# beagleconnect

# The Problem

- Many disciplines seek to acquire and process sensor data
- Today's affordable solutions require knowledge of electronics, communications and software integration
  - Check out the Arduino sensor library to get an idea of the complexity
- Integrated solutions have limited body of sensors, are very expensive, still require multiple manual configuration steps, and are not fully open
  - Check out ncd.io for a good example

# The Concept

- **Digital Dust ->** A low cost sub $10, low-profile edge node that is easily deployed almost anywhere
  - Sub 1GHz network based on TI-15.4 stack
- User experience is simple and seamless with out of box setup taking minutes
- Adaptable by Makers and Professionals alike for it's plug and play usability
  - Professionals would use for proof of concept, assume higher volumes would result in design / manufacturing customization opportunities and the wider portfolio of IoT services

Use Linux to maintain the software and mikroBUS for the body of sensors

# The User Experience

## Step 1 – Gateway login

Host (Linux)

Gateway
(BeagleConnect Leash)

Node
(BeagleConnect Leash +
mikroBUS add-on board)

# The User Experience

## Step 2 – Connect with button push

Host (Linux)

Gateway
(BeagleConnect Leash)

Node
(BeagleConnect Leash +
mikroBUS add-on board)

# The User Experience

## Step 3 – Live edge data automatically appears

Host (Linux)

Gateway
(BeagleConnect Leash)

Node
(BeagleConnect Leash +
mikroBUS add-on board)

# BeagleConnect Leash Feature Set

FRONT

CC1352 (wireless MCU)

USB (debug/ flash/power)

Power

BACK

MSP430 (USB MCU)

2x mikroBUS headers

2x buttons

mikroBUS add-on boards

# User Experience Value Proposition

1. Automatic provisioning for I2C, SPI, GPIO, UART, ADC, and PWM
2. No cut-and-paste
    1. No device specific code lives my program
    2. Driver maintenance is owned by Linux kernel
3. No “firmware” development
    1. Everything a developer needs to do sits above the OS in any language
4. All sensor data is readily accessible in read and write files
5. Every programming language supported
    1. No language specific libraries
6. Out of the box support for ecosystem of 500+ mikroElektronika click boards

# The Ask

1. Marketing Support
    1. How can TI drive market awareness – what does TI need from BB.org to do this?
2. Software and Hardware Development
    1. Design support and consultancy for discrete implementation of CC13xx
        1. Required to achieve pricing targets
    2. Split cost of 6 months firmware development, ~$150k
3. Pricing
    1. Target BOM cost is $3 to achieve a MSRP of <$10

# Appendix

# Example: flood mitigation system

# Software Proposition

- Greybus: automatic provisioning for I2C, SPI, and GPIO

## USB in Linux Today

## Before Greybus

*Specific device tree required*

## With Greybus

# The Concept

- Low cost (< $10), low-profile edge node that is easily deployed almost anywhere
- Adaptable by Makers and Professionals alike for it’s plug and play usability
  - Professionals would use for proof of concept, assume higher volumes would result in design / manufacturing customization opportunities and the wider portfolio of IoT services
- Features Long Range Radio comms (Sub-GHz TI 15.4 compare with LoRA) module with on-board MCU for control and uFL connector
- Low power with ample GPIO for easily sensor attachments
- Compatible with MikroBus interface, allowing for deployment of MikroE click sensor & actuator boards
- Works (& communicates) out-of-the-box with PocketBeagle or BBB, enabled with their respective Long Range Comms cape
- Debug / Programming via header / JTAG connector / USB option(s)
- Battery-holder for Li-Ion coin-cell
- Power-management with appropriate voltage translations

- What is probing and a probable bus?
-

# PocketBeagle top

# PocketBeagle bottom

P2 Header

P1 Header

# PocketBeagle bottom

# PocketBeagle expansion

PocketBeagle Expansion Headers (Rev A2a)

## P1

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SYS | VIN | 1 | 2 | 87 | | 6 | AIN 3.3V | 9 | PRU1 |
| | | USB1 | V_EN | GPIO | 109 | 3 | 4 | 89 | | | | 11 | |
| | | | | USB1 | VBUS | 5 | 6 | 5 | GPIO | CS | SPI0 | TX | PRU |
| | | | | | VIN | 7 | 8 | 2 | | CLK | | RX | UART2 |
| | | | | | DN | 9 | 10 | 3 | | MISO | | TX | |
| | | | | | DP | 11 | 12 | 4 | | MOSI | | RX | PRU |
| | | | | | ID | 13 | 14 | 3.3V | SYS | | | | |
| | | | | | GND | 15 | 16 | GND | | | | | |
| | | | | AIN 1.8V | REF- | 17 | 18 | REF+ | AIN 1.8V | | | | |
| | | | | | 0 | 19 | 20 | 20 | GPIO | | | 16(in) | PRU0 |
| | | | | | 1 | 21 | 22 | GND | SYS | | | | |
| | | | | | 2 | 23 | 24 | VOUT | | | | | |
| | | | | | 3 | 25 | 26 | 12 | GPIO | SDA | I2C2 | TX | CAN0 |
| | | | | | 4 | 27 | 28 | 13 | | SCL | | RX | |
| PRU0 | 7 | QEP0 | STRB | GPIO | 117 | 29 | 30 | 43 | | TX | UART0 | 15 | PRU1 |
| | 4 | | A | | 114 | 31 | 32 | 42 | | RX | | 14 | |
| | 1 | PWM0 | B | | 111 | 33 | 34 | 26 | | | | | |
| PRU1 | 10 | | | | 88 | 35 | 36 | 110 | | A | PWM0 | 0 | PRU0 |

## P2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PWM1 | A | 50 | 1 | 2 | 59 | GPIO | | | | |
| | | | PWM2 | B | 23 | 3 | 4 | 58 | | | | | |
| | | | UART4 | RX | 30 | 5 | 6 | 57 | | | | | |
| | | | | TX | 31 | 7 | 8 | 60 | | | | | |
| CAN1 | RX | I2C1 | SCL | | 15 | 9 | 10 | 52 | | | | | |
| | TX | | SDA | | 14 | 11 | 12 | PWR BTN | SYS | | | | |
| | | | | SYS | VOUT | 13 | 14 | VIN | BAT | | | | |
| | | | | | GND | 15 | 16 | TEMP | | | | | |
| | | | | GPIO | 65 | 17 | 18 | 47 | GPIO | STRB | QEP2 | 15i | PRU0 |
| | | | | | 27 | 19 | 20 | 64 | | | | | |
| | | | | SYS | GND | 21 | 22 | 46 | | IDX | QEP2 | 14(in) | PRU0 |
| | | | | | 3.3V | 23 | 24 | 44 | | A | | 14(out) | |
| CAN1 | RX | SPI1 | MOSI | GPIO | 41 | 25 | 26 | NRST | SYS | | | | |
| | TX | | MISO | | 40 | 27 | 28 | 116 | GPIO | IDX | QEP0 | 6 | PRU0 |
| PRU | eCAP | | CLK | | 7 | 29 | 30 | 113 | | | | 3 | |
| PRU1 | 16(in) | | CS | | 19 | 31 | 32 | 112 | | | | 2 | |
| PRU0 | 15(out) | QEP2 | B | | 45 | 33 | 34 | 115 | | B | QEP0 | 5 | |
| PRU1 | 8 | AIN 3.3V | 5 | | 86 | 35 | 36 | 7 | AIN 1.8V | | | | |

# mikroBus Click

# Connecting mikroBus Clicks

# Single cable development

- Power, network, develop
- You can add a network and power many other ways

# Download image

https://beagleboard.org/latest-images

beagleboard.org®

Start ⇓ Discover Boards ⇓ Learn ⇓ Explore ⇓ Collaborate ⇓

BeagleBoard.org › latest-images

## BeagleBoard.org Latest Firmware Images

Download the latest firmware for your BeagleBoard, BeagleBoard-xM, BeagleBoard-X15, BeagleBone, BeagleBone Black, BeagleBone Black Wireless, BeagleBone Blue, SeeedStudio BeagleBone Green, SeeedStudio BeagleBone Green Wireless, SanCloud BeagleBone Enhanced, element14 BeagleBone Black Industrial, Arrow BeagleBone Black Industrial, Mentorel BeagleBone uSomIQ, Neuromeka BeagleBone Air, or PocketBeagle

See the Getting Started guide and the community wiki page for hints on loading these images.

### Recommended Debian Images

Stretch IoT (non-GUI) for BeagleBone and PocketBeagle via microSD card

- Debian 9.2 2017-10-10 4GB SD IoT image for PocketBeagle, BeagleBone, BeagleBone Black, BeagleBone Black Wireless, BeagleBone Blue, SeeedStudio BeagleBone Green, SeeedStudio BeagleBone Green Wireless, SanCloud BeagleBone Enhanced, element14 BeagleBone Black Industrial, Arrow BeagleBone Black Industrial and Mentorel BeagleBone uSomIQ - more info - bmap - sha256sum: be1eac7a5e5269301555202153 29a6c39071b82199c0745c300e68b7e6c7180b

Stretch for BeagleBone via microSD card

- Debian 9.1 2017-08-31 4GB SD LXQT image for BeagleBone, BeagleBone Black, BeagleBone Black Wireless, BeagleBone Blue, SeeedStudio BeagleBone Green, SeeedStudio BeagleBone Green Wireless, SanCloud BeagleBone Enhanced, element14 BeagleBone Black Industrial, Arrow BeagleBone Black Industrial and Mentorel BeagleBone uSomIQ - more info - bmap - sha256sum: bc8292d97458987481d45da025ef9868b8ccf8477a72f11b541bf97d329a6d7e

Jessie for SeeedStudio BeagleBone Green Wireless via microSD card

- Debian 8.6 2016-11-06 4GB SD SeeedStudio IoT image for SeeedStudio BeagleBone Green Wireless - more info - bmap - sha256sum: 48582b8a1a134679ff324eacc1e0b4af6f2cdabfb56dafb6b932fe11129b404f

Stretch for BeagleBoard-X15 via microSD card

# Write image to microSD with Etcher

# Insert microSD and boot

# Connect to the USB network

# Open the IDE

cloud9 - Cloud9
192.168.7.2:3000/ide.html
Cloud9
File
Edit
Find
View
Goto
Run
Tools
Window
Preview
Run
New File Alt-N
New From Template
New Plugin
Open... Ctrl-E
Open Recent
Save Ctrl-S
Save As... Ctrl-Shift-S
Save All
Revert to Saved Ctrl-Shift-Q
Revert All to Saved Alt-Shift-Q
Upload Local Files...
Download Project
Line Endings
Close File Alt-W
Close All Files Alt-Shift-W
Welcome
Welcome
The Cloud9 Blog
Edit from the Cloud9 Terminal like a Boss!
Since the dark ages when the green on black screens were the only interface to a machine, the terminal has been a coder's best friend.
This has been especially true with the advent of command line driven ecosystems like the Ruby and the Node.js communities.
more...
Docs
Immediate
debian@beaglebone:/var/lib/cloud9$
examples
LICENSE
pumpkinBlinky.py
README.md
Workspace
Navigate
Commands
Changes
Outline
Debugger
6:31 PM
12/14/2017