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

Gateway
(BeagleConnect Leash)

Node
(BeagleConnect Leash +
mikroBUS add-on board)

The User Experience

Step 2 – Connect with button push

Gateway
(BeagleConnect Leash)

Node
(BeagleConnect Leash +
mikroBUS add-on board)

The User Experience

Step 3 – Live edge data automatically appears

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

HOST **Peripheral**

Connect Device

Probe
what is it

Tell it

Load
Driver

It Works!

Before Greybus

Specific device tree required

With Greybus

Connect Device

Probe
what is it

Manifest

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

PocketBeagle bottom

PocketBeagle expansion

PocketBeagle Expansion Headers (Rev A2a)

P1

			SYS	VIN	1	2	87	GPIO	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	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	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

Analog - **AN**

Reset - **RST**

SPI Chip Select - **CS**

SPI Clock - **SCK**

SPI Master Input Slave Output - **MISO**

SPI Master Output Slave Input - **MOSI**

VCC-3.3V power - **+3.3V**

Reference Ground - **GND**

PWM - PWM output

INT - Hardware Interrupt

RX - UART Receive

TX - UART Transmit

SCL - I²C Clock

SDA - I²C Data

+5V - VCC-5V power

GND - Reference Ground

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, Neurometa BeagleBone Air, or PocketBeagle

beagleboard.org®

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