SmartConnect: Data connectivity for peripheral health facilities

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The town of Nueva Guinea has few facilities, but the curious traveler may appreciate visiting a place so out of the way.

- Moon Nicaragua Travel Handbook
Today’s talk

• Establishing a data connection for rural health facilities
  – Which processes can be improved with network connectivity?
• Needs assessment: Nicaragua
• Design discussion
Data connectivity

• What is the minimum useful connectivity
  – Broadband?
  – 9600 baud?
  – 1000 bytes per day?
The case for SMS connectivity

• Cellular connectivity is reaching remote areas
• Relatively low cost for 161 character messages
  – $0.00 to $0.20 per message
• Non cellular alternatives can be prohibitively expensive
The case for a facility based communication device

• Clinic ownership versus individual ownership
  – Charging and payments are key
• Communication appliance for dedicated applications
  – Avoid issues of keeping a PC running
• Integration with sensors
• Secured to a fixed location
• Potentially more reliable than a cell phone
• Potentially better connectivity (with antenna or improved cell phone radio)
Smart Connect Vision

• Facility based communication device providing data connectivity
• Integrated with other electrically powered equipment, e.g., a vaccine refrigerator
• Provide a basis for increased communication and integration in the health system
Needs assessment

• Are there existing processes that would benefit from low bandwidth data communication?
• Which applications?
• Primary source:
  – Requirements gathering visit to Nicaragua
• Secondary sources:
  – Informants from vaccination project in Vietnam
  – WHO guidelines
Expectations, pre-visit

• Target facilities with vaccine storage
  – Grid power or solar power
  – Associate the device with the refrigerator
    • Solar refrigerator power SmartConnect

• Key use cases
  – Refrigerator temperature monitoring, stock out reporting, inventory management, surveillance reporting
Nicaragua

- Population: 6,000,000
- GDP per capita: $2800
  - Lower middle income country
- HDI: Rank 124
  - 2\textsuperscript{nd} lowest in Americas
- Health challenges
  - Poverty, access, child mortality, dengue fever, malaria
- Geography
  - Pacific, central mountains, Atlantic lowlands
Health Post Zompopera
Yolaina
El Serrano: Doctor with Assistant
La Fonseca
La Fonseca: Solar Panels (not in use)
Nicaragua Public Health System

- Health Post
- Health Center
- SILAIS
- MINSA (Ministry of Health)

“Under resourced but functional and rational”
Power situation

• Grid power generally good
  – Has improved in recent years (help from Hugo)
• Power lost one evening during visit
• Some health centers identified power as a problem
• Low voltage (should be 110)
• Some sites recently added to the grid
Cell Phone Coverage

- Two companies
  - Claro
  - Movistar
- Claro has much broader coverage for rural areas
- Almost all health workers had phones
- Electricity may have wider distribution than cell phone coverage
  - Did not see any candidate solar + cell phone sites
Health Post Connectivity

• Visit included moderately remote health posts.
  – All were close to cell phone connectivity, some on site, some required a walk up the hill, at others reception depended on the quality of the phone
• Previously, Health Posts had radios, but these are being phased out where cell phones are available
• Communication from HP to HC often easier than communication from HC to HP
• Travel and visits another important communication mechanism
Cold Chain
Cold Chain
Cold chain

• 1350 refrigerators, including 250 solar. Kerosene refrigerators being phased out
• Vaccine distributed monthly in Pacific, once every three months in Caribbean
• Electric refrigerators considered reliable
• Problems with solar refrigerators
  – Primarily with solar generation
  – Batteries the weak link
Cold chain reporting

- Consistent recording of temperature twice a day
  - WHO guideline
- SILAIS has a refrigerator technician
  - On call for repairs
  - Annual maintenance visits
- Vaccination data reported up from Health Posts
Surveillance Reporting

- Reports on diseases and mortality
- Daily or weekly from health post to health center to SILAIS to MINSA
- Submitted through different mechanisms
  - Phone, radio, hand delivery
- Commitment to accuracy at all levels
  - Quality control processes observed
- MINSA wanted more frequent reporting
  - Complained no data came in on weekends
Use of surveillance data

- Data summarized at health center and above
- Health centers and SILAIS generated statistics and used them for evaluating programs and tracking results
Information flows

• Surveillance data
  – From health posts to MINSA, collated at various levels

• Immunization
  – Twice daily temperature recording (reported???)
  – Vaccination numbers
  – Adverse reports, incidence reports on vaccination preventable diseases

• Pregnancy tracking
  – HP to HC only?

• Incidence reporting
  – PILOT Program: HC to SILAIS level
Requirements summary for Nicaragua

• Cell phone based communication device
  – Validated
  – Important to consider “marginal coverage”
  – Support for other radio communication would be valuable

• Target solar powered facilities with vaccination storage
  – Not validated
  – Relatively few solar powered facilities (and difficulties with solar)
  – Electrical grid more widespread than solar
  – Possible need in Atlantic region
Requirements summary

• Vaccine refrigerator reporting
  – Validated
  – Paper based recording of temperatures at all clinics
  – District cold chain supervisors would benefit from the information
    • Immediate repair
    • Identification / diagnosis of problem equipment
  – Anecdotal cases of failure from clinic staff (attributed to power loss)
  – Monitoring of up to five refrigerators would be helpful

• Stock reporting
  – Not validated
  – In person weekly visits adequate for collecting supplies
Requirements summary

• Surveillance reporting
  – Partially validated
  – Desire to speed up surveillance reporting
  – Reporting used at multiple levels
  – System design needs to get information to intermediate levels
  – User interface challenges in implementing this

• Incidence reporting
  – Not anticipated
  – Could be valuable to integrate this with existing cell phone solutions

• Lab diagnostics
  – Getting results to clinics can be very slow
  – Not clear which diagnostics are critical
Requirements summary

• General communication
  – Asymmetry in communication between levels
  – Pager for health posts
  – System must be considered in relation to cell phone communication

• Peripherals
  – Label printer could augment some of the processes
  – No use cases for bar code reading

• Telemedicine and consultation
  – No evidence of demand (although not a focus of the investigation)
How general are these requirements?

How much do these depend on the specifics of the Nicaraguan health system?

Comparison of different regions of Nicaragua
- Pacific
- Central
- Atlantic
WHO Standards

PQS performance specification

**TITLE:** Integrated electronic maximum-minimum thermometer, with factory programmed alarms, for vaccine refrigerators and freezers

- **Specification reference:** E06/TH06.1
- **Product verification protocol:** E06/TH06.VP.1
- **Date of origin:** 30 November 2006
- **Date of last revision:** New specification

4.2.12 **Alarm settings:** Upper and lower alarm settings must be factory programmed into the device as follows:

- **Version for vaccine refrigerators:**
  - **Low alarm setting:** Exposure to a single temperature event of -0.5°C or below for 60 minutes.
  - **High alarm setting:** Exposure to a single temperature event of +10°C or above for 10 hours.

- **Version for vaccine freezers:**
  - **High alarm setting:** Exposure to a single temperature event above -15°C for 60 minutes. A low alarm is not required.

Once an alarm event has occurred, the alarm event indicator is to remain activated until cancelled by the user, even if the temperature inside the cabinet has subsequently returned to within acceptable limits.
System Requirements

• Smart Connect Device
  – Cell Phone Radio
  – Microprocessor
  – Sensors
  – Keypad input
  – Text display

• Server connected to Internet
Design choices for SmartConnect

• Develop a device to pilot test within one year
• Determine the value of a low bandwidth facility based communication device
• Create assets that could be turned into a “product” in 2 to 3 years
Design options

- Use a low cost PC
  - Know difficulties of deploying PCs in this environment
  - Still need GSM connectivity
- Use a Smart Phone
  - Price too high
  - Difficult to pilot as a facility based device
  - Connecting external sensors is an issue
- Build a custom device
- Base device on a low cost phone
  - Use components of a phone
  - External device attached to phone - FoneAstra
Custom Device
**Custom Device**

- Different design and packaging model
  - Target a facility based device
- Easier integration and support of other hardware
- Superior cell phone radio (?)
- Future components may be cheaper
- Possibility of an embedded device
- Support for other communication technologies
- Aim for compatibility with FA on server side

**FoneAstra**

- Lower cost
  - Cell phone: $30
  - Telit 862: $100
- Leverage scale and professional engineering
- Integrated power source
- Current version cannot support control of the cell phone display
  - Does not support all SmartConnect scenarios
- We are planning to use FA instead of SC for some scenarios
Questions and Comments