Cloudlets on Phones

Gaetano Borriello
Department of Computer Science & Engineering
University of Washington

Context

- Lots of smart people in the developing world
  - Entreprenurial, know what is needed in their communities
- They face lots of barriers to creating mobile applications
  - Little fixed infrastructure (power, PCs, servers, …)
  - Limited ecosystems for mobile applications
  - Lack of local tech knowledge (programming, services, …)
  - Few data plans, mostly just voice/SMS

Our goal

- Create an environment with smaller stepping stones to creating/deploying mobile applications

- Simple model that can be used to try out ideas

- Can easily migrate to larger and larger deployments as the market is verified and investment possible

Cloudlets

- Computation
  - Services run entirely from mobile platforms (phones)
  - Memory and computation now more than enough

- Transport
  - Requests via SMS (eventually, GPRS)
  - Incoming SMS are free, only pay for outgoing

- Financing
  - Transfer of funds via phones
  - M-PESA model in E. Africa

Applications

- Answering simple searches

- Dissemination of market prices

- Micro-finance accounting

- Transportation systems

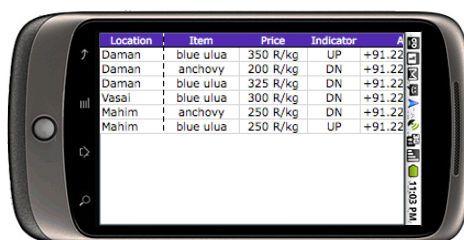- Data collectors in the field

Increasing functionality

Answering Simple Searches

- Weather, agricultural tips, fertilizer/pesticide dosing, …

- Many SMS toolkits do this, but on server with modem

- Phone can directly answers SMS

- Simple table lookup

- Data entered by a service provider with Internet access

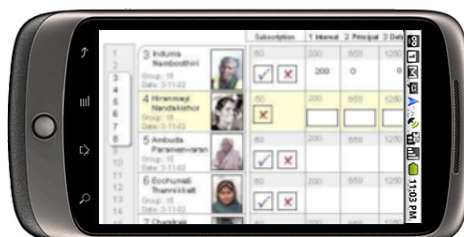| Location	Date	T-Lo	T-Hi	Preci
Kampala	5/26/10	25	34	16-18
Entebbe	5/26/10	25	33	16-18
Matuga	5/26/10	25	32	0-3, 1
Sentema	5/26/10	24	35	0-2, 1
Mukono	5/26/10	23	35	0-2, 1
Mpigi	5/26/10	20	33	18-20
Nakifuma	5/26/10	20	32	18-20
Kalule	5/26/10	20	31	17-19
Kalagala	5/26/10	21	32	17-19

Disseminating Prices

- Market prices at various locations

- Agents send in SMS with local price

- Customers can ask for a commodity price and receive summary

- Slightly more than table lookup – results need to be combined

- Data entered by authorized agent phone numbers

Location	Item	Price	Indicator	A
Daman	blue ulua	350 R/kg	UP	+91.22
Daman	anchovy	200 R/kg	DN	+91.22
Daman	blue ulua	325 R/kg	DN	+91.22
Vasai	blue ulua	300 R/kg	DN	+91.22
Mahim	anchovy	250 R/kg	DN	+91.22
Mahim	blue ulua	250 R/kg	UP	+91.22

Micro-finance Accounting

- Transactions of self-help groups (micro-loan payments)

- Agents collect transactions in self-help group meetings

- Phone summarizes transactions – aggregated ledger

- Aggregated results go to local banks

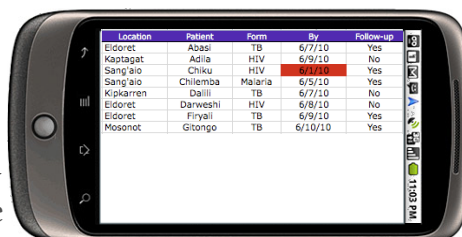- Data entered through camera-based form scanning (CAM)

Transportation Systems

- Location and departure updates from private busses

- SMS from user used to obtain computed ETA to bus stop using past history of route

- One SMS can trigger daily updates (commute)

- Bus driver phone or bus sensor responds to user phone

Data Collectors in the Field

- Send tasks to data collectors in the field (where/who/what)

- Complete data collection, update supervisor, send some subset of data

- Create follow-up tasks for self or others

- Spreadsheet as a view onto a larger database

Stepping stones

- Human-mediated SMS/Voice response

- Automated SMS response after simple table lookup

- Merging of search results

- Scanning of bar codes, general optical recognition

- Complex background algorithms for learning/aggregation

- Distributed system – multiple phones
  - General-purpose discovery service (a la DNS)
  - Use of SMS acks and USSD

- Migration to cloud-hosted implementation

Conclusion

- Phone not just a platform for communication but also for service deployment

- Integration with a payment system

- Special services (e.g., DNS for distributed services)

- Subsidized use of USSD messages