Choosing A Microprocessor

IEEE Northern VA Section Hands-On Workshop Series

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Hobby vs. Production

- Today's project is low-volume for learning
  - Individual modules are wired together
- What if we planned to sell it in volume?
  - We'd probably put all the parts we could on a single board
    - It usually reduces the total cost and increases reliability
    - There are exceptions...
- How would we design it?
  - Often the most critical choice is the Microcontroller Unit

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MCU vs. CPU

- Most Internet-of-Things are based on a Microcontroller Units – "MCU"
  - These are smaller than typical Intel or AMD processors or "CPU" found in servers, desktops, and laptops
- They integrate more functionality onto a single chip
  - Modern ones often include memory controllers, some memory, and I/O like USB, GPIO, Ethernet, etc.
- They are usually grouped by width of internal data bus
  - 8, 16, and 32 bit MCU's are most common

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Quick Aside

- Integrated Device Manufacturers Intel, Samsung, and TI both design and manufacture chips
- Due to the extreme cost, most manufacturers are fabless
  - Foundies like TSMC and UMC make chips for others
- Modern chips are some complex they are designed using a Hardware Description Language
  - HDL enable automated design and verification
  - IEEE 1076 VHDL and Verilog are the two most widely used

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Choices Abound

- Dozens of vendors offer thousands of different models

How do we choose?

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Supply Chain Factors

- Manufacturer
  - Ability to deliver desired volumes on time
  - Reputation for addressing defects
  - Technical support access and cost
  - Financial stability
- Distributor
  - Existing relationships/commitments
  - Local support

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Time To Market

- Existing engineering experience with related products
  - Both hardware and software
- Availability of development kits
  - Available at low cost for many MCUs
- Development environment
  - Many vendors have their own special tools with learning curves
- Documentation depth and quality
  - Often hundreds or thousands of pages

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Performance

- Processing speed
  - Depends on the data processing and communication needs
  - Some offer "accelerators" for encryption and other functions
- Power utilization
  - Many devices offer low-power sleep modes to conserve battery life
- Device Families
  - Related MCU's that offer more speed, pin and code compatibility if the product needs to be enhanced

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Test and Certifications

- Testing
  - Ability to verify the chip is functioning after assembly reduces Return Merchandise Authorizations (RMA)
  - IEEE Standard 1149.1 (JTAG) boundary scan is commonly used
- Certifications
  - Some modules may need to pass tests in certain countries
    - Federal Communications Commission (FCC) in US
    - Restriction on Hazardous Substances (ROHS) in EU
  - Pre-certification ensures the assembly meets requirements

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Integration

- Higher integration is often key to reducing cost
  - Integration is the incorporation of additional functions like memory and interfaces onto the same piece of silicon
  - It can also refer to packaging multiple components into a single package - “system on chip” or “system on module”
- There are many benefits because it reduces:
  - Number of parts to order, track, install
  - Engineering time to design circuit board
  - Circuit board size and (sometimes) number of layers
  - System power requirements

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Open Source

- Open Source Software has been around for decades
  - Developers agree to publish code but place conditions on use
  - There are many license (Apache, BSD, GPL, MIT,...)
- Open Source Hardware is more recent
  - Availability of reference schematics, circuit board layouts, mechanical drawing, BOMs can save significant time and risk

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Cost

- Ultimately the choice usuall comes down to cost
  - Particularly when you hope to sell in large volumes
  - Save $1 off the cost of making each of one million devices saves $1,000,000
- Integration is often the key to achieving lowest cost
  - It eliminates external support devices from the "Bill of Materials" (BOM)
  - It reduces the "Non-recurring Engeering" (NRE) costs previously discussed

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IEEE GlobalSpec

- Parts comparison databases support the selection
- IEEE recently acquired GlobalSpec from IHS
  - The Engineering360 Platform helps engineers choose components

- **IEEE GlobalSpec At-A-Glance**
  - More than 8 million registered users
  - 95 million technical documents
  - 200+ million datasheets
  - 220 million indexed technical webpages
  - 1,100+ annual newsletter editions
  - 200,000+ suppliers
  - 82,000 product announcements
  - 63,000 digitized catalogs
  - 835 specification guides

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About The ESP8266

- The chip at the core of our weather station, the ESP8266, is a highly integrated module
  - MCU, Memory, WiFi, analog support components
- Many people are using it
  - It's designed into many hobby modules
  - There appears to be a lot of information available
  - It supports Arduino sketches, TCP/IP stack
  - It's relatively power efficient
- Further research necessary before choosing for a high-volume product

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Questions?

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