Water + Sanitation for the poor: harder than cell phones

Role of low-cost smart meters

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WATER SOURCES ARE DIVERSE
Groundwater (Potou - Senegal)

Spring Protection (Ruhiira-Uganda)

Sub-soil storage, Koraro, Ethiopia
No maintenance then systems not reliable
No reliability $\rightarrow$ customers stop paying, even lower reliability

Poor willing to pay for reliability, transparent transactions
Pay for amount that is used. Governments can pay for “lifeline” consumption

LAST-MILE KEY TO SUSTAINABILITY
A public tap staffed 2 hrs/day; users pay 2 KSh/20L jerrycan; goes to pay staff, fuel, maintenance
A network of pipes distributes safe water to 25,000 people spread over 400 sqkm.
Mayange, Rwanda
Water collection in Methare- Kenya

This kiosk supplies 300 daily customers with 20-50 liters of water each

Customers pay the kiosk attendant but transactions are not monitored

A flat rate of 7 KES/20 L is paid regardless of container size - 3.5 times more than other residents of Nairobi
Water kiosks designs

Water kiosks are used in communities around the world
Elements of a smart meter

- Flowmeter
- Vertical standpipe
- Spigot
- Water inlet
- Latching solenoid valve
- Flow
Design Challenge: Water Valve

- **Challenge**
  - Low cost flow meters exist but *low-cost potable remotely actuated valve* does not exist

- **Requirements:**
  - Low Cost (at scale < $6)
  - Potable (current designs are not)
  - Electrically Actuated
  - Low-power (20K actuations with 9V x 560mAh)
  - Low Pressure (less than 10 psi)
  - Low Flow (0.1 to 10 GPM)
Overall Market

• Billions pay ~$2/month for water
• 5 years → $125
• $25 → for “metering and payment systems”
• Payment system down to $5/customer
• Key cost elements: meter + valve + electronics
• Currently: latching solenoid valves are made for the automatic sprinkler market
Test Apparatus

Water Storage Tank

Flow Control Assembly

Integrated PCB
Design Challenge: Water Valve

- **Low Cost**
  - Sub $25/unit retail price point in production quantities (> 1000 units).

- **Potable**
  - Applications include drinking water kiosks
  - NSF/ANSI 61 certifiable materials*

* National Sanitation Foundation
Design Challenge: Water Valve

- Low Pressure
  - Typical water kiosks are locally gravity fed tanks
Design Challenge: Water Valve

- Low Pressure
  - Regional water towers

- Operating Pressure
  - 0-10 psi
Design Challenge: Water Valve

• Electrically (remotely) Actuated
  • Capable of being actuated from microprocessors
  • 12-24V DC

• Low Flow
  • 0-10 GPM

• Piping
  • ~1/2-3/4” NPT
Design Challenge: Water Valve

• Unit Volume
  • ~ 6 x 6 x 6” Envelope

• **Operating Specifications**
  • 0-10 psi

• Temperature Range
  • 0°-150°F

• Desired power consumption
  • Desired power consumption to be 5000+ actuations per standard 9V (560mAh) battery

• Life Cycle
  • 100,000 per unit
Design Challenge: Water Valve

• Low Power Consumption
  • Valve needs to be powered from typical, stand-alone, low cost PV-Battery source for long periods of time.
  • Example: http://www.voltaicsystems.com/3-5-watt-kit