Lime microsystems

Vodafone CrowdCell Course:

Crowd Cell – Case Study
NBIOT Webserver

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Introduction

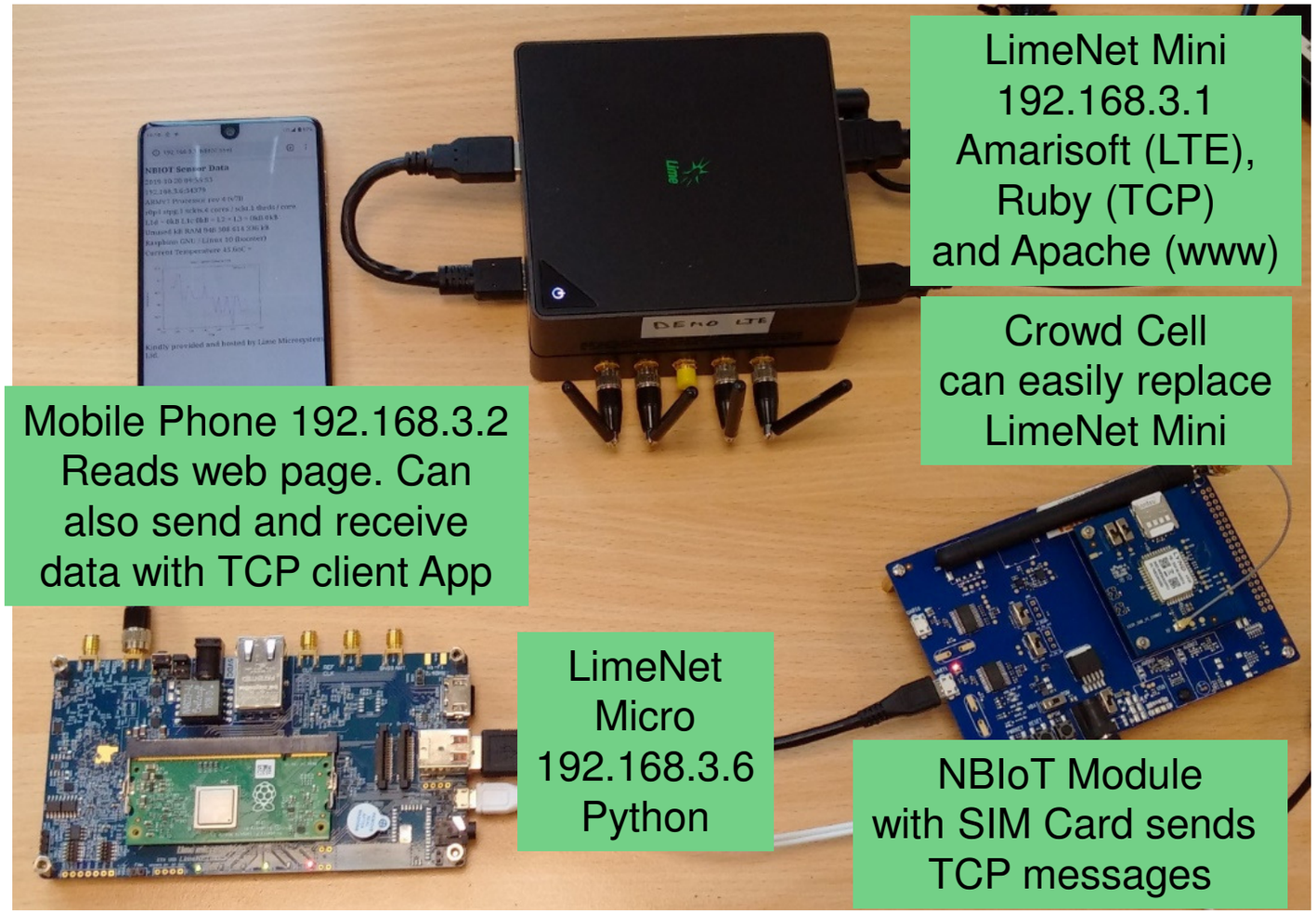
Modern packet based communications:

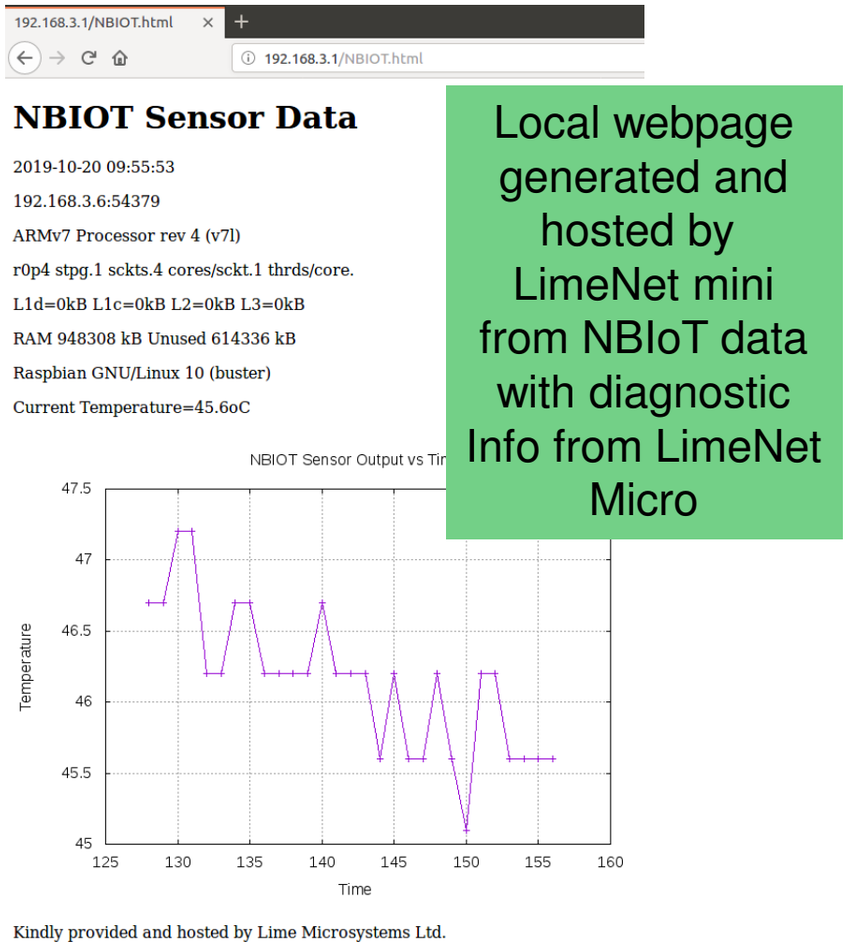
- Hides the details of the network from both programmer and the user.
- 4G, NBIoT, WiFi, Ethernet all look the same! Transparent.
- Mobile phone, Tablet, Desktop computer all look the same.

The only thing that matters is data movement

Lets look at a small 4G local network case study…

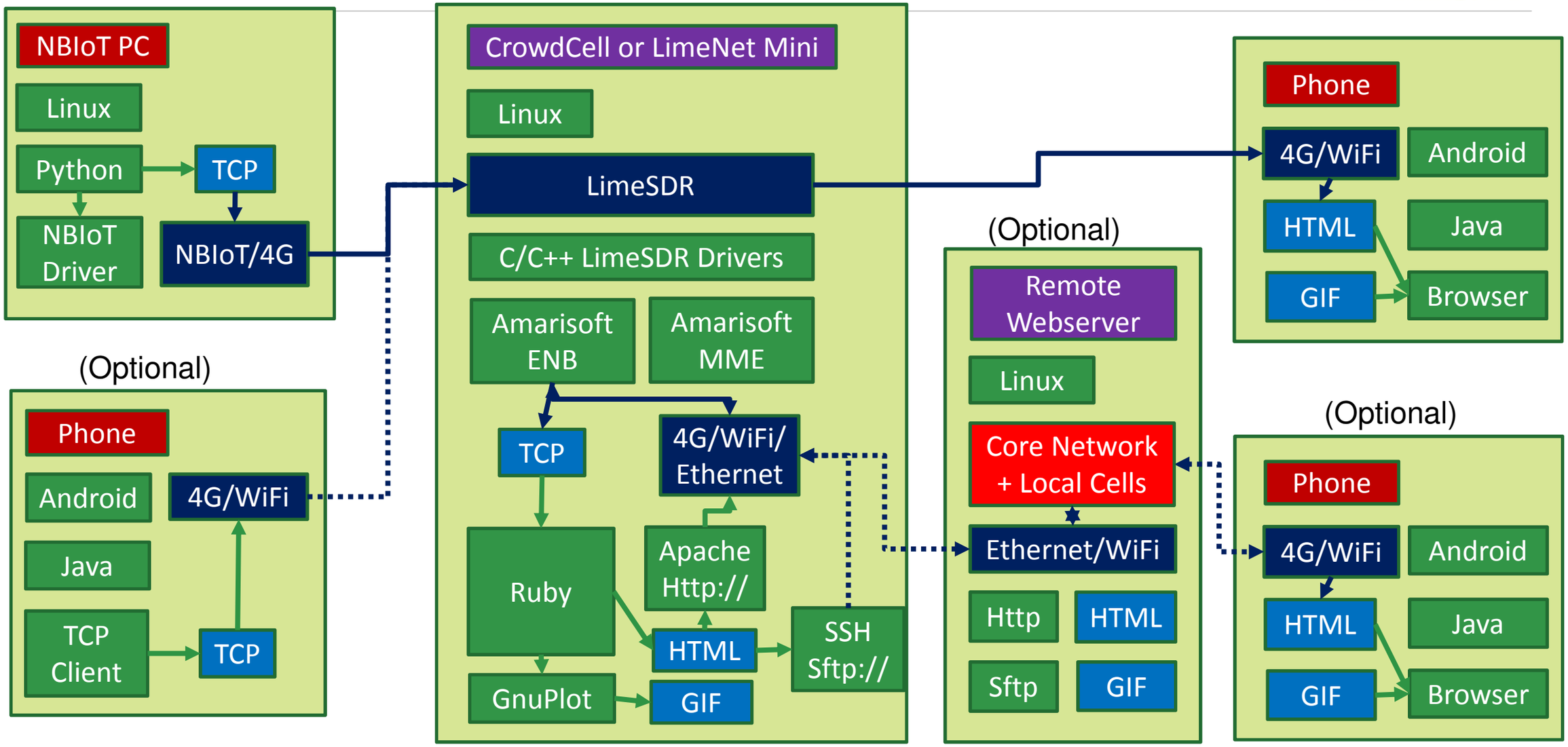
NBIoT Webserver Case Study – Hardware





Local webpage generated and hosted by LimeNet mini from NBIoT data with diagnostic Info from LimeNet Micro

NBIoT Case Study – Local or Remote Networking



NBIoT Module

NBIoT devices vary

- Some look like USB dongle (TTY serial device) E.g. Quectel and Lynq (usually 9600 baud)
- Some are microcontroller based e.g. Pycom FiPy with built in Micro Python
- Requires sim card
- Most modules will try to connect to network in idle state.

NBIoT USB Devices

- Uses heavily customised ‘AT’ commands.
- Supports many protocols SMS, TCP, UDP etc.
- Use Python Serial and /dev/tty in Linux to connect.
- Ubuntu: dialout and tty groups to make sudo free.

NBIoT Python Interface

Program Loop

- Set up / diagnostic phase
- RF IP Connection Loop
- Based on APN service
- If connection lost, try to reconnect
- TCP Message Loop
- Whilst connected, send data via TCP
- Computer temperature used as example data. Keep messages short! Avoid AT reserved symbols +,:

Python Code:

- import serial
- ser=serial.Serial(port='/dev/ttyXRUSB0', baudrate=9600, parity=serial.PARITY_NONE, stopbits=serial.STOPBITS_ONE, bytesize=serial.EIGHTBITS, timeout=5)

Timing can be an issue

- some SIM cards are slower than others.
- Use Sleep() to simplify handshaking.

NBIoT Amarisoft Interface

Use NBIoT example code from Amarisoft

NBIoT Coexists with normal Amarisoft MIMO LTE service

- Approx 100Mb/s with 10MHz MIMO with 256-QAM (tested with Iperf)
- Basic Definitions
  - MME IP ports connections,
  - Antennas, NDLRBs
  - NID, NMC ,NCC etc
- RF Driver – LMS7002trx library – LimeSuite library – LMS7002M
- LTE MIMO Module
  - optional command for 256-QAM
  - optional command Number of PDCCHs symbols – trade number of UEs for data throughput
  - RI, CSI options for MIMO
  - SIB definitions
- NBIoT Module
  - automatically dedicates 1 RB for NBIoT

Ruby TCP server

Ruby chosen over Python due to maturity and availability.

Ruby implements a TCP server.

- TCPserver()

When TCP server receives a packet, it is decoded

Data is piped to gnuplot and saved as a .gif file.

- Gnuplot::Plot.new()

Ruby then generates simple .html files referring to the .gif file.

- Open(localFile,”w”)

Ruby saves files to local Apache2 server

- localFile=“/var/www/html/index.html”

Or sftp files to remote web server

- Net::SFTP.start(uri.host,usename,:password=>password,:port=>portSFTP)
- sftp.upload! localFile1, remoteFile1

Apache Server Set up

Very simple to set up basic webserver

- Sudo apt-get install apache2
- Sudo ufw app list
- Sudo ufw allow ‘Apache’
- Sudo ufw status
- Sudo systemctl status apache2
- Hostname –I

HTML Files are in

- /var/www/html
- Index.html, 404.html, NBIOT.html,NBIOT.gif

Amarisoft acts as a DHCP server for the 4G network.

- Gateway normally to 192.168.3.1
- Hostname –I should include 192.168.3.1
- User types in 192.168.3.1 in web browser on phone to see latest results.

Future

Work in progress…

Fully integrate into the Crowd Cell project

Use https server

- Security

Javascript

- Automatic updating

Dongle NBIoT+R’Pi

- Reduce physical size of demo

LimeNet Micro

- Use additional RF capabilities
- E.g. Spectrum scanning to avoid interference.