Water + Sanitation for the poor: harder than cell phones

Role of low-cost smart meters

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WATER SOURCES ARE DIVERSE

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← Groundwater
(Potou- Senegal)

Spring Protection
(Ruhiira-Uganda)

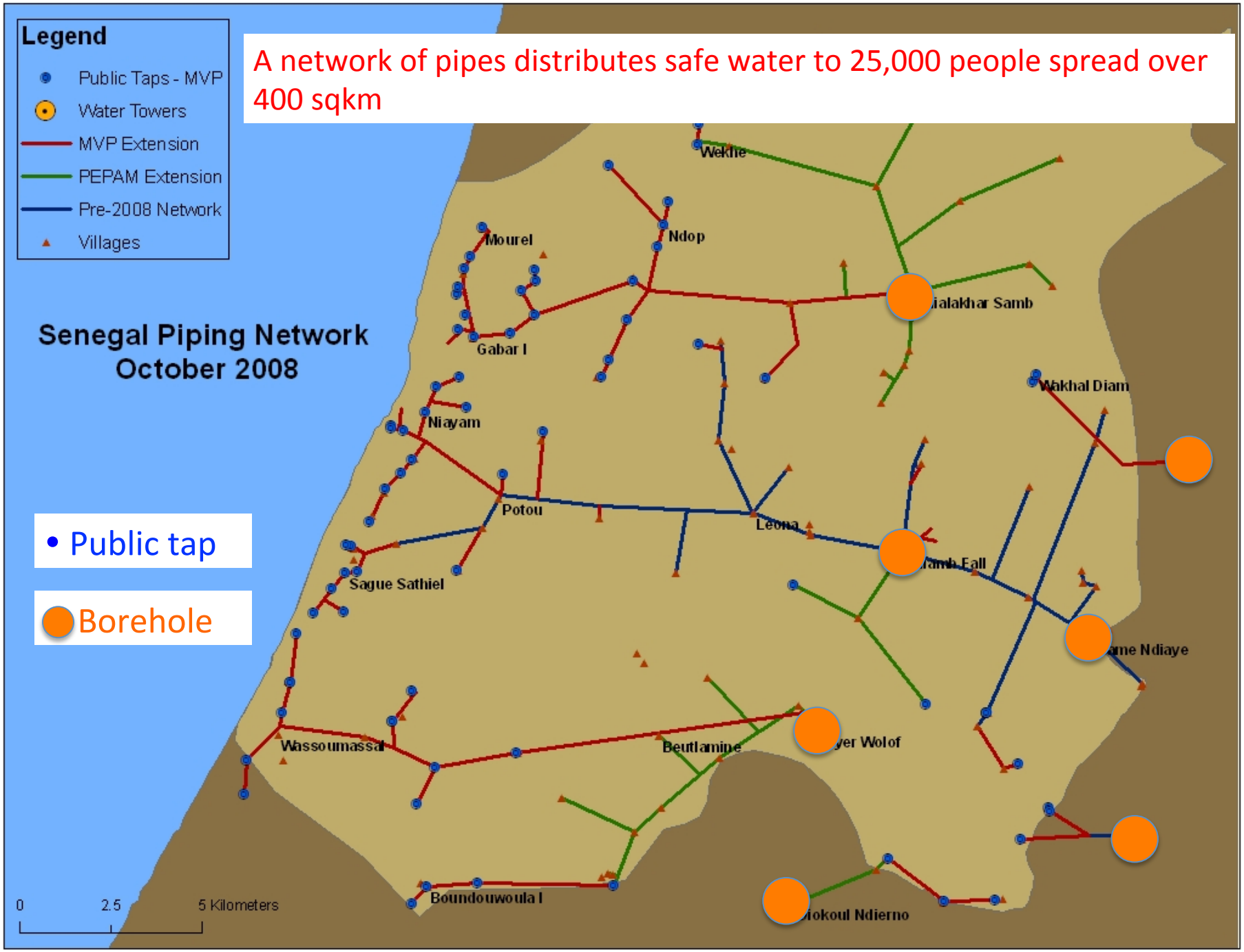
← Sub-soil storage, Koraro, Ethiopia

No maintenance then systems not reliable
No reliability → 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


Legend
Public Taps - MVP
Water Towers
MVP Extension
PEPAM Extension
Pre-2008 Network
Villages
A network of pipes distributes safe water to 25,000 people spread over 400 sqkm
Senegal Piping Network
October 2008
• Public tap
Borehole
Wekhe
Mourel
Ndop
Gabar I
Niayam
Potou
Sague Sathiel
Wassoumassai
Boundouwoula I
Wakhal Diam
0
2.5
5 Kilometers


Nazreth Ethiopia

Mayange, Rwanda

Water collection in Methare- Kenya

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

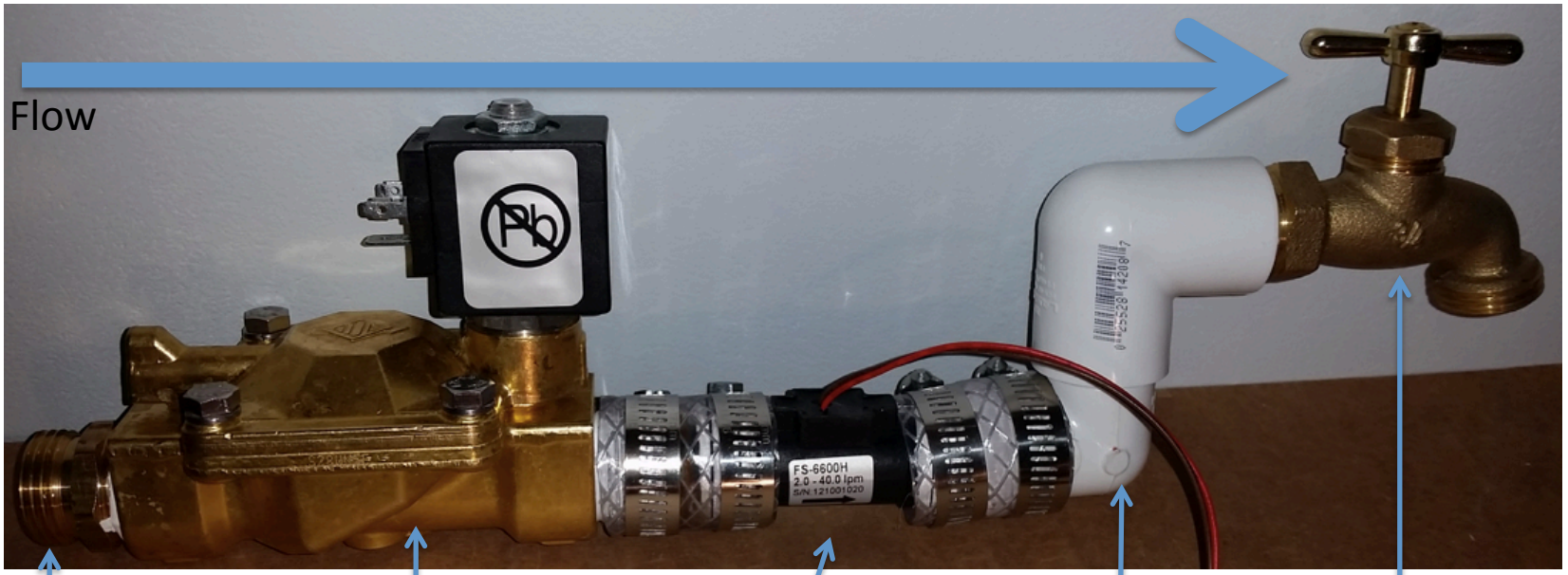
Customers pay the kiosk attendant but transactions are not monitored

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



Water Inlet

eg Latching Solenoid Valve

Flowmeter

Vertical standpipe

Spigot

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)

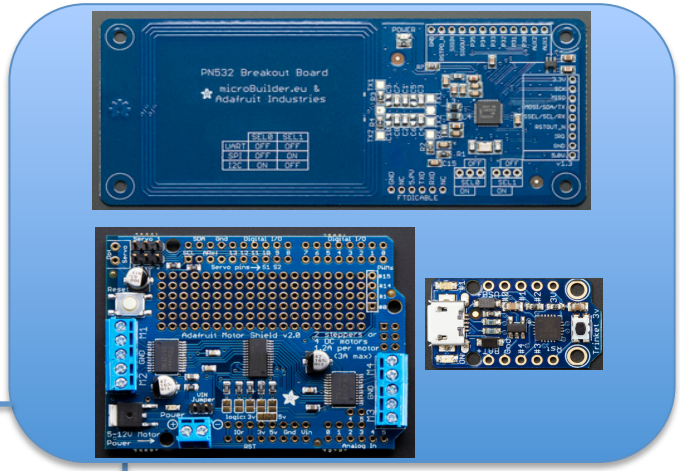
Overall Market

- 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

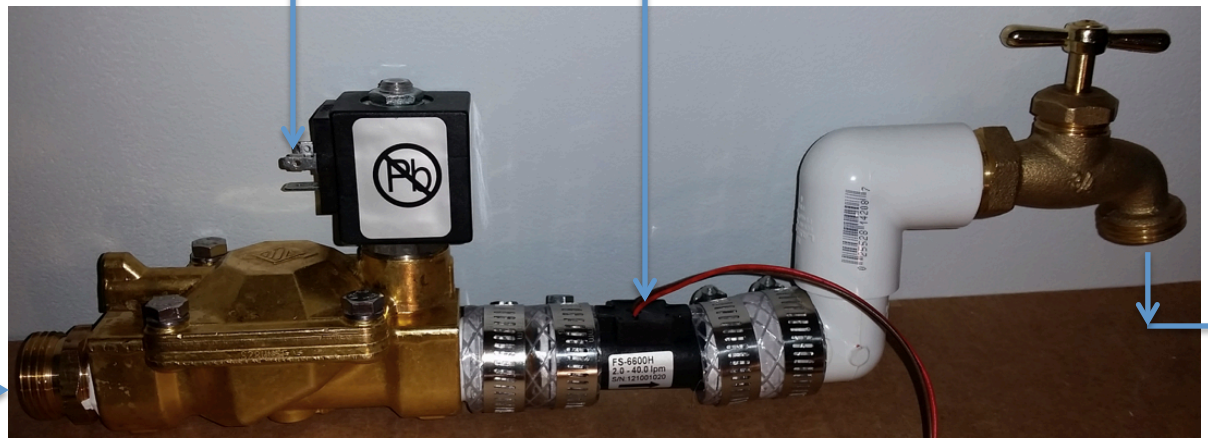
Test Apparatus

Water Storage Tank

Integrated PCB



Flow Control Assembly



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