ESP Hardware Overview

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2G ESP Machine Types

- shallow
  - 50 meter rated can
  - All but one 2G ESP is of this type
- 4km
  - 4000 meter rated titanium sphere
  - Only one ever deployed
- mfb
  - standalone microfluidic block
    - affectionately named “tombstone”
    - still supported, but not none deployed

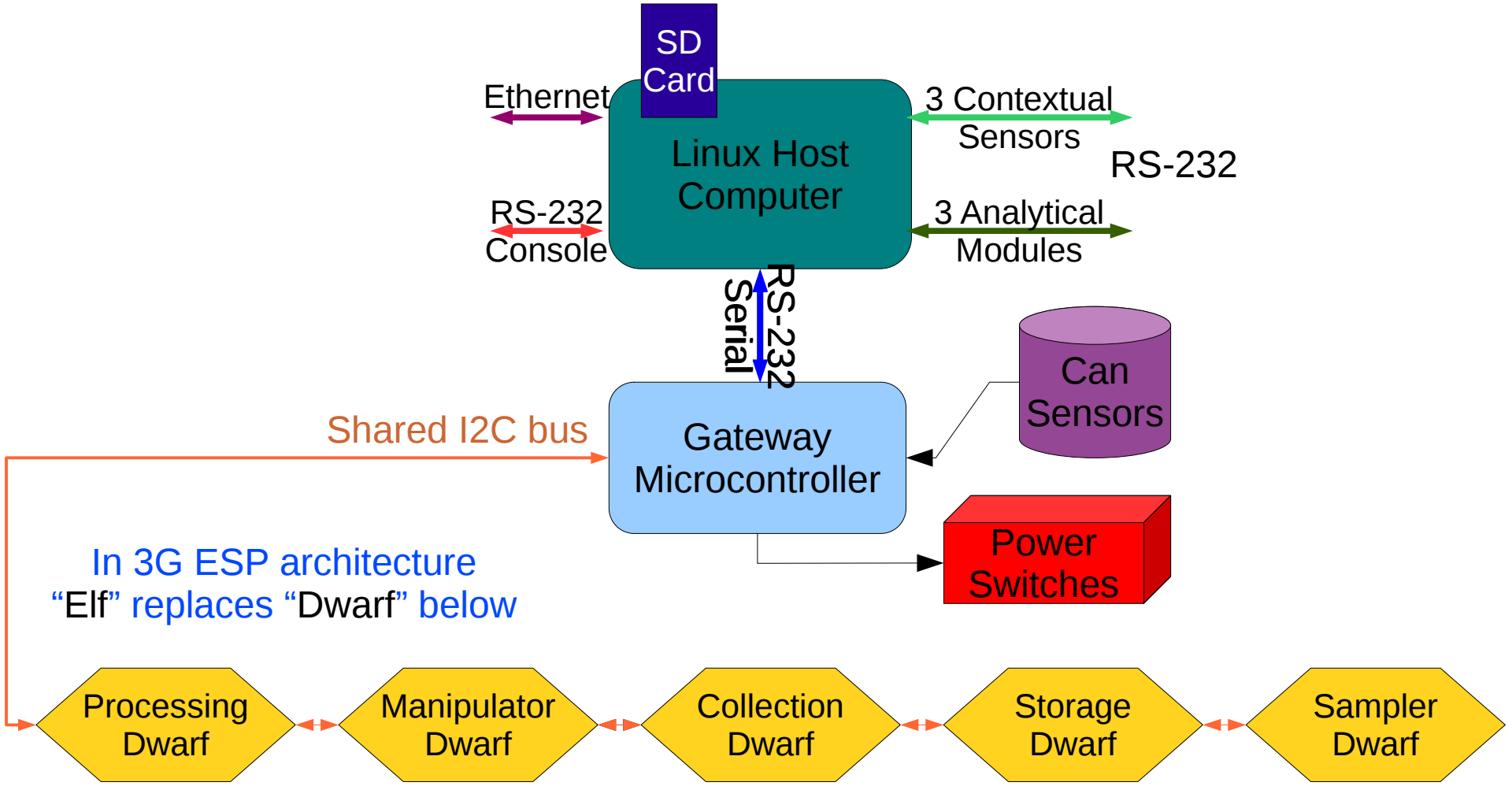
3G ESP Machine Types

- auv
  - Includes cartridge carousel
  - Suitable for deployment in MBARI Long-Range AUV
- portable
  - Single cartridge
  - Used for protocol development in lab

ESP Hardware Architecture

- Distributed control
  - All “work” delegated to microcontrollers
    - 2G calls them “dwarves”, 3G “elves”
  - All dwarf/elf microcontrollers are identical
    - all communicate on a shared I^2C bus
    - all run the same firmware
  - The unique “gateway” microcontroller
    - connects the Linux Host Computer (via an RS-232 serial port)
    - to the microcontrollers’ common I^2C bus

2G ESP Hardware Connectivity



Almost all ESP activity is funneled through the RS-232 link between Gateway and Linux Host
The Linux host may be replaced with any computer with a serial port (for lab testing)
Failures on *any* Microcontroller may cause I2C bus errors on others
Gateway failures may also be reported as I2C bus errors

Simulated Hardware

- Can run in simulated time or real-time
- Each Simulated Dwarf or Elf
  - Implemented as a separate Ruby thread
    - while real microcontrollers are programmed in ‘C’
  - Responds to the exact same I^2C bus messages
  - Models basic, linear motor and heater physics
    - Simulates “crash” if one attempt to run past end stop
    - However, does not model two actuators colliding
    - Heaters do not model boiling water
- In real-time, may be combined with real contextual sensors on RS-232 ports

Simulation Limitations

- Can environment is unchanging
- Energy Use is not tracked
- Filter clogging is not simulated
  - samples at constant rate until goal reached
  - one can set this simulated filtering rate
- No images generated
- No email messages in simulated time
  - But you can get emails running real-time sims
- Run your simulated time sims on a laptop
  - >100x faster than the ESP!