acal bfi European leader in advanced technology solutions

Open source platform for IoT with cellular 2G to 4G

running open source software

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Acal BFi and IoT

- SIERRA WIRELESS
- AIROHA
- OriginGPS
- SKYWORKS
- USI
- SparkLAN
- Honeywell
- MITSUBISHI ELECTRIC
- Cubic
- LANTRONIX


Sensors


WiFi, Bluetooth, LoRa

INTERNET *of* THINGS


GPS / GNSS


Antennas

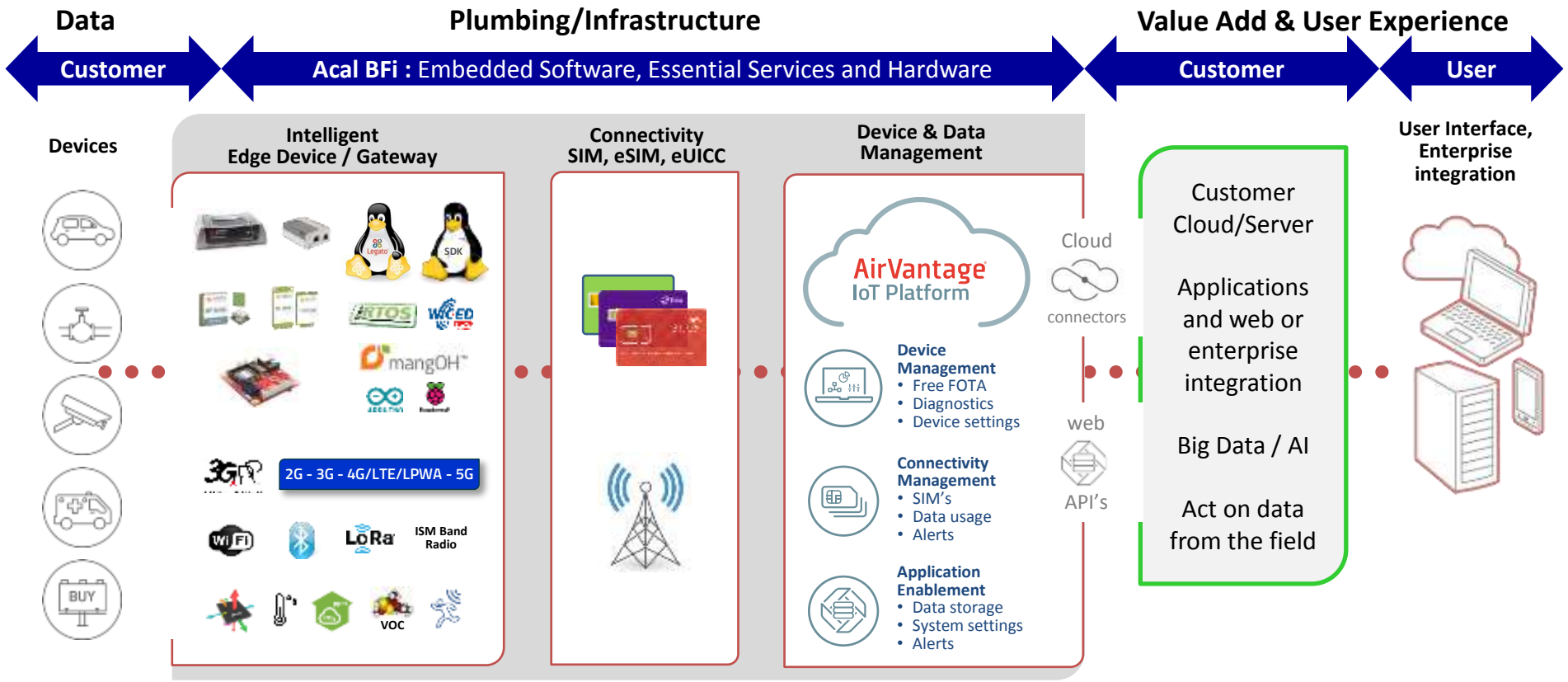

Displays


RF Devices

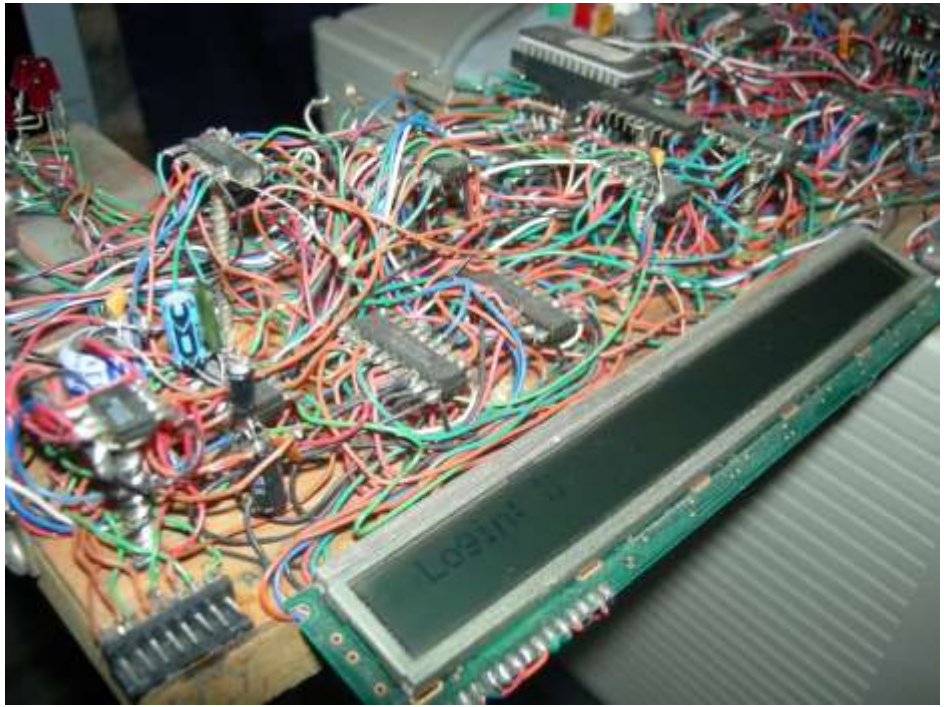
- Wireless IoT
- Open Source
- Device-to-Cloud
- Embedded app's
- LPWA, NB-IoT
- LTE cat M1/NB1
- Mobile Broadband
- WiFi, Bluetooth
- LoRa, ZigBee
- Navigation
- Displays
- Power

Part of discoverIE Group plc. : 430 MEUR / 3700 employees
Acal BFi Europe : 188 MEUR / 440 employees
Acal BFi Nordic : 20 MEUR / 25 employees

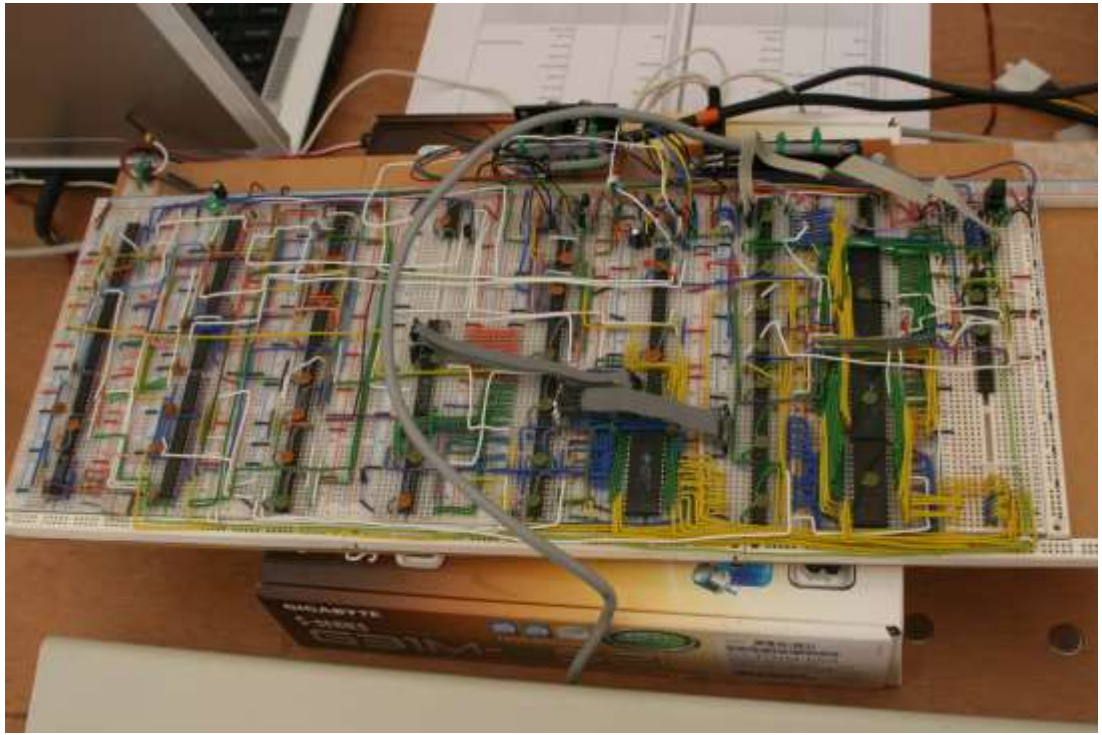
Acal BFi in the IoT value chain



Open Hardware : Old School



Open Hardware : Not as, but still, Old School



Open(?) Hardware : Since the last few years

mangOH open Hardware : A NEW Breed for IoT

mangOH™

open source **hardware**

Reference Designs

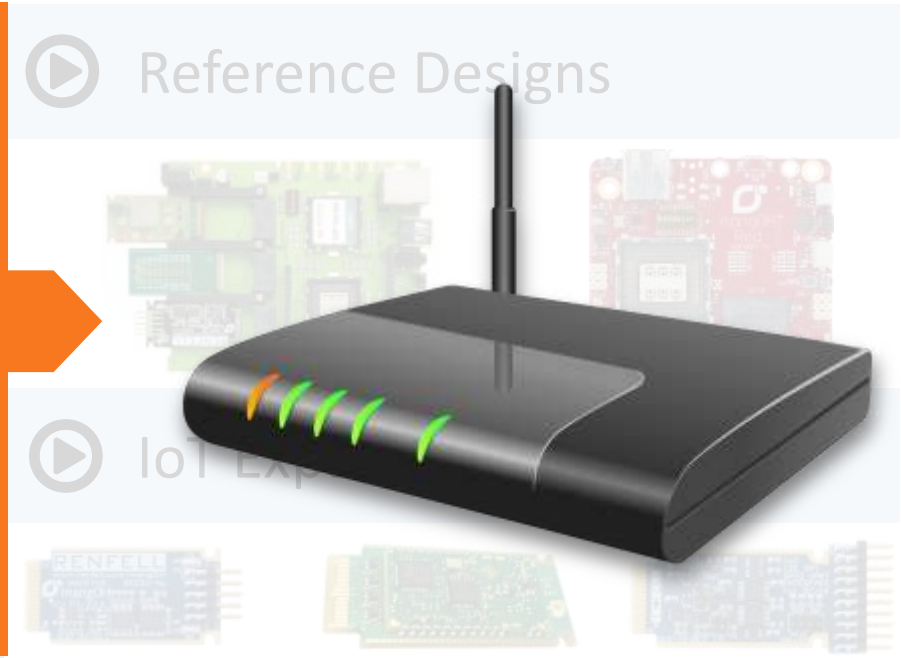
IoT Expansion Cards

With a Business-Friendly Open Source License

creative commons

no restrictions

freedom to modify design to build commercial products



Reducing Time-To-Market : Your journey to Success

Legato™

Open source Linux embedded application development platform

legato.io

mangOH™

Open source hardware platform with a complete set of documentation available *(Schematics, BOM, Gerbers, CAD files)*

mangoh.io

IDEA

PROTOTYPE

PRODUCT

The objective of mangOH Open Hardware

Test your prototype in market conditions

Develop your applications

mangOH™ reference design

90% of your prototype delivered out-of-the-box

➔ **Focus on application development**

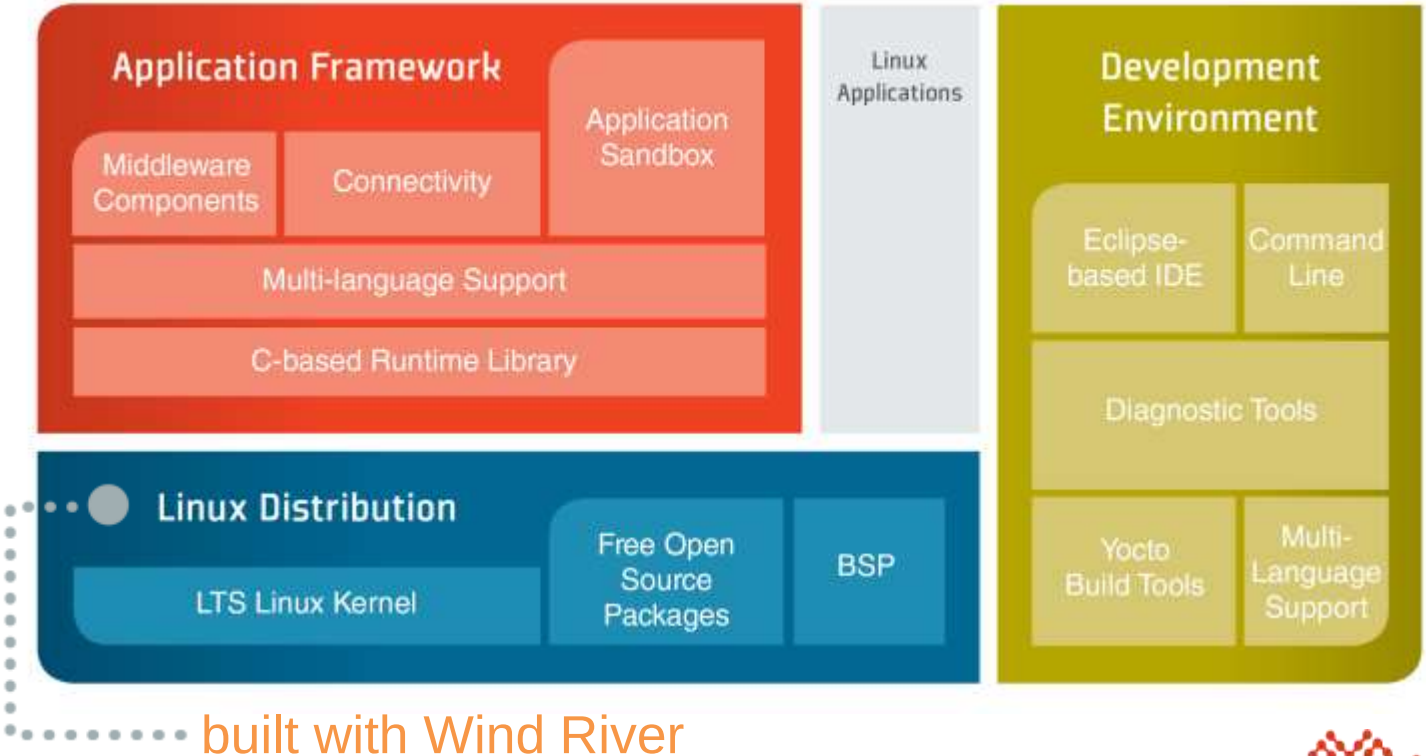
acal bfi

Open source Linux OS
with the Legato application framework

Legato™

Components of the Legato™ platform

yocto PROJECT · Designed to give embedded IOT development a head start



built with Wind River

Legato : A few users and eco system members

PSA took the whole solution chain from module to Legato to AirVantage and service elements.

Volkswagen have chosen Legato together with Sierra Wireless AR series modules (AR is an automotive module with the same core as WP).

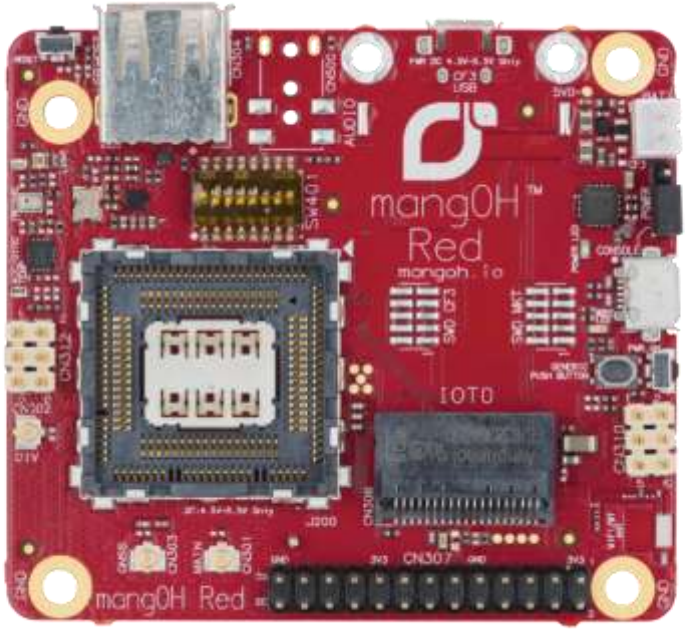
Not yet official to disclose

Linux professional services

Your local Nordic support partner

acal bfi

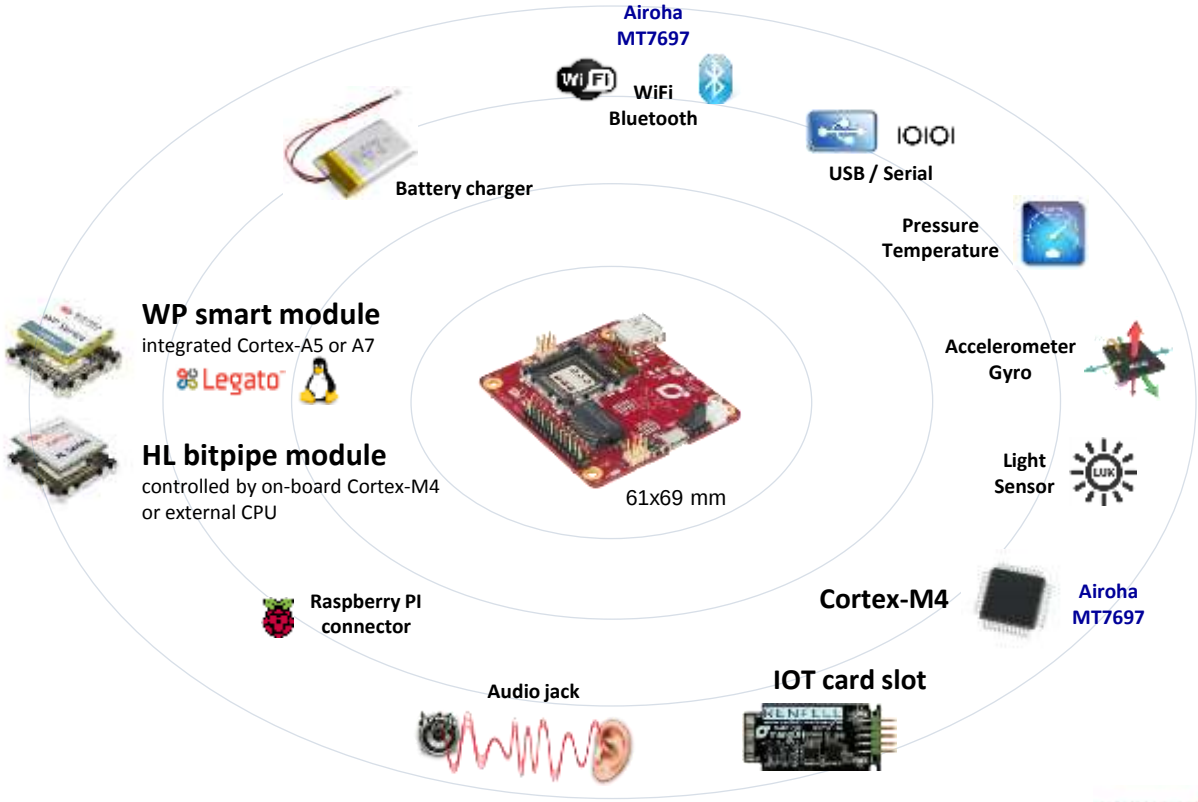
mangOH™ Red



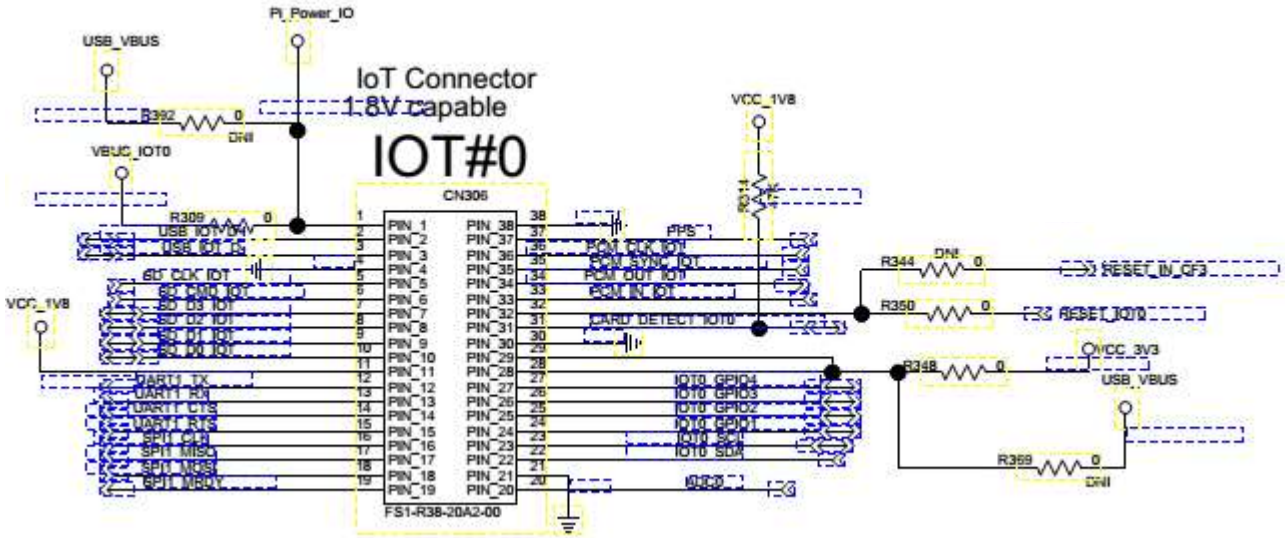
mangOH Red overview

CF3 socket for:

- 2G : GSM/GPRS/EDGE
- 3G : HSPA/HSPA+
- 4G : LTE cat 1 and 3/4
- LPWA : LTE cat M1/NB1 (NB-IOT)



IoT card slot interfaces



I/O's

- USB
- UART1
- SPI1
- I2C
- 4x GPIO
- SDIO
- ADC0
- PCM
- PPS
- RESET IOT#0
- Card Detect IOT#0

Power/Ground

- 1.8V, 200 mA
- 3.3V, 900 mA max
- 5.0V, 500 mA max
- GND

IOT cards : A hardware expansion for mangOH (& FX30)

I/O
(I2C, SPI, 4xGPIO, UART)

RS-232

- Open interface standard
- Simple, industrial grade and low cost
- Standard 38 pole connector with interfaces to communication ports and control signals
  USB, UART, SDIO, SPI, I2C, ADC, PWM, GPIO's, Digital audio, Stratum clock (pps), Reset, Card detect
- Growing ecosystem of companies and technologies supporting

- Easy to design your own IOT card if what you need is not already available.
  design specification is freely available

Host Hardware Architecture : Linux core

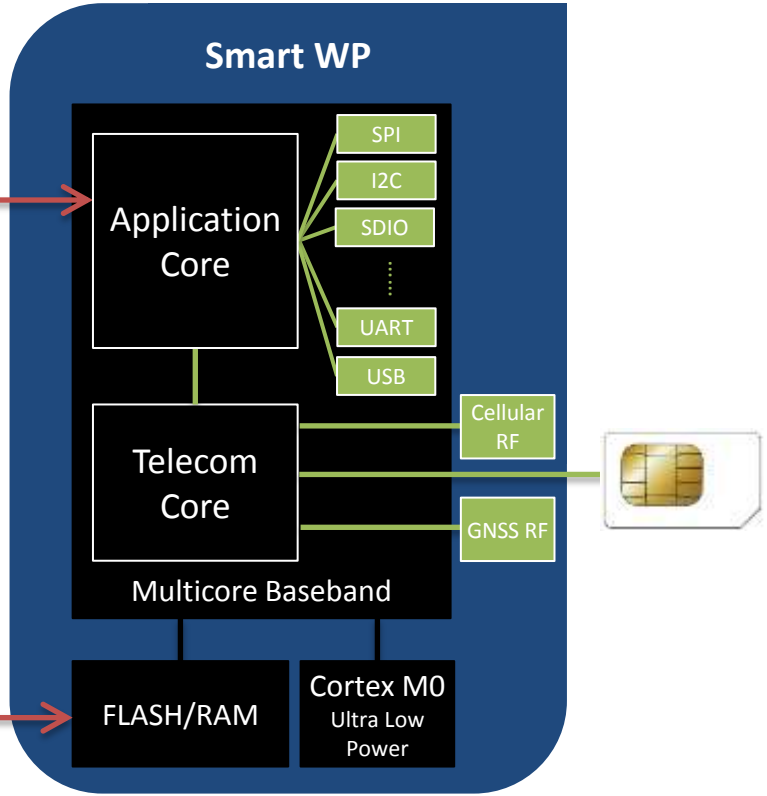
The Legato Platform is running on a dedicated core with dedicated memory

WP8548 (3G) / WP75xx (4G)

CORTEX-A5 @ 550 MHz
32 KBytes I-cache
32 KBytes D-cache
256 KBytes cache L2
ARMv7 instructions
Up to 863.5 MIPS

WP76xx/77xx core is a Cortex-A7, 1.3 GHz

Memory*	RAM	FLASH
Boot loader	-	1 MB
Linux Kernel*	25 MB	20 MB
Root File System*	-	50 MB
Framework*	8 MB	15 MB
User application	95 MB	170 MB
Total	**128 MB**	**256 MB**



(*) Based on default configuration and subject to variation.
Code is executed in RAM. The telecom core uses a separate memory area.

Host Hardware Architecture : RTOS core

Cortex®-M4 with FreeRTOS + WiFi/Bluetooth integrated

Processor and Memory
ARM Cortex M4 MCU with FPU with up to 192MHz clock speed.
Embedded 352KB SRAM and 64KB boot ROM, 32 Mbit external Flash.

Real-time I/O's

Pin	Signal	Purpose
1	WIFI_I2C0_DATA	I2C bus for sensors and other devices
2	GPIO_1_EXP	User-defined GPIO
3	WIFI_I2C0_CLK	I2C bus for sensors and other devices
4	ADC1_WIFI	Analog input
5	GPIO_0_EXP	User-defined GPIO
6	ADC2_WIFI	Analog input

WiFi/Bluetooth
WiFi 802.11 b/g/n, 2.4 GHz
Bluetooth 4.2 BLE

Lowest power open hardware in the world running Linux

mangOH™ Red

- Connected idle mode : 10 mW*
- Low power mode : 25 µW

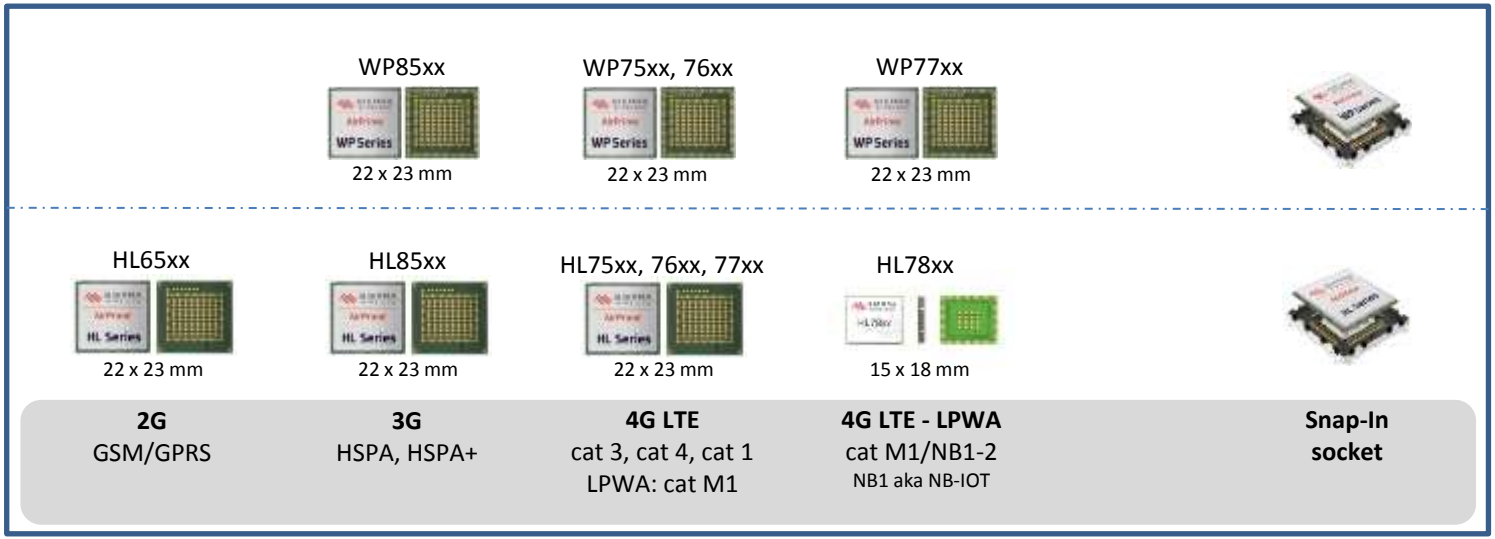
  Wake-up capabilities:
  - Timer : 5 µA
  - GPIO : 50 µA
  - Analog threshold : 50 µA

* LTE/3G, WP8548, WP75xx
will be lower for LPWA such as WP77xx (LTE cat M1/NB1).

Overview of cellular CF3 modules suitable for mangOH

SMART
std CF3

ESSENTIAL
std CF3



Notes,

- Smart : Module with an OS and Application Framework
- Essential : Module controlled via AT commands only
- 2G and 3G modules are Global devices, 3G regional is available
- 4G LTE, cat 1/3/4 are Regional devices : Not possible to fit in all bands due to cost and size constraints.
- 4G-LPWA, cat M1/NB1 are **Global devices** : Due to the new radio architecture the necessary bands can be accomodated for at a reasonable cost.

An actual Nordic OEM customer case

PoC Development

Engineer at Start-up company read about mangOH & Legato

Playing around in Start-up Company

Legato app ready for deployment

Prototypes installed at customer site

Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

Ordered mangOH Green and WP8548

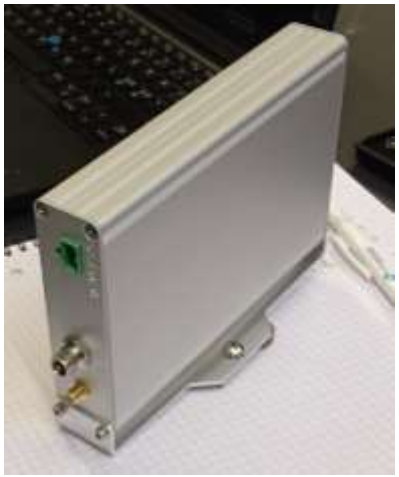
Started assignment for OEM using mangOH & Legato

First End-to-End installation with cloud

An actual Nordic OEM customer case

PoC Development

Engineer at Star
company read a
mangOH & Leg



ite

Mar

Dec

Message from customer on December 7
"We managed assemble 15 prototypes based on MangOH boards, 5 of those are already out in the field with operational equipment.
Before sending them out we qualified them by putting them in our test facilities, putting them through temperature test and vibration test (-20dC to +80dC swings for 4 days) and 9G vibration testing and finally voltage surges for the power supply that we did (custom board for stepping down from 36V).
The MangOH board have performed supreme until now, as we haven't had a failure until now."

Fast prototyping and commercial deployment

FX30 3G programmable IoT gateway

...uses same core and OS as mangOH (WP+Legato) but is fully certified

Regulatory & Industrial certifications

- **CE** (Europe)
- **GCF** (Global except North America)
- **FCC, IC, PTCRB** (North America**)**
- **RCM** (Australia, New Zealand)
- **ROHS, REACH**
- **IEC60950-1** (Safety Europe)
- **UL Listed** (Safety North America)
- **E mark** (Vehicle Europe)

...another one but with mangOH Red

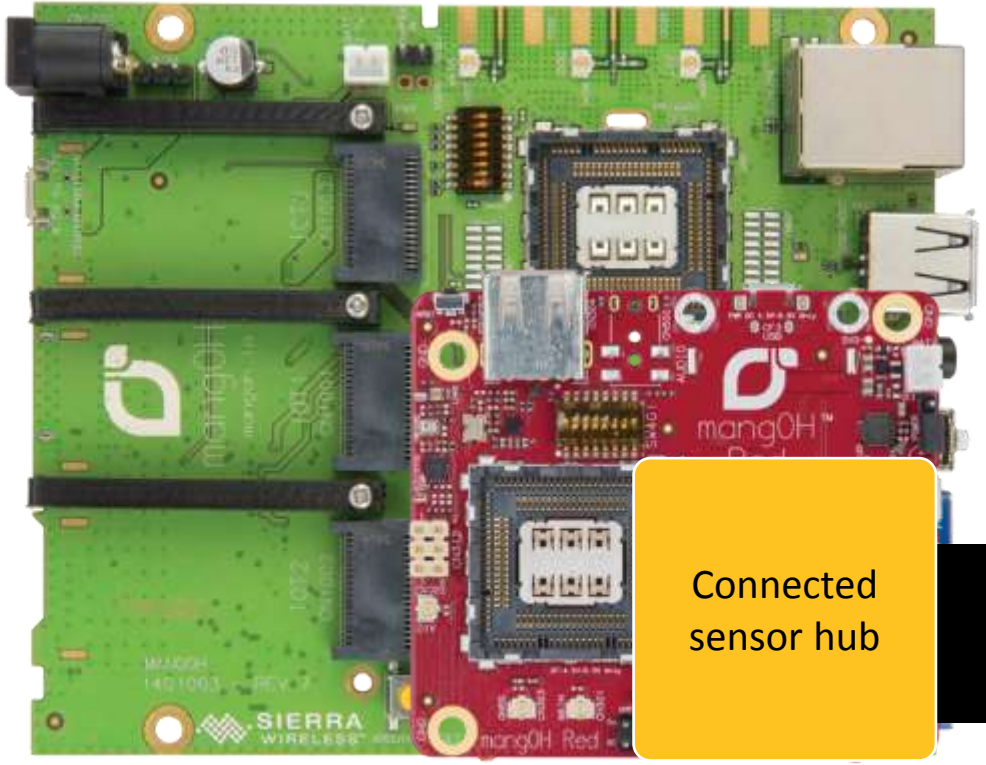
Pressure and temperature measurement in truck tires

- 1st contact Sep 21, 2017
- 2nd meeting Oct 5
- 1st mangOH Red for evaluation delivered Oct 13
- Another 6 units for prototypes delivered on Nov 29
- 1st production order on Dec 22
- Deployment in trucks end Feb, 2018

  5 months from first contact to first deployment at end customer !!

- Fast and easy development and prototyping with mangOH Red and Legato
  A "complete IoT system" available out of the box.
  - A known OS, Linux, with the Legato application framework.
  - Global 3G/2G cellular connectivity, WP8548
  - 4G and LPWA with same size/pad-out (CF3) available: WP76xx, WP77xx
  - Connectivity included (SIM card with data)
  - Cloud platform for device management included

mangOH : Planned evolution



mangOH™ Green

mangOH™ Red

Connected sensor hub

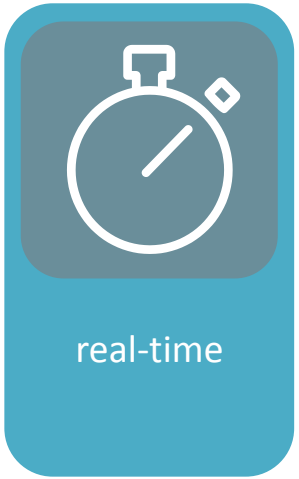
mangOH™ Yellow

100 x 120 mm

61 x 69 mm

40 x 40 mm

Open Source software evolution : Legato on RTOS



Summary : mangOH hardware

mangOH™ are **open source hardware** platforms for the Internet-of-Things (IoT), running **open source software**, that turn your ideas into commercial products quickly by delivering 90% of your prototype out-of-the-box. **mangOH Red is specifically designed to enable small size, low power solutions.**

Open Source
Business friendly license so you can copy, modify, and build commercial products based on mangOH.

Adaptable
Flexible enough for you to prototype any IoT use-case based on wired, wireless, and sensor technologies.

Industrial
The BOM is made up of proven & available, industrial-grade components to quickly turn your prototypes into products.

Summary : mangOH & Legato

Test your prototype in market conditions
...and prove the idea to stake holders and investors

Develop your applications

mangOH™ reference design

90% of your prototype delivered out-of-the-box

➔ **Focus on application development**

+

...and your business case!

Thank You!

Welcome to our stand

International presence

Acal BFi operate throughout Europe, with dedicated sales force and technical support teams in:

- Belgium
- Denmark
- Finland
- France
- Germany
- Italy
- Norway
- Sweden
- Netherlands
- United Kingdom

We also have a presence in China, India, Poland, Slovakia, Baltics, South Africa, South Korea, Sri Lanka and USA.

www.acalbfi.com

http://www.acalbfi.com/se

http://www.acalbfi.com/se/IoT

/company/acal-technology-ltd

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Acal BFi Nordic, Areas of expertise

- IOT and Wireless
- 2G/3G/4G-LTE, LPWA, WPAN
- Embedded computing
- Displays
- Sensors
- Power suppliers
- Magnetic components
- Semiconductors
- RF and Frequency control
- Fibre optics
- Imaging
- Photonics

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