Mobile Phone Technology

Lecture 8: CSE 490c

Announcements

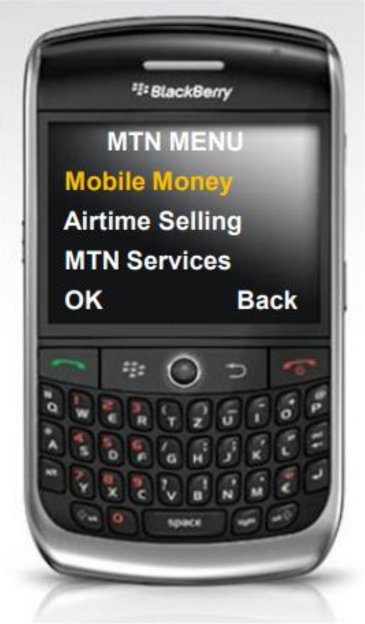
- Sign up to demo programming assignment one

Mobile Money Technology

- Financial accounts associated with mobile phone
- Over the counter (OTC) agents are available for Cash In, Cash Out

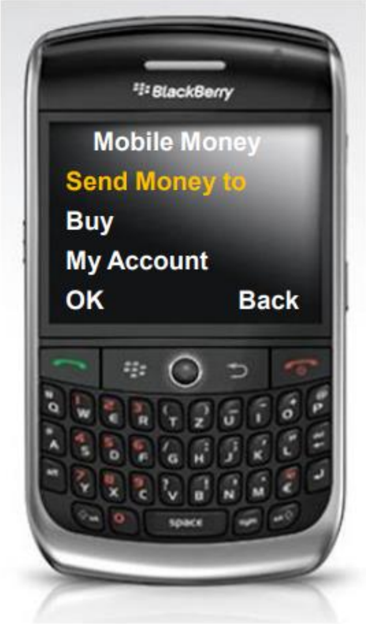
Sending Money [To a Registered User]

Step 1



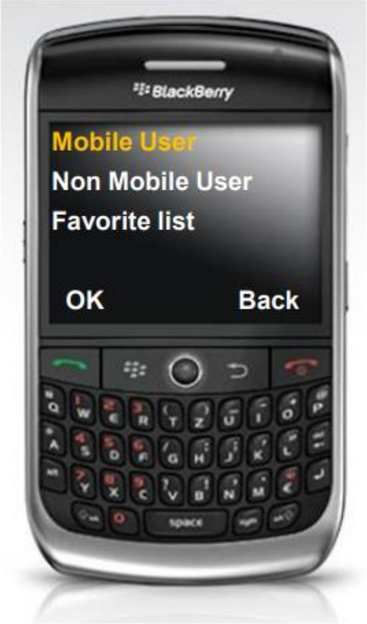
Select Mobile Money

Step 2



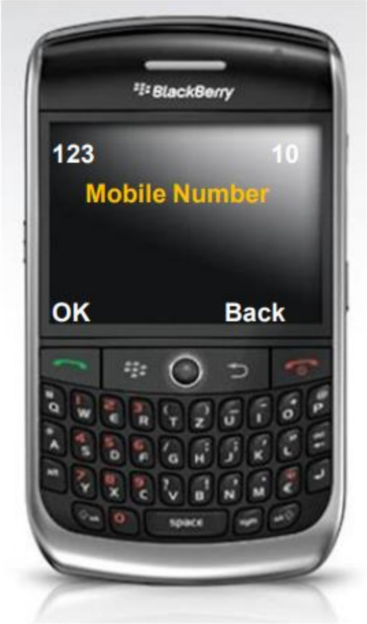
Select Send Money to

Step 3



Select Mobile User

Step 4

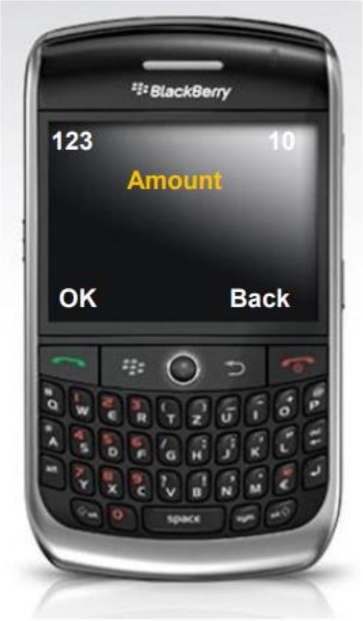


Enter Mobile Number

Sending Money [To a Registered User]…

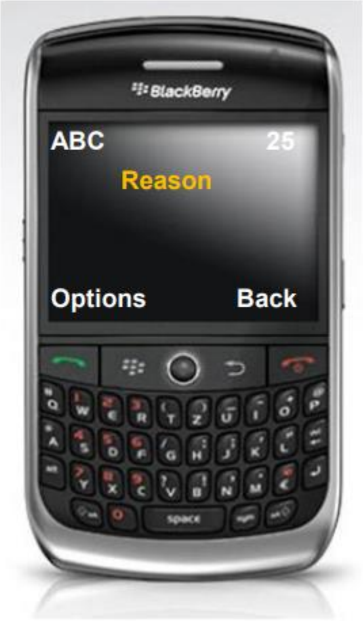
everywhere you go

Step 5



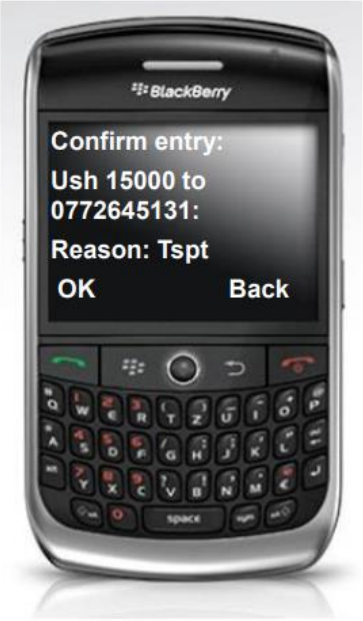
Enter Amount

Step 6



State reason

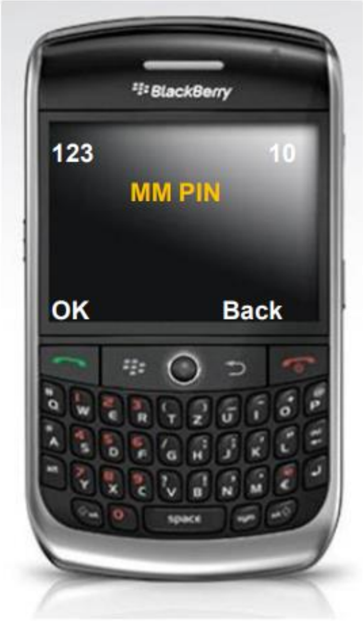
Step 7



Confirm entry:
Ush 15000 to
0772645131:
Reason: Tspt

Confirm details

Step 8



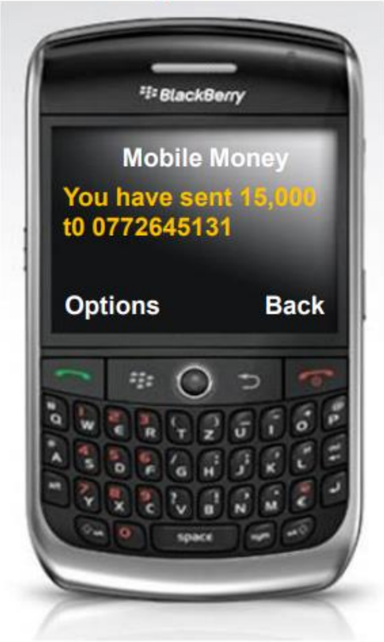
Enter MM Pin

Currency: Uganda Shilling (Ush)

Sending Money [To a Registered User]…

MTN
everywhere you go

Step 9

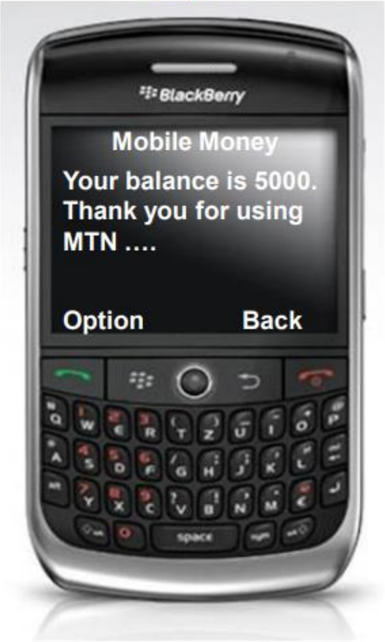


Mobile Money

You have sent 15,000 t0 0772645131

Transaction confirmed

Step 10



Mobile Money

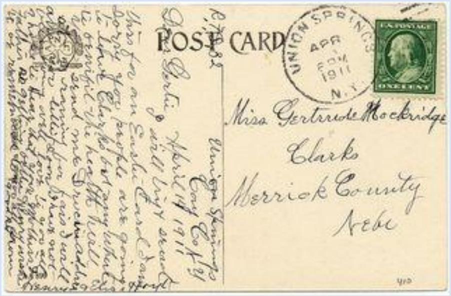
Your balance is 5000. Thank you for using MTN ....

Balance confirmation!

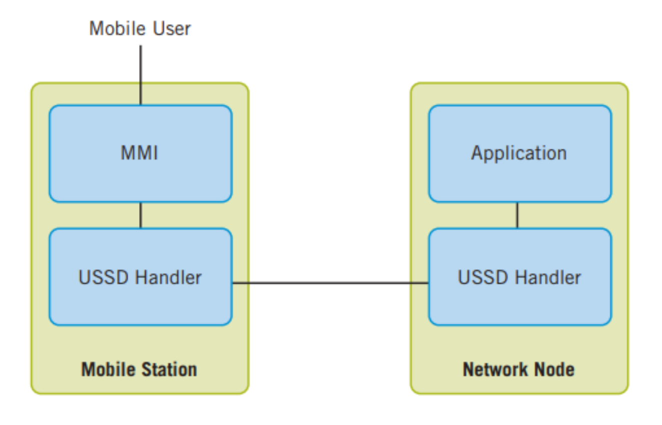
Implementation using SMS

- Does SMS work for mobile money?
- Send as a text message:
    - TO: 2065431695 AMT: 1000.00 PIN: 1234
- Multiple issues, some are partially addressable
    - Usability
    - Spoofing
    - Message interception
    - Multiple rounds may be needed for confirmation

USSD Protocol

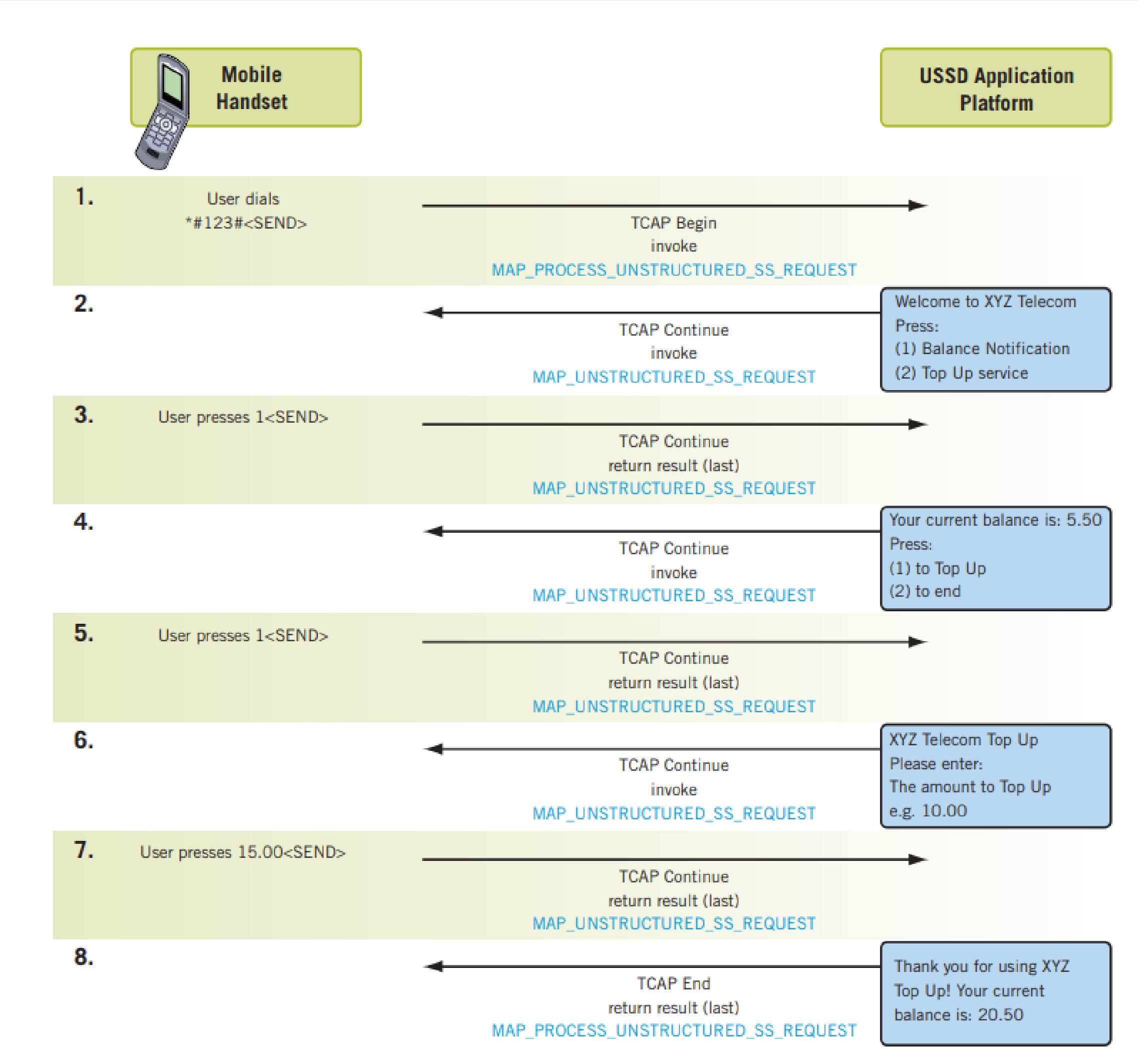


- Networking: Post cards vs. phone calls
- Session opened between mobile operator and handset
  - Can be opened in either directions
  - Fixed size messages with header and text payload
  - Phone number (short code) can trigger USSD app
  - Timeouts on operations
  - Session time out



Source: European Telecommunications Standards Institute (ETSI)

USSD Protocol



Mobile Handset

USSD Application Platform

1. User dials *#123#<SEND>
TCAP Begin
invoke
MAP_PROCESS_UNSTRUCTURED_SS_REQUEST

2. TCAP Continue
invoke
MAP_UNSTRUCTURED_SS_REQUEST

Welcome to XYZ Telecom
Press:
(1) Balance Notification
(2) Top Up service

3. User presses 1<SEND>
TCAP Continue
return result (last)
MAP_UNSTRUCTURED_SS_REQUEST

4. TCAP Continue
invoke
MAP_UNSTRUCTURED_SS_REQUEST

Your current balance is: 5.50
Press:
(1) to Top Up
(2) to end

5. User presses 1<SEND>
TCAP Continue
return result (last)
MAP_UNSTRUCTURED_SS_REQUEST

6. TCAP Continue
invoke
MAP_UNSTRUCTURED_SS_REQUEST

XYZ Telecom Top Up
Please enter:
The amount to Top Up
e.g. 10.00

7. User presses 15.00<SEND>
TCAP Continue
return result (last)
MAP_UNSTRUCTURED_SS_REQUEST

8. TCAP End
return result (last)
MAP_PROCESS_UNSTRUCTURED_SS_REQUEST

Thank you for using XYZ
Top Up! Your current
balance is: 20.50

Security of Mobile Money

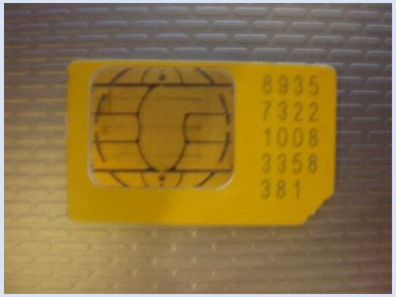
- Connection between handset and tower
- Encrypted transport to MNO Servers
- Secure banking operations
- As secure as the GSM System

Subscriber Identity Module

Sim Card

- Smart Card
  - Integrated Circuit on card form
  - File system, programs, operating system, parameters
- Sim Card
  - Smart Card for handset to communicate with base station
  - Power and communication provided by handset
  - Issued by mobile operator
  - Each Sim Card is unique

Sim Card Data



- ICCID, Integrated Circuit Card Identifier
  - Identifier of the SIM card itself
- IMSI, International Mobile Subscriber Identity
  - Identify Subscriber and Network
- Authentication Key (K_i)
  - Unique, 128 bit key for authentication
  - Secret, not readable
- Location area identity
- SMS Messages and Contacts

Tower validating a phone

Establishing a connection

- Handset (Sim Card) and tower must share a secret to prove identity and allow a connection to be established
  - A session key is then created for secret communication
- Sim Card has the Authentication Key, and Tower can look it up from the subscriber data base
- However the handset can't send the key, since someone could be listening

Challenge Response Algorithm

- Simcard sends IMSI (subscriber identity)
- Tower looks up secret key, K_t
- Tower generates random 128 bit number X
- Tower sends X to handset
- Tower computes $F_t = A(K_t, X)$
- Handset computes $F_h = A(K_h, X)$
- Handset sends F_h to Tower
- If Tower confirms that $F_h = F_t$ communication is established

Cryptography

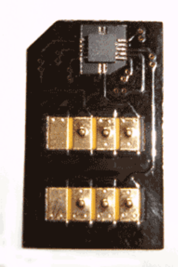
- Function A is a non-invertable hash function
  - If you know x, you can compute A(x)
  - If you know A(x), you can't figure out x
- To the eavesdropper, both X and F look random
- 128 bits is big enough that brute force probably won't work
- Different ciphers A have been used in the GSM standard
- Many studies have been done on extracting secrets from Sim cards and attempting to clone Sim cards

Mobile Money in a SimCard

- Since the SimCard can have programs, Mobile Money can implemented on the Sim Card
- Similar Menu Based operations to USSD
  - But more flexibility in interface, or response
  - Can implement cryptography for encoding
  - Can use encrypted SMS or USSD as a communications mechanism
- Will generally rely on SMS receipts to acknowledge transaction

Thin Sims

SIM
card
SIM
card
SIM
card
SIM
card

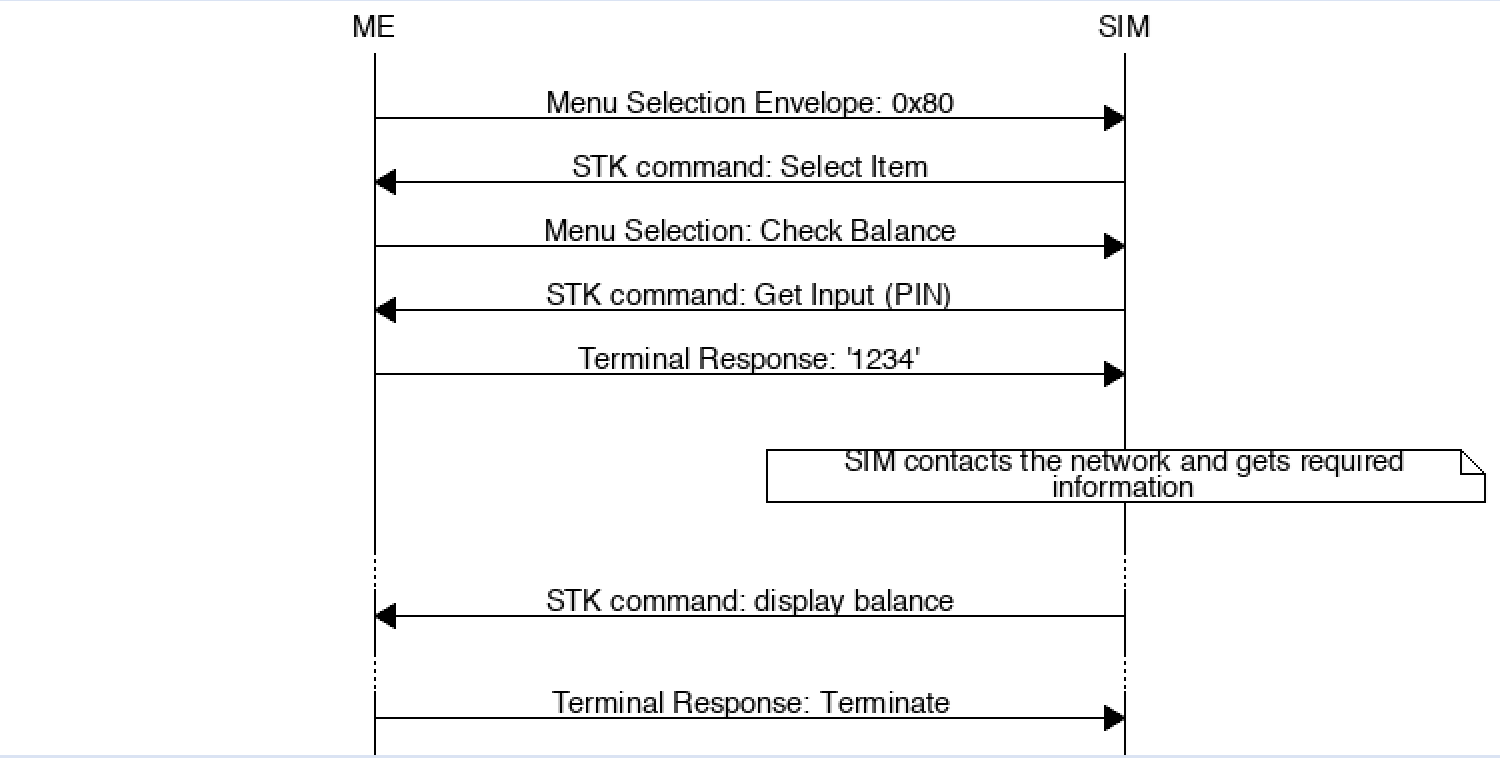


2FF Form Factor
TAISYS
3FF Form Factor
4FF Form Factor

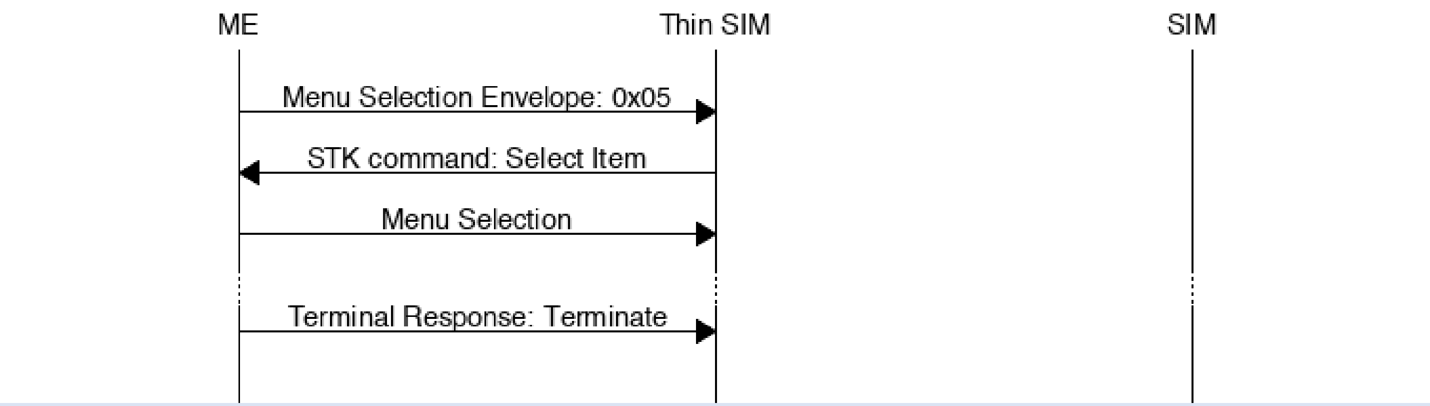
Thin Sims: What

- Field installable
- Contains all the functionality of a sim card
- Allows third party apps
- Free from carrier restrictions
- Can read and modify all communication between the phone and the sim card

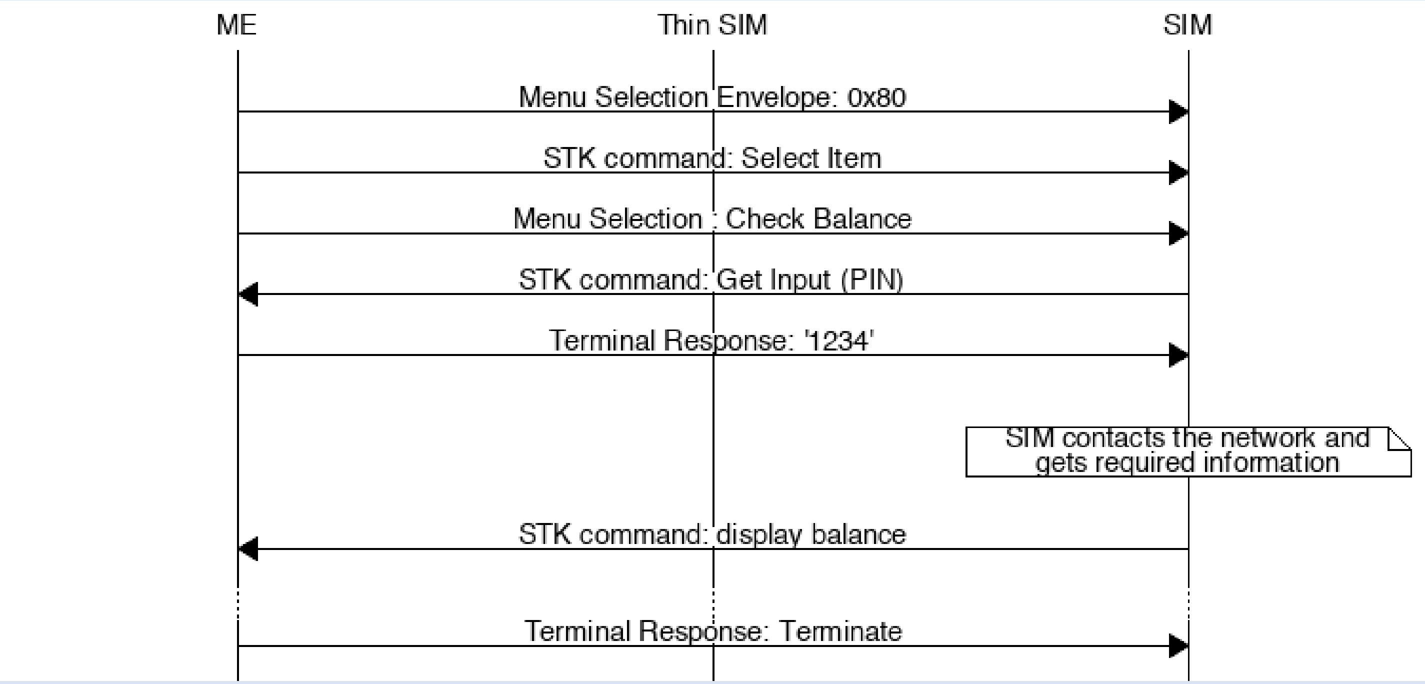
Communication between Person and SIM


ME
SIM
Menu Selection Envelope: 0x80
STK command: Select Item
Menu Selection: Check Balance
STK command: Get Input (PIN)
Terminal Response: '1234'
SIM contacts the network and gets required information
STK command: display balance
Terminal Response: Terminate

Communication between Person and Thin SIM



Checking mobile money balance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Thin Sims: WHY

- Cell phone unlocking
- Distribution of apps
  - Equity Bank, Mobile Money, Kenya
  - Community Health Worker application, Medic Mobile
- Malicious Installation

MEDIC MOBILE

EQUITY

Bank The Listening, Caring Financial Partner