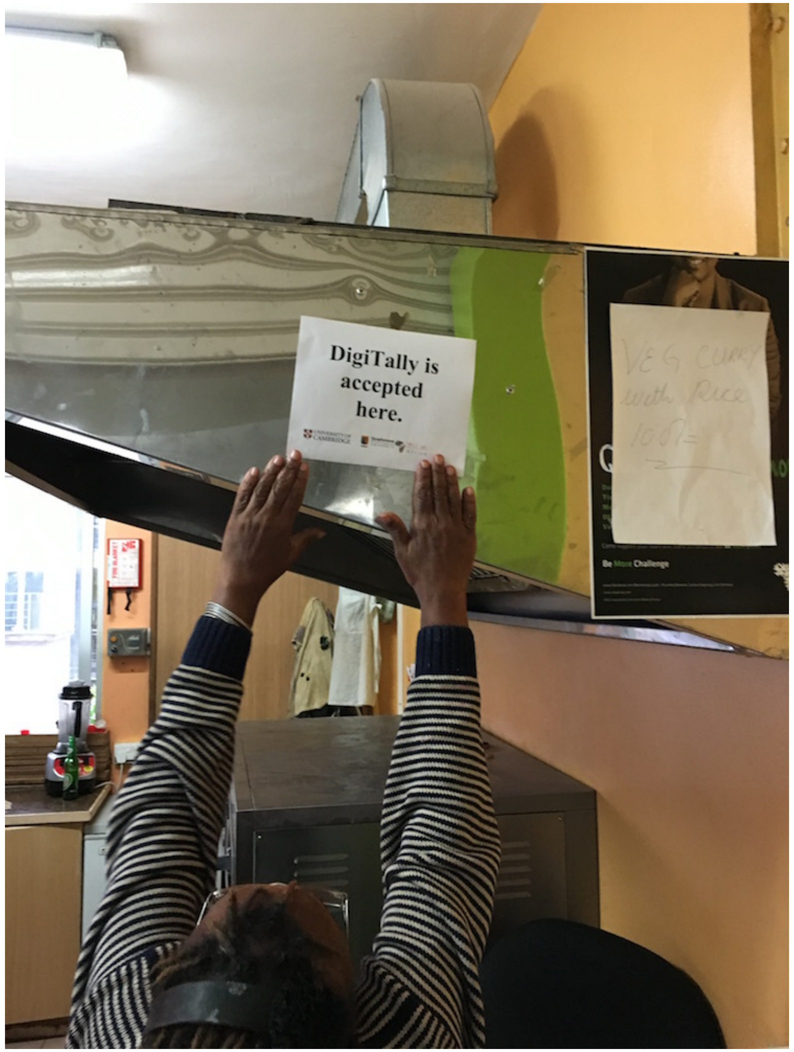
- Collaborate with Strathmore University (Nairobi, Kenya)
- 19 participants at Strathmore University
- Duration: 5 days
- Loaded balance for student phones with Ksh 2000 (about $19.50)
- Three outlets: Coffee shop (one till, quiet), Bookshop (two tills, bursty traffic), Cafeteria (five tills, madly busy at mealtimes)

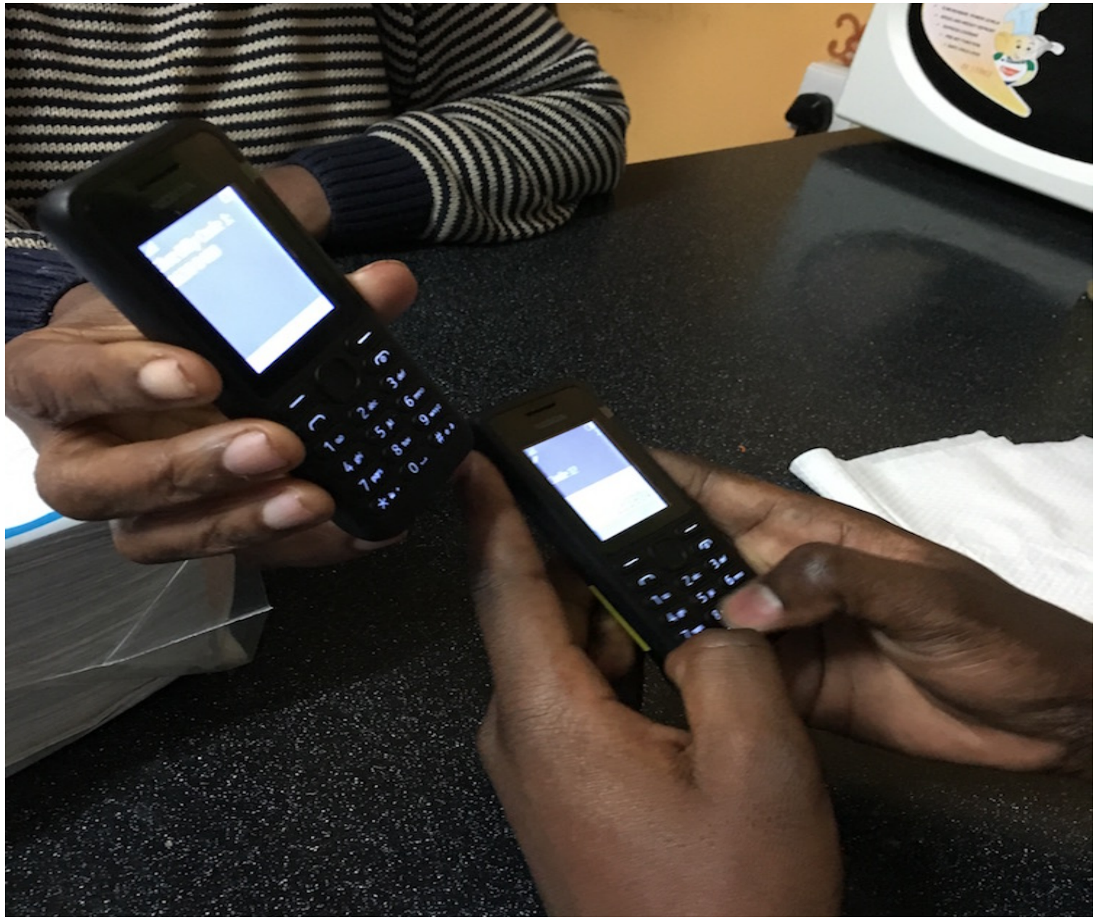
Bookshop

Cafeteria



The coffee shop





Preliminary study (II)

- Data collected:
  - Error rates (code-entry errors, and wrong PIN input)
  - Number of transactions
  - Number of attempts to unlock the SIM
  - Total amounts for all transactions (spent and received)
  - Transaction duration times

Results (students)

$Code_1$ errors	$Code_2$ errors	Total code errors	Average time (seconds)
0	8 (26.7%)	8 (26.7%)	30.9
9 (32.1%)	0	9 (32.1%)	24.4
2 (11.1%)	8 (44.4%)	10 (55.6%)	28.1
9 (40.9%)	1 (4.6%)	10 (45.5%)	44.9
1 (3.5%)	0	1 (3.5%)	24.2
0	1 (3.9%)	1 (3.9%)	54.3
1 (3.9%)	0	1 (3.9%)	50.9
5 (17.9%)	0	5 (17.9%)	32.4
0	4 (40.0%)	4 (40.0%)	28.8
0	0	0	37.1
0	0	0	42.1
5 (22.7%)	0	5 (22.7%)	38.9

Results (merchants)

$Code_1$ errors	$Code_2$ errors	Total code errors	Average time (seconds)
0	4 (6.8%)	4 (6.8%)	40
0	6 (9.8%)	6 (9.8%)	43.9
0	4 (6.8%)	4 (6.8%)	69.8

Results (System Usability Scale)

- All participants: the average SUS score for DigiTally was 78.8 (‘Good’; ‘B+’ grade)
- Eight participants gave the equivalent of an ‘A+’ grade
- Merchant participants: the average SUS score was 71.4 (‘Good’; ‘C+’ grade)
- Student participants: the average SUS score was 83.1 (‘Excellent’; ‘A’ grade)

Final remarks

- Our goal was to investigate usability problems for offline payments, and user requirements for development projects
- DigiTally participants' experience was generally positive (perceived security, speed, deterministic, no network req.)
- Research direction: rethink (reintroduce) resilience in critical systems, learn from delay-tolerant networks (DTNs), etc.
- Focus on the ‘bottom billion’ and the effects of unreliable networks and constrained tech on security and usability

Q & A

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