

# uSOP: an embedded Linux board for the Belle2 detector controls

G. Tortone, A. Anastasio, V. Izzo, INFN Napoli, Italy

A. Aloisio<sup>1</sup>, F. Di Capua<sup>1</sup>, R. Giordano<sup>1</sup>, Dipartimento di Fisica Università di Napoli Federico II, Italy

F. Ameli, INFN Roma, Italy

P. Branchini, INFN Roma 3, Italy

<sup>1</sup>also at INFN Napoli, Italy

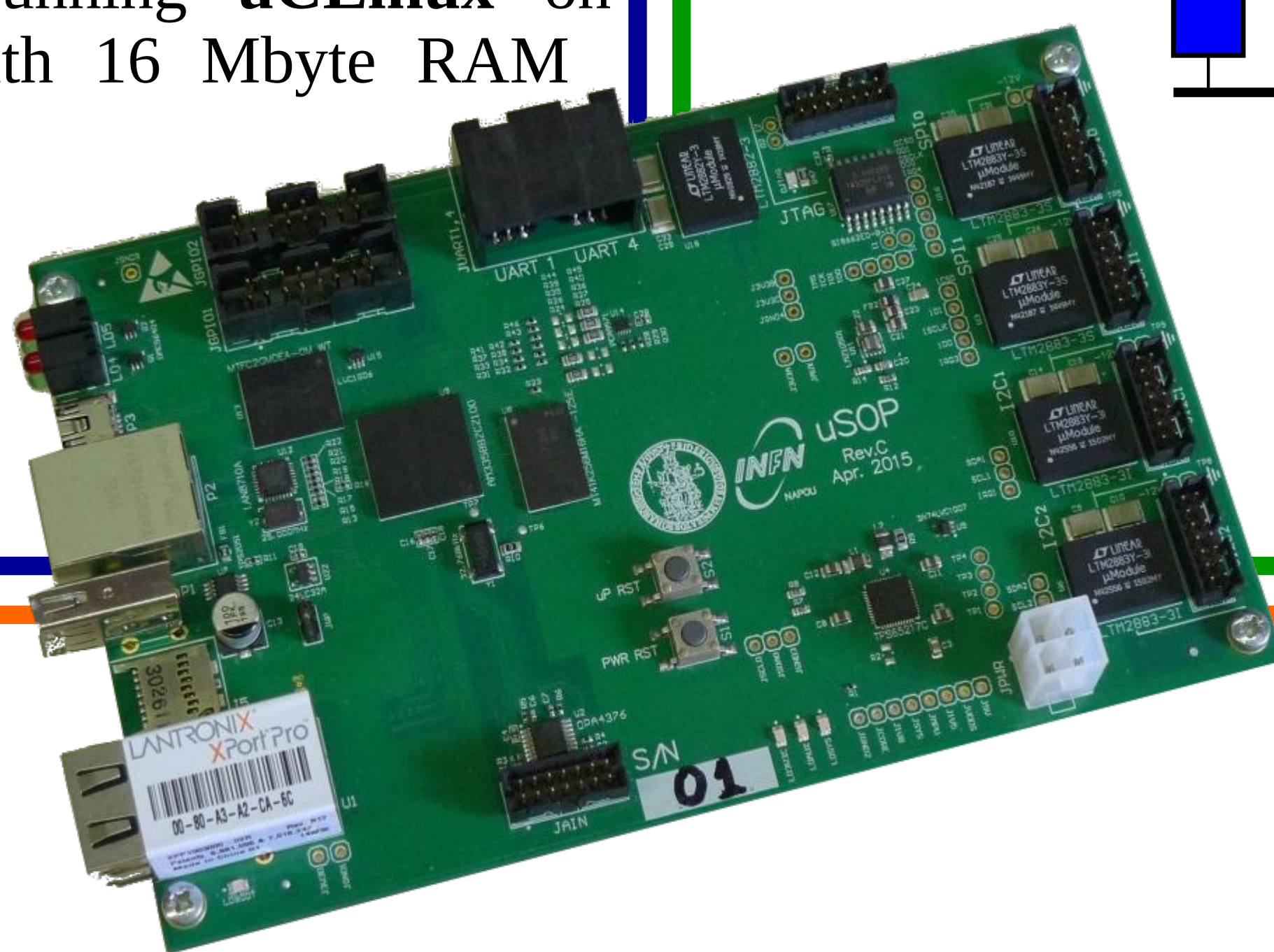
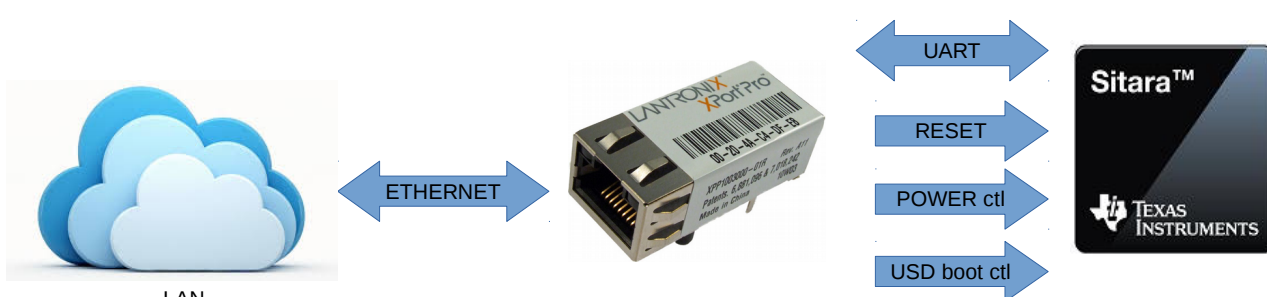
## Hardware

uSOP board is a Single-Board Computer (SBC) derived from **BeagleBone Black** Open-source Hardware project.



- TI Sitara AM335x Cortex A8 @ 1 GHz
- Programmable Real Time Units (PRU) (2)
- 4 Gbyte eMMC
- 512 Mbyte RAM
- **RS-232** (2) / **JTAG** (1) / **I2C** (2) / **SPI** (1) available on connectors through galvanic isolator modules
- 12-bit **ADC** (4)
- 16 **GPIO** on expansion connectors
- **USB host** (1) / **USB device** (1)
- **Fast Ethernet** 10/100 Mbps (1)
- **uSD** slot for external storage
- 3U **Eurocard** form factor
- DC Vin 5V

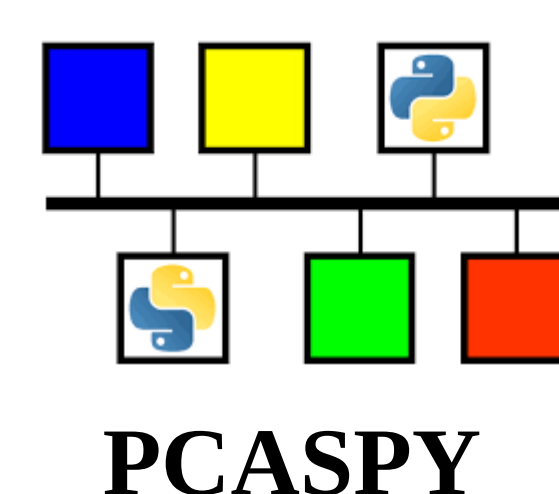
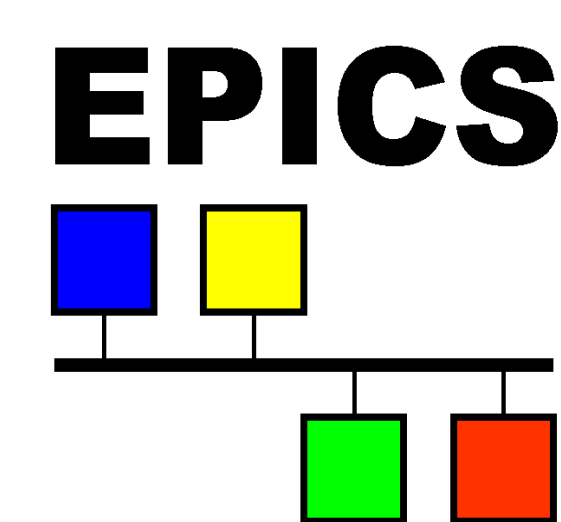
**Remote management** of board (power on/off, console, boot selection) by a dedicated out-of-band connection with **Lantronix XPort Pro** module running **uCLinux** on Freescale Coldfire @160 Mhz with 16 Mbyte RAM and 16 Mbyte flash



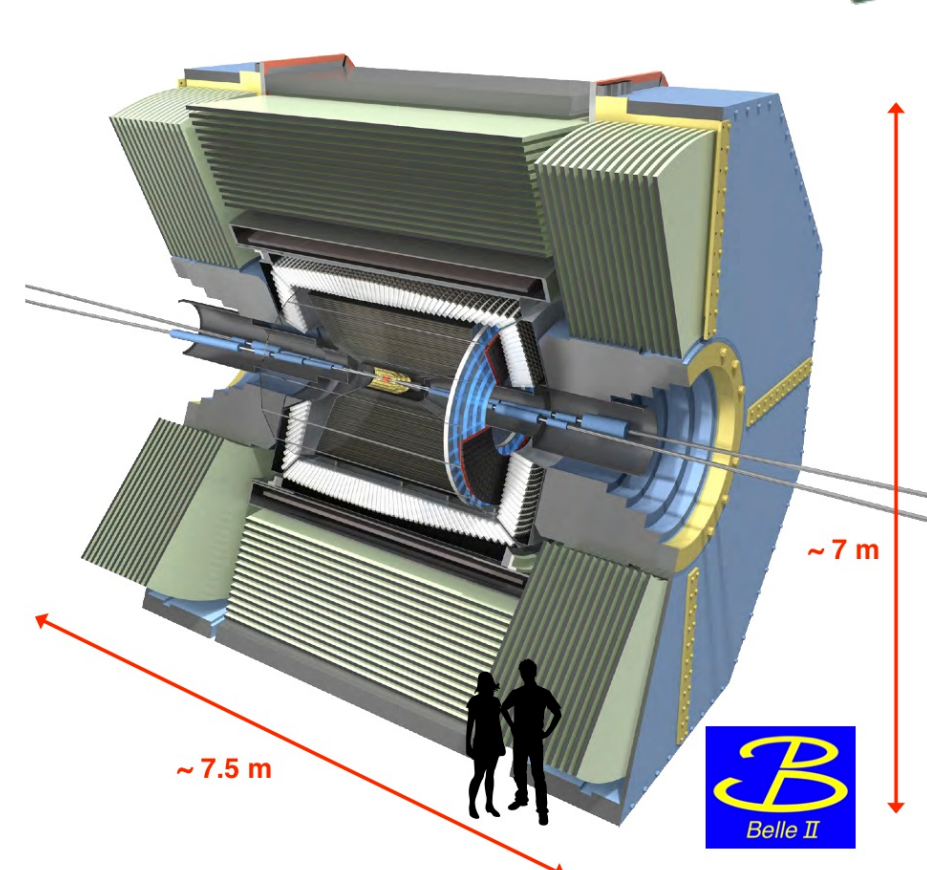
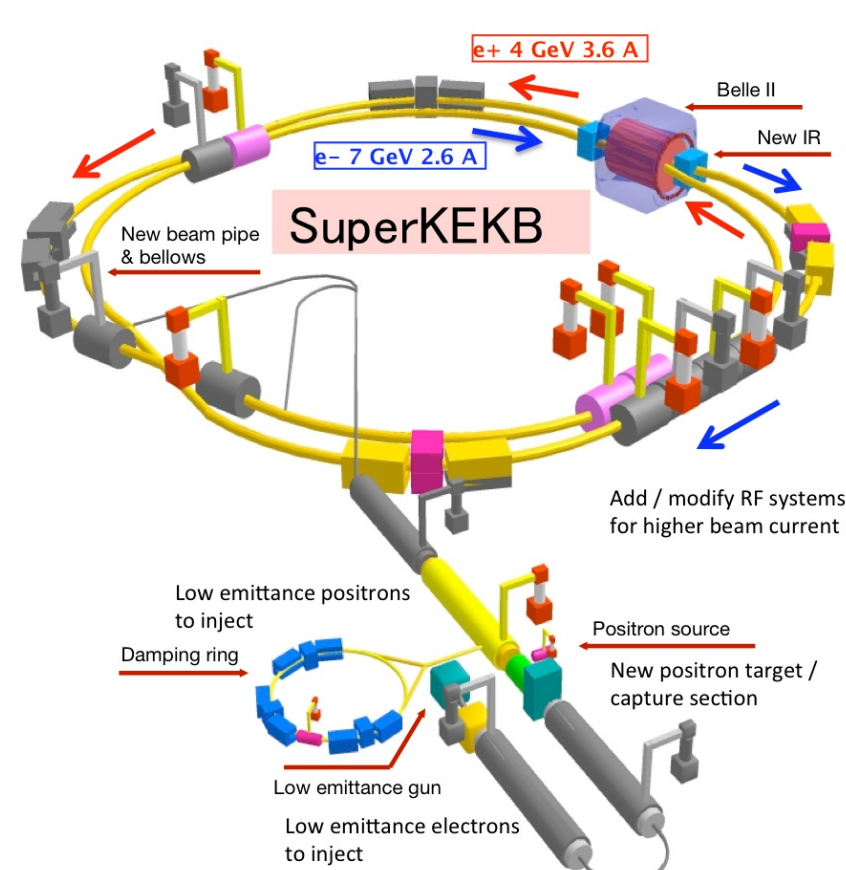
**Linux Debian** has been selected as distribution for uSOP board. Sitara AM335x processor is supported by **BeagleBoard.org Foundation** that provides open-source Linux kernel drivers and patches.

Using an **image-builder** scripts set it is possible to generate (on a separate PC) a root filesystem image based on last ARM Linux kernel with a selection of packages ports. The rootfs image is suitable for **eMMC/micro-SD** installation or **network booting**.

Last **EPICS** base (R3.15.5) is selected for uSOP and EPICS IOC development can be done directly on board using C/C++, Python and related utilities.



## Software

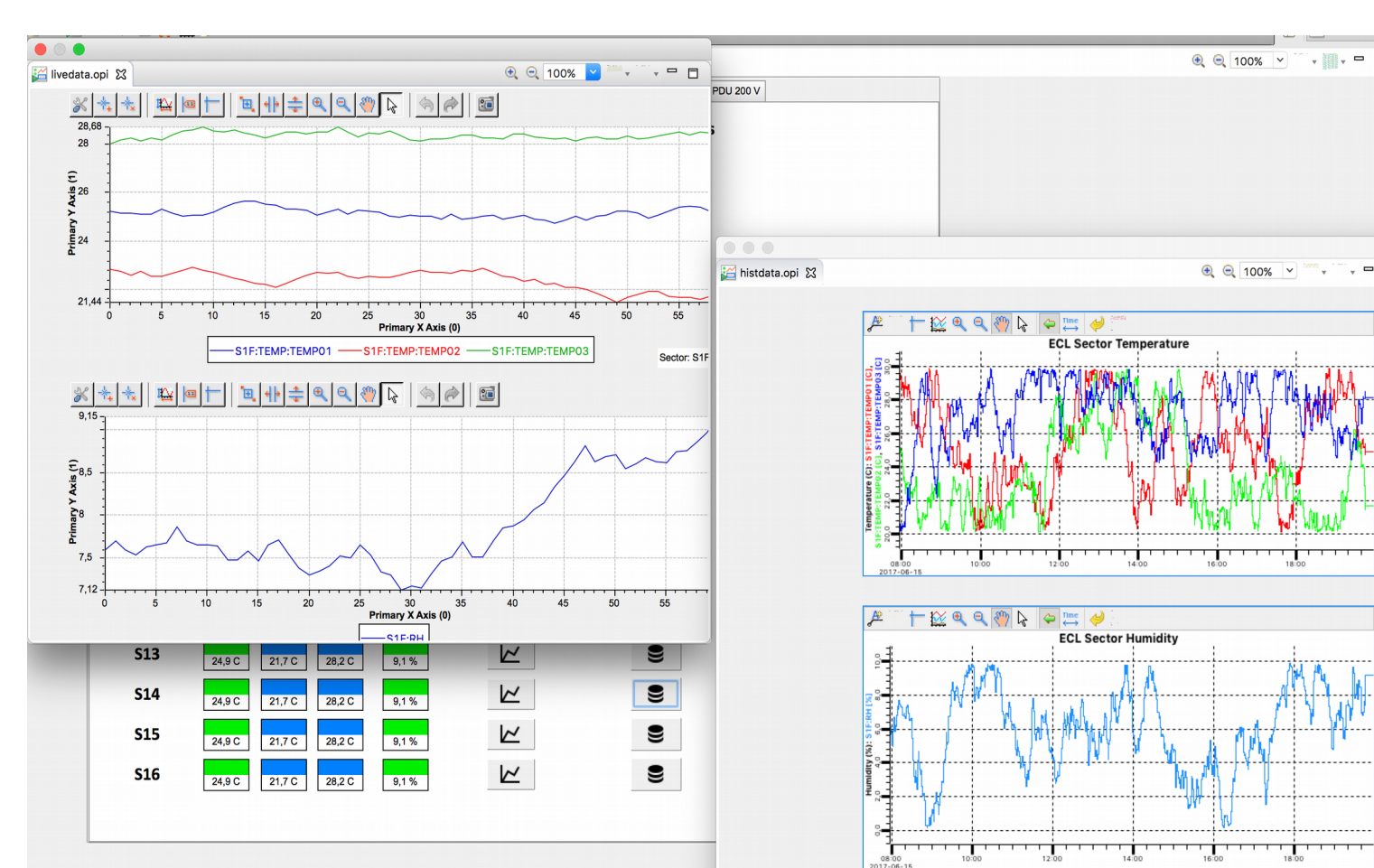


The **BelleII** detector is currently under construction at the **SuperKEKB** electron-positron collider at the KEK Laboratory (Tsukuba, Japan). As a major upgrade of the forerunner Belle experiment at the KEKB collider, the BelleII detector has been improved to make measurements of CP-violating asymmetries in rare **B meson decays**, to achieve precision determination of CKM parameters, and to perform sensitive searches for lepton flavor violation and lepton number violation in rare and forbidden B and D decays.

Temperature and relative humidity in the two **BelleII ECL endcaps** are monitored by a **uSOP-based network**. Each endcap is read out by four uSOP boards placed in a 19-inches 6U crate. Each uSOP unit is hosted in a 6U carrier box with **ADC unit** for readout of **thermistors** and **humidity probe** readout.

A specialized **EPICS IOC** has been developed to interface uSOP with LTC2983 ADC through SPI bus. Each temperature and humidity value is published on BelleII EPICS network and stored in an **EPICS Archiver**.

**Control System Studio (CSS)** is the visualization tool selected by BelleII. ECL temperature and humidity values are monitored with various control panels.



## uSOP for Belle 2 Experiment