SE-IOT: Internet of Things

Hardware Platforms and Project Plan

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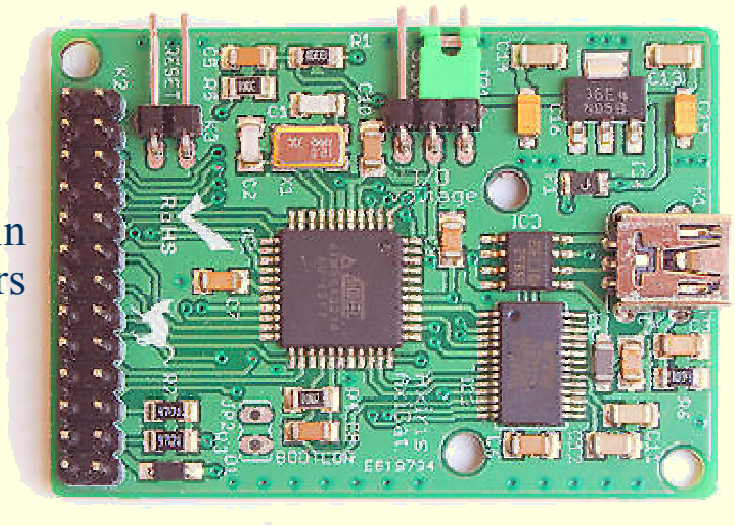
Reading from sensors/Writing to actuators

Desktop	Embedded Platform
USB to GPIO interface board	Built-in onboard
General purpose computing	Specific functionality
Compiler	Cross-compilation
Higher cost □$700	Cheaper □$50
Faster processor □i5	Limited □ARM processor
More RAM □4GB	Limited □64MB □512MB

USB-to-GPIO expansion for Desktops

GPIO pin headers

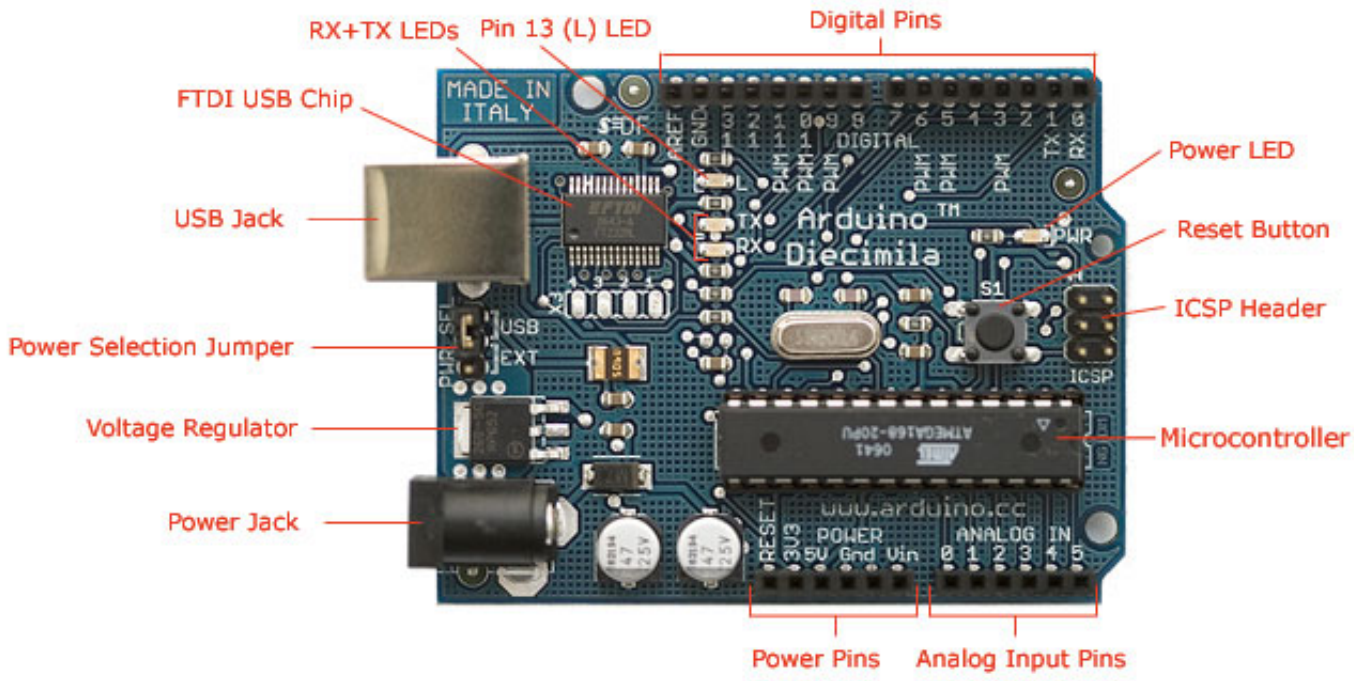


USB connector

Embedded platforms

- Arduino
- Raspberry Pi
- Hackable SOHO routers

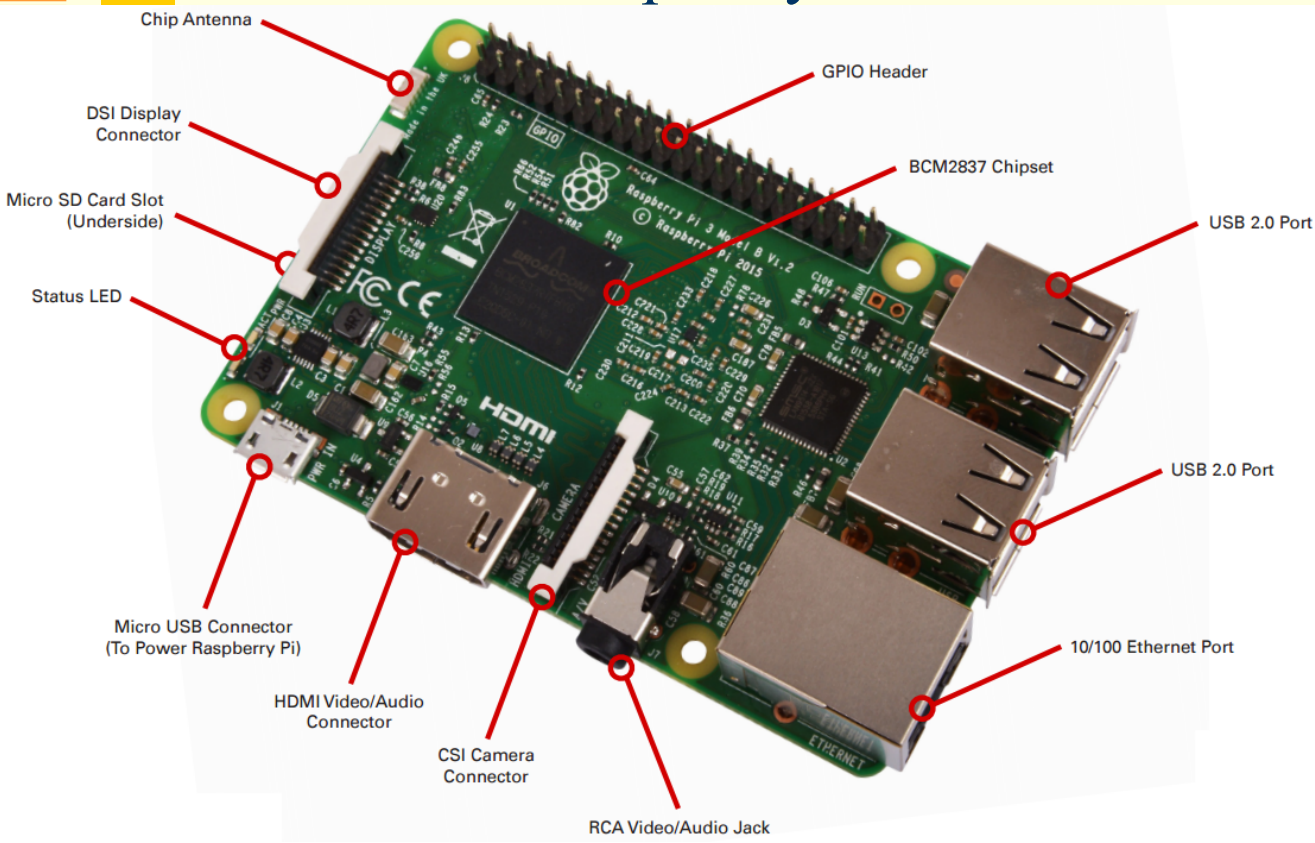
Arduino microcontroller



Arduino microcontroller

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB

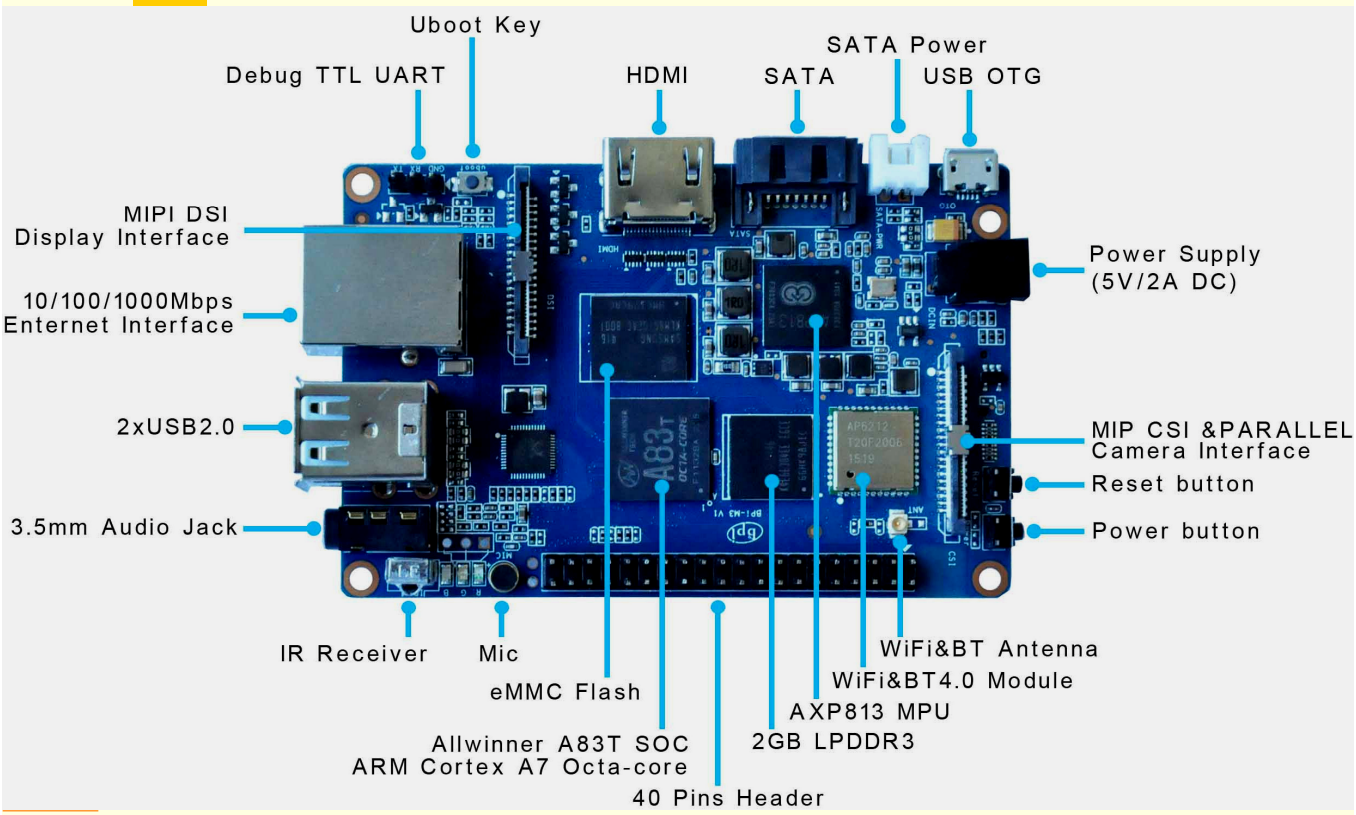
Raspberry PI



Raspberry PI

	RPI 1	RPI 2	RPI 3	RPI Zero
CPU	Single core 700MHz	Quad core 900MHz	Quad core 1.2GHz	Single core 1GHz
Memory	512MB	1GB	1GB	512MB
USB	2x	4x	4x	1x
Cost	USD$35	USD$35	USD$35	USD$5

Banana Pi



DLink DIR-860L

- Next Generation 11AC Wi-Fi: Dual Band (up to 300Mbps + 867Mbps)
- Simultaneous Dual Band: Delivers faster Wi-Fi speeds and less interference for maximum throughput
- Personal Cloud: Network access to USB 3.0 storage
- Gigabit Ethernet
- USB 3.0

DLink DIR-860L

Instruction set	MIPS
Vendor	MediaTek
System-on-Chip	MT7621AT
CPU/Speed	880 MHz (Dual-Core)
Flash-Chip	MX25L12805D
Flash size	16 MB
RAM	128 MB DDR3
Wireless No1	MT7612E 802.11an+ac
Wireless No2	MT7602E 802.11bgn
Switch	Integrated into SoC (Gigabit)
USB	Yes 1 x 3.0
Serial port	Yes

Raspberry PI operating systems

- Raspbian (official Raspberry PI Debian)
- Ubuntu Desktop
- Ubuntu Core (for developers)
- Windows 10 IOT Core
- OSMC Open source Media Centre
- OpenELEC Open Embedded Linux Entertainment Centre

(vs

- No operating system on Arduino)

Raspbian vs Ubuntu desktop

- **Raspbian** and **Ubuntu** are both based on **Debian**
  - Raspbian is official supported distribution
  - Ubuntu desktop seen as Linux distribution (for humans)
- Usage is **similar** except for low-level hardware support and lower compute resource available
  - Linux commands are mostly similar
    because sources recompiled for ARM, eg
    - **`bash`**
    - **`ssh`**
    - **`cron`**

Python on Raspberry PI

- Python is native to Raspberry PI
- Python modules may wrap around existing C/C++ libraries
  - large collection of supported libraries
- large user-base
  - (to contribute to development and testing)
- sufficiently high-level and flexible
- good integration/ glue language incorporate existing commands and C/C++ libraries

Basic Requirements

- Low cost for deployment
- Sufficient compute power for encryption
- Robust casing for weather proofing and tamper proof
- Adequate network/system infrastructure

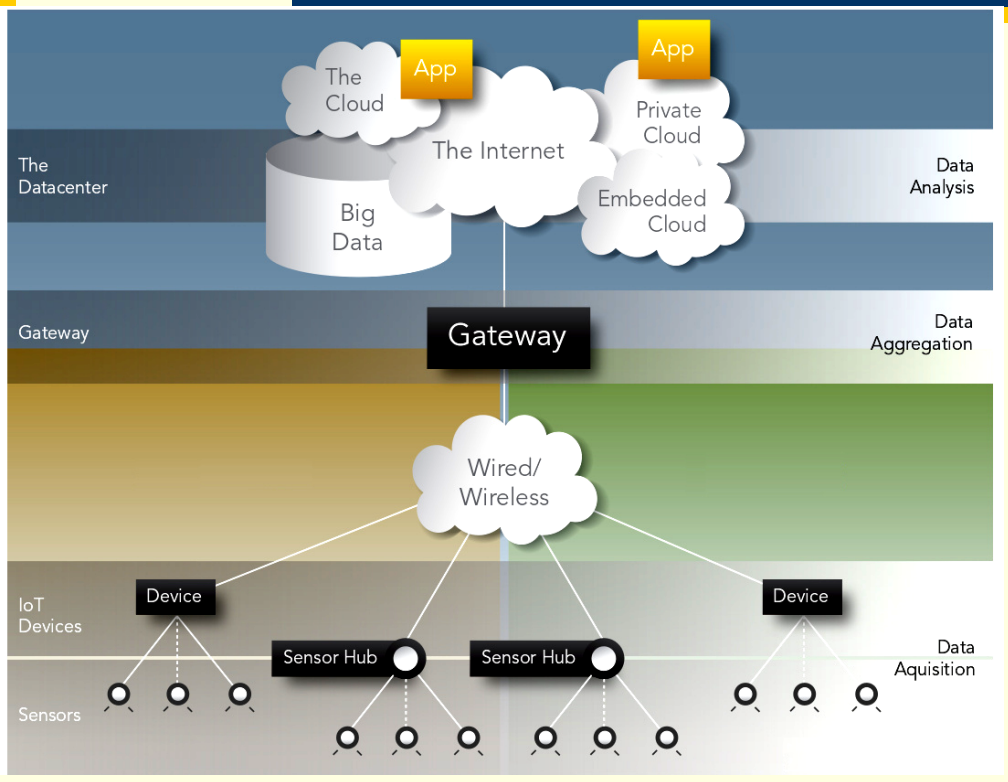
Prototyping Hardware

- Arduino gives full control on reading sensors
  - C/C++ cross-compile
  - Programming interrupts
- Raspberry Pi has a managed environment
  - windowing desktop
  - Availability of language interpreters/infrastructure
  - Large user community
- Unlikely to use a router unless networking domain
  - file server
  - network snooping

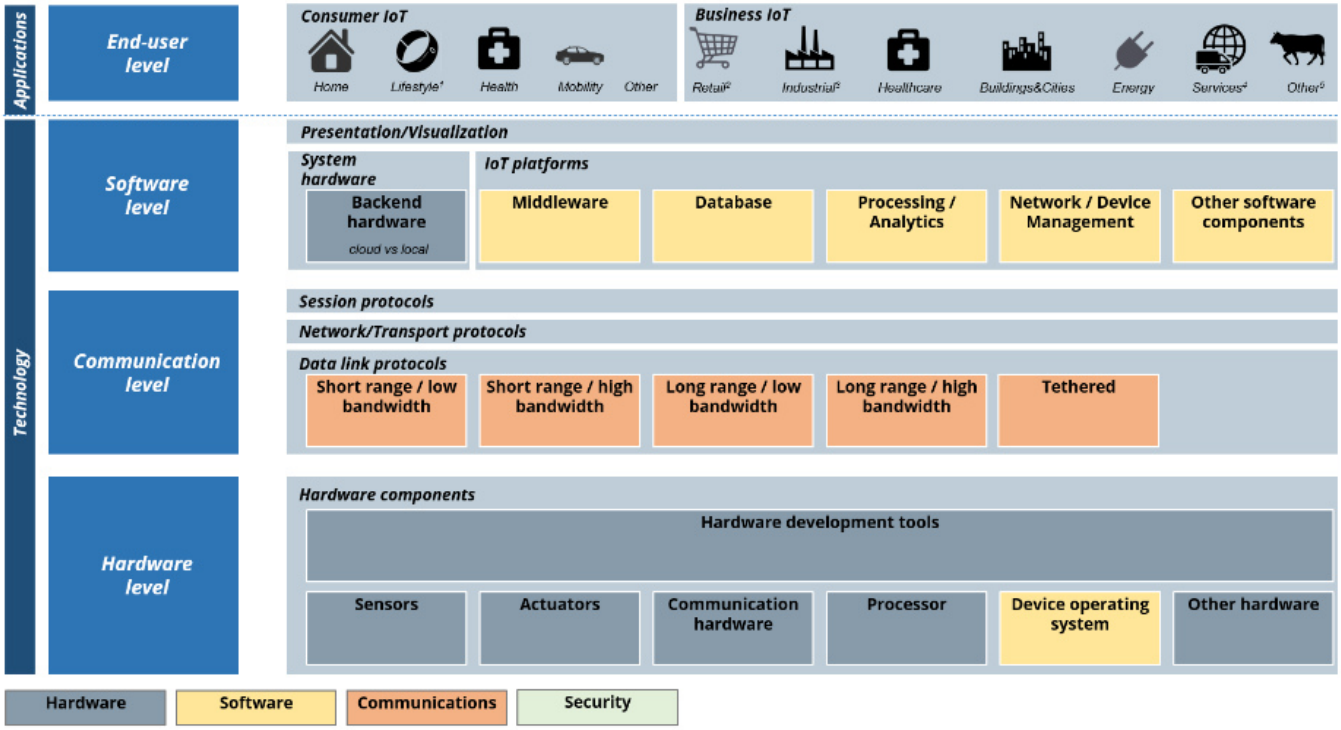
Integrating IoT Technology into Enterprise

- High-level exploration of technology & concept
  - #1: Build an IoT Team (diverse manpower)
  - #2: Define the IoT System (data, analysis, policies)
- Explore project feasibility and value
  - #3: Determine the Business Value (CBA)
  - #4: Acquire Stakeholder Agreement and Funding (confirm ROI)
- Plan and scope project
  - #5: Classify the Sensor Data
  - #6: Choose IoT Devices and Design the Network Infrastructure
  - #7: Review Environmental Conditions
  - #8: Define Space and Electrical Power Needs
- Develop and deploy system
  - #9: Secure the IoT Devices and Data
  - #10: Align with Privacy and Corporate Governance Policies
  - #11: Design for Scalability
  - #12: Integrate and Manage the IoT Devices
  - #13: Establish a Support Model
  - #14: Plan the Resources

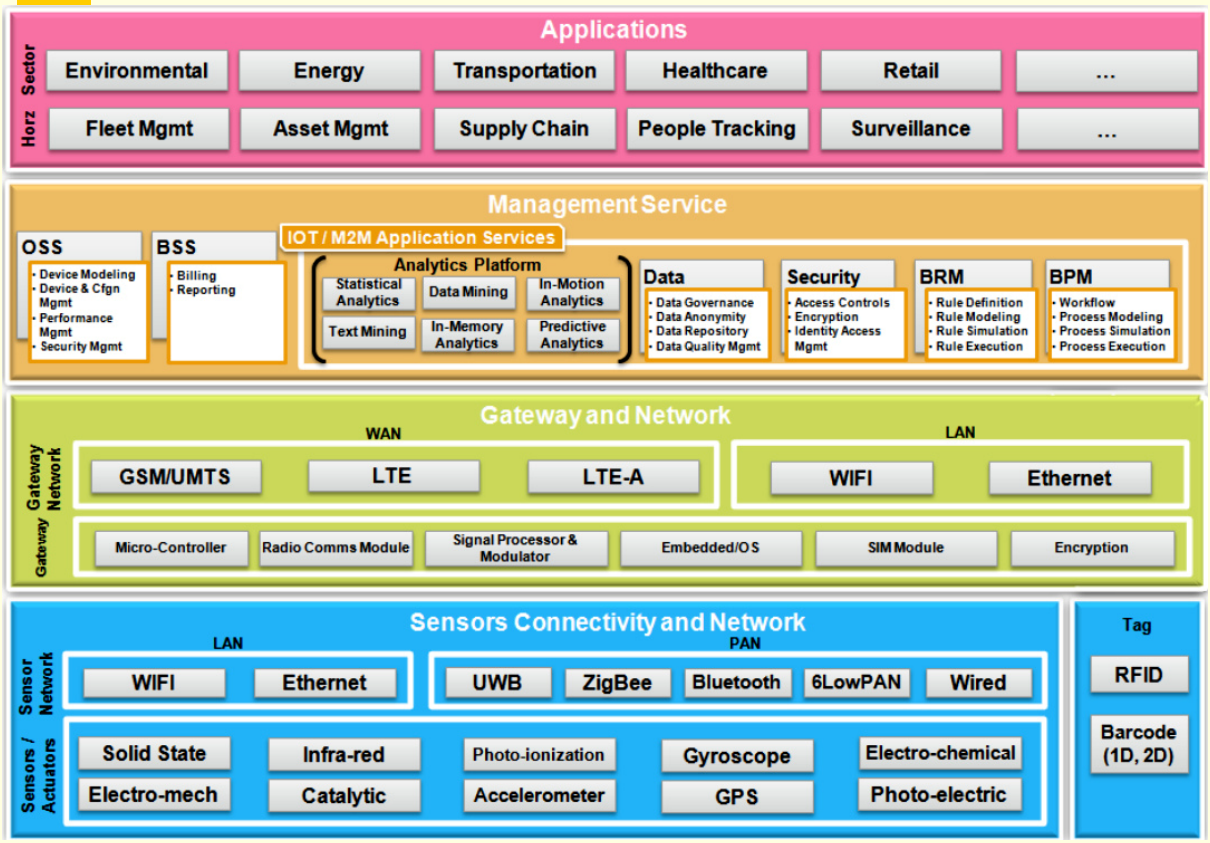
IOT Sensor/Data/App Layers



Technology Layers



IoT Architecture



Summary

- Enterprise project involves more than just hardware and sensors
- Typical project guidelines
  - Practicality
  - Real business value
  - Correctness, Robustness, Security