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ARM-9 Board Hardware

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Powerful Embedded Systems

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Computers from big to small

In the 1980:

- Big: mainframe computer (~ 1M$)
- Medium size: mini-computers (VAX, PDP-11 ...) (~200 k$)
- Small: Micro computers (~2 k$)

Today:

- Big: PCs arranged in computing farms (~100k$)
- A little less big: Desktop PCs and Laptops (~2k$)
- Medium size: PDA, handphones (~200 $)
- Small: Micro controllers in embedded systems (50 c)

Data Acquisition and control

- PC with devices directly attached through dedicated interfaces
- A powerful embedded system with attached sensors is connected to a network and controlled from a PC
- A network of “intelligent sensors” is read by an powerful embedded system which in turn is controlled by a PC

What do we call a “powerful embedded system”?

- Micro-controllers are powerful enough to run a full operating system
- Flash memory to store boot loader or full operating system
- Typical RAM memory sizes of 64 or 128 Mbytes
- Many interfaces allow to connect to the outside world:
  - Ethernet, WiFi
  - I2C bus
  - USB
  - RS-232
  - TTF screen and touch screen

Where are they used?

- The first such systems were used in network routers
- Now in games consoles
- Mobile phones
- GPS systems
- PDAs

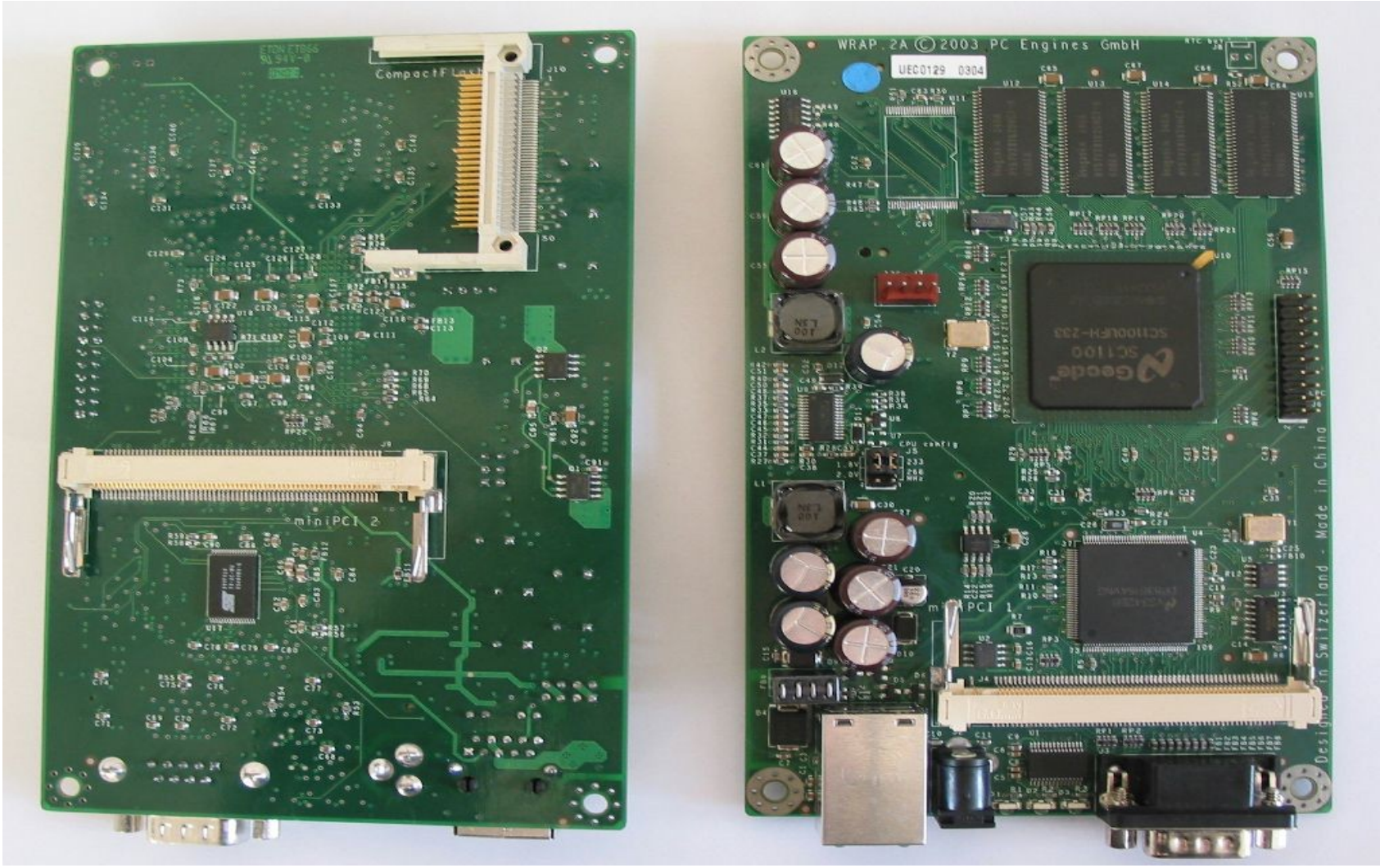
  These systems are mass produced and therefore cheap. The components are cheap as well
- Can we make use of this for data acquisition and control applications?

2 different approaches

We have 2 types of systems:

- PCEngines Wrap board
  a commercial board designed as router hardware
- A home built ARM-9 system designed for camera readout in an astronomy experiment
  The board has been designed by
  G. Kasprowics, a doctoral student at CERN

The PC-Engines Wire Router Application Platform (WRAP)



Information on the WEB

- PC Engines WEB site
- AMD Geode SC1100 WEB site

The Wrap board

- Runs the Geode chip, a i386 compatible micro controller
- Has a stripped down BIOS similar to a PC
- CF card interface
- Ethernet
- Mini PCI
- LPC bus (could be usd to interface sensors)
- Designed as a Wifi to Ethernet gateway

WRAP features

- Uses the AMD Geode Chip (486 compatible)
- 266 Mhz SC1100 CPU
- 128 Mbytes of RAM
- ~3-5 Watts
- Small (128 kBytes) flash for BIOS
- I2C bus
- LPC (low pin count bus)
- Compact flash interface
- 100 Mbit Ethernet
- Cost: ~ 100 $ US (the board is now discontinued but replaced by a similar design (ALIX)

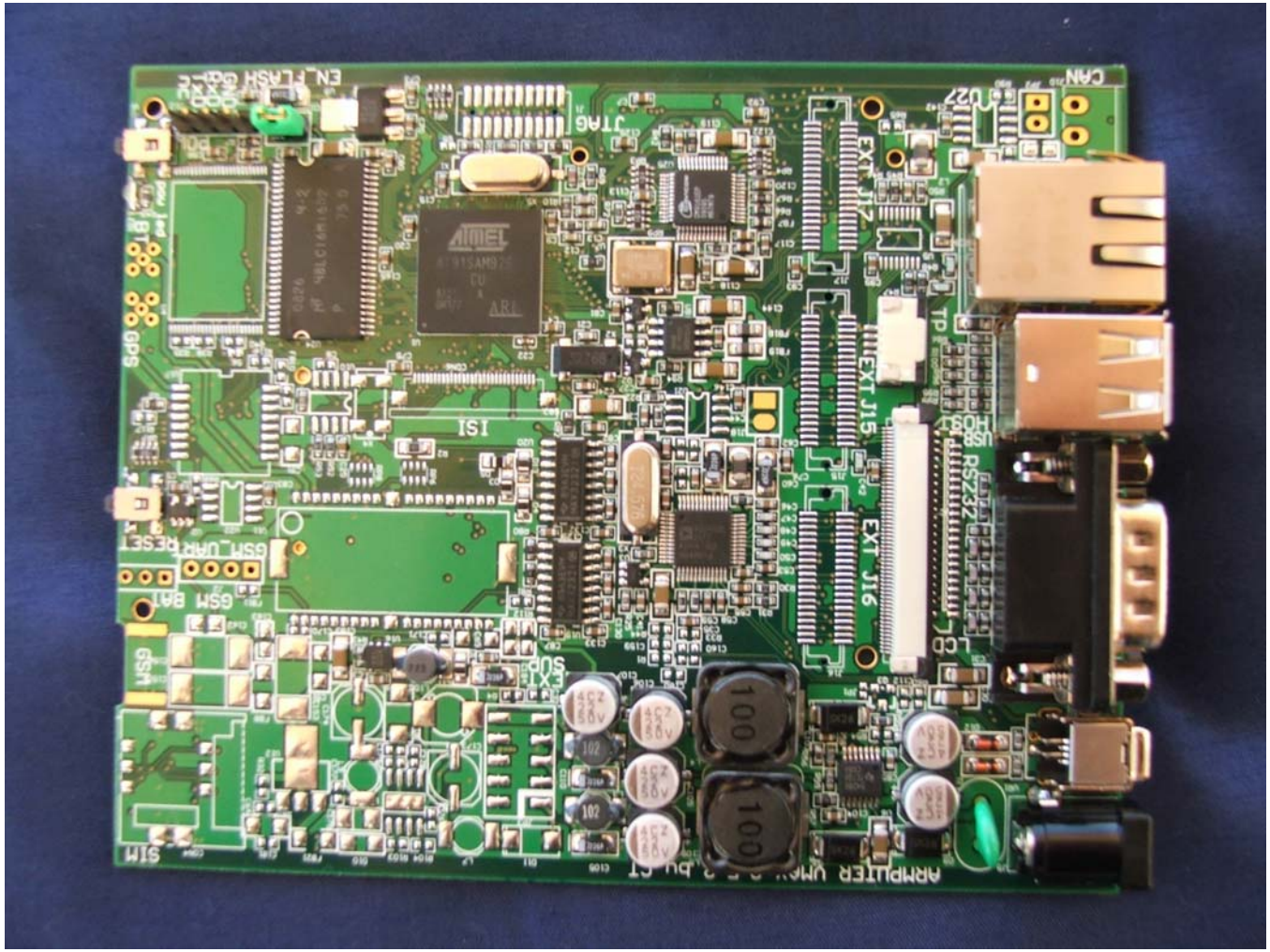
ARM-9 board

The ARM (Advanced Risc Machine) architecture is very popular for hand held devices

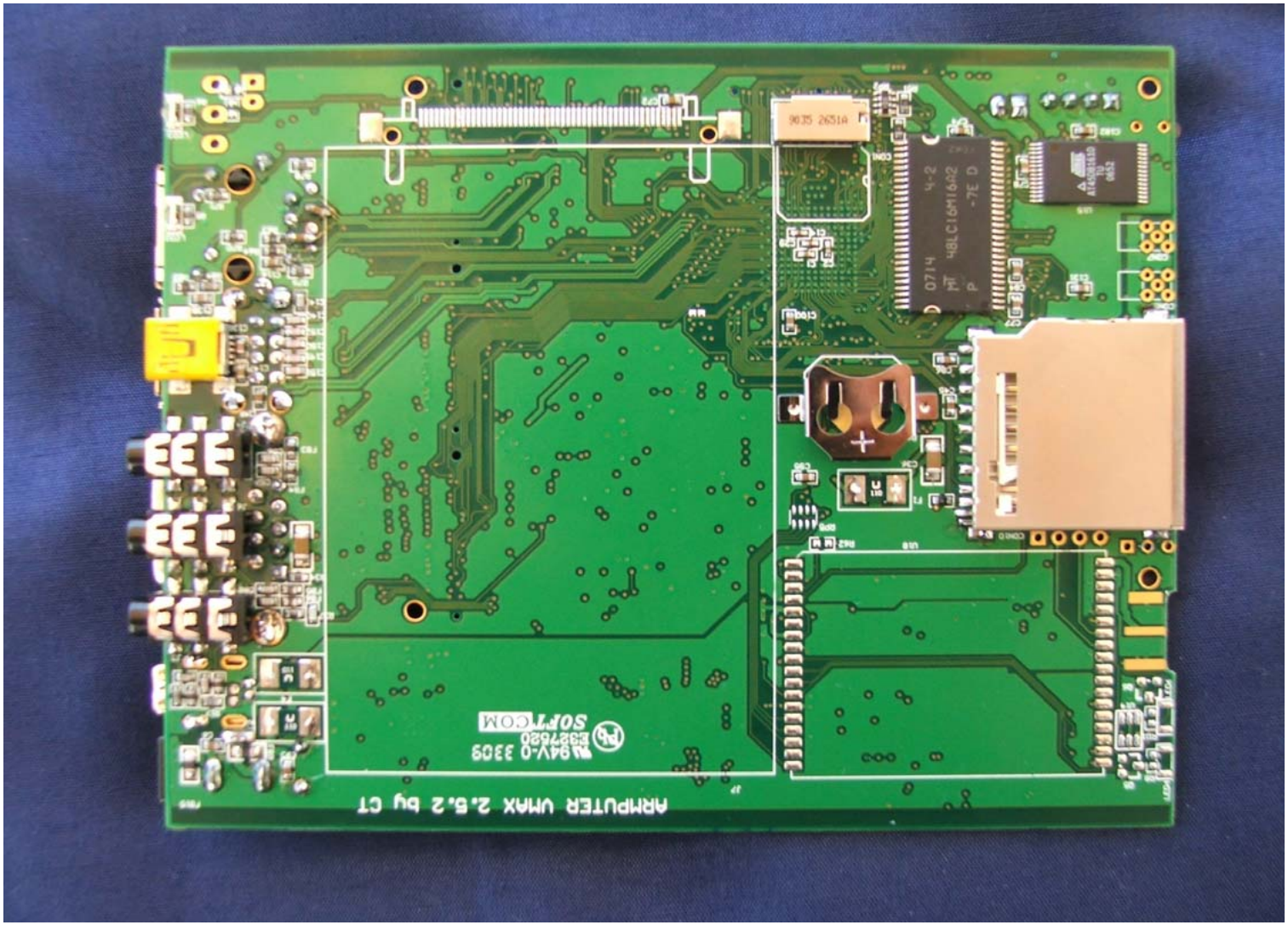
Advantages:

- Cheap
- Powerful
- Many manufacturers have micro-controllers with a big range of interfaces
- Well supported by open source software (Linux and GNU compiler chain + libraries)

The ARM board



The ARM's back side



Some features

- CPU with arm-9 architecture (at91sam9263)
- Program for booting in ROM
  - Program for booting in ROM
  - 100 Mbit Ethernet connection
  - Memory controller for
    - SDRAM memories
    - Nand flash memories
    - Dataflash memories
  - Asynchronous serial interface (RS-232)
  - Debugging/console port (RS-232)

More features (ARM)

- I2C bus interface
- TFT screen interface
- Audio interface (can be used for data sampling)
  - 96 ksamples/sec stereo input
  - Stereo outputs
- Harddisk interface
- GSM (not mounted on out boards)
- Bus extension connector (not mounted on our boards)
- 3 USB ports

The I/O board

- Board specifically designed for this college
- Has a series of I2C and 1-wire devices
- I2C is a 2-wire (data + clock) serial bus invented by Phillips
- Often used on CPU boards for infrastructure (ventillator and temperature control)
- In at91sam9263 I2C is implemented in the chip
- 1-wire bus (Dallas) accessed by I2C to 1-wire bridge

WEB resources for at91sam9263

- Atmel at91sam9263 Website
- Atmel at91sam9263 evaluation kit Website
- Linux4sam Website