BeagleDust
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Concept and business case
Premier Farnell and BeagleBoard.org
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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
BeagleDust Feature Set

FRONT

- Power
- Coin Cell Battery
- CC13xx Module
- cJTAG

BACK

- 2x mikroBUS Headers
- Click Boards
The User Experience

Step 1 – Gateway login
The User Experience

Step 2 – Connect with button push
The User Experience

Step 3 – Live edge data automatically appears
The User Experience

Same firmware, infinite sensors
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
Example: flood mitigation system

Beagle Dust

Water level sensor

Beagle Dust

Overflow/Sluice Gate

Beagle Dust

Emergency Pump

0.5Km

0.3Km

1Km

BeagleBoard SBC with Connectivity

Internet/Cloud

Control room, office or enclosure
Software Proposition

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

USB in Linux Today

HOST

- Probe
  - what is it
- Load
  - Driver

Peripheral

- Connect Device
- Tell it

It Works!

Before Greybus

Specific device tree required

HOST

- Probe
  - what is it
- Load
  - Driver

Peripheral

- Connect Device

With Greybus

HOST

- Probe
  - what is it
- Manifest

Peripheral
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?
Example: flood mitigation system

- Beagle Dust
- Water level sensor
- Overflow/Sluice Gate
- Beagle Dust
- Emergency Pump
- Beagle Dust
- Control Room or office
- PocketBeagle + Connectivity Cape
- Internet/Cloud

Distances:
- 0.5Km
- 1Km
- 0.3Km
Digital Dust feature-set

- GPIO headers
- Radio Module (CC13xx) w/ uFL conn
- USB port
- Pwr Mgmt
- JTAG
PocketBeagle bottom

P2 Header

P1 Header
# mikroBus Click

<table>
<thead>
<tr>
<th>Function</th>
<th>Pin 1</th>
<th>Pin 2</th>
<th>Pin 3</th>
<th>Pin 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog</td>
<td>AN</td>
<td>PWM</td>
<td>INT</td>
<td></td>
</tr>
<tr>
<td>Reset</td>
<td>RST</td>
<td></td>
<td>INT</td>
<td></td>
</tr>
<tr>
<td>SPI Chip Select</td>
<td>CS</td>
<td>CS</td>
<td>RX</td>
<td>TX</td>
</tr>
<tr>
<td>SPI Clock</td>
<td>SCK</td>
<td>SCK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI Master Input Slave Output</td>
<td>MISO</td>
<td>MISO</td>
<td>SCL</td>
<td></td>
</tr>
<tr>
<td>SPI Master Output Slave Input</td>
<td>MOSI</td>
<td>MOSI</td>
<td>SDA</td>
<td></td>
</tr>
<tr>
<td>VCC-3.3V power</td>
<td>+3.3V</td>
<td>+3.3V</td>
<td>+5V</td>
<td>GND</td>
</tr>
<tr>
<td>Reference Ground</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

**Pins Description**

- **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 Latest Firmware Images

Download the latest firmware for your BeagleBoard, BeagleBoard-xM, BeagleBoard-X15, 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, Mentor BeagleBone uSDi2, Neuroske BeagleBone Air, or PocketBeagle.

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

Recommended 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 Mentor BeagleBone uSDi2 - more info - bmap - sha256sum: bea4ca97e4526303155520215329a5c390710b219c0754c300e686b76d7c180b

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 Mentor BeagleBone uSDi2 - more info - bmap - sha256sum: c0c392d697438837410455aa25af9685d8c0c040f7a721f1054109f3229a07e

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: 49582db8a134147e69f324eacc1ed6bae62f2cd20fb55d6ff68932fe11120b4d04f

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