

Motivation

- Rapid growth in industry for smart home devices
- Market for "The Internet of Things" to be double the market size of smartphone, PC, tablet, connected car, and wearable devices
- There is a high cost of installing network equipment in a building
- Majority of devices in the modern home will be connected
- No convenient way to consolidate various applications

Objective

- Reduce the cost of smart devices by cutting out redundant communication modules
- Reuse existing powerline infrastructure already available in all homes and businesses, and create a platform for smart devices
- Utilize powerline communication technology to transfer power metrics of appliances

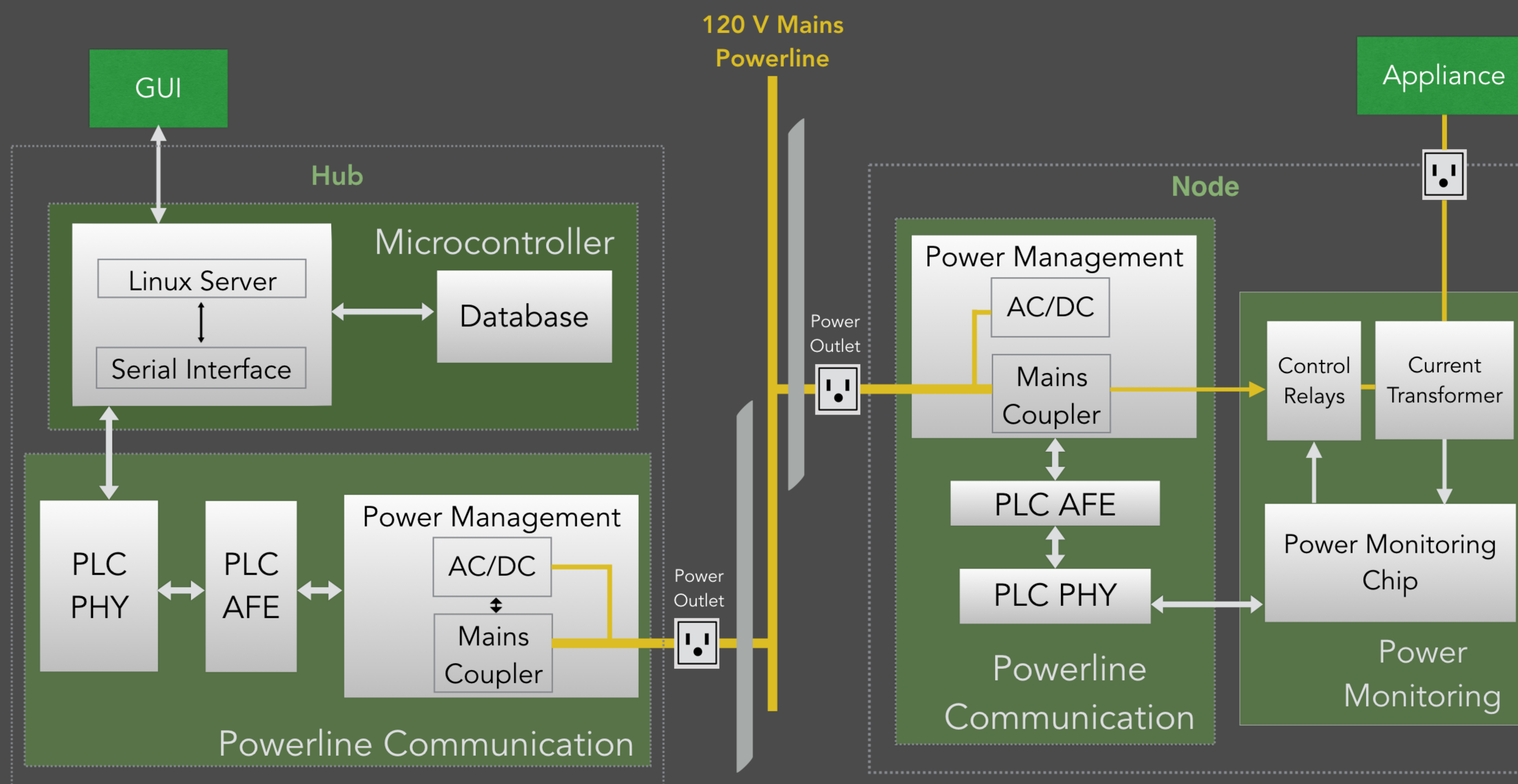
Design Advantages / Alternatives

- Cypress CY8C20 PLC chip able to send over 15 power measurements per second from a single device [1]
- Chose event-driven IO instead of polling for all data-transfers to reduce resource usage and CPU load
- PLC chips with higher data rates considered for prototype, but only available to certified corporations for high costs
- Existing products allow control of LEDs over a powerline, or provide hardware to allow a powerline as a communication medium [2][3]

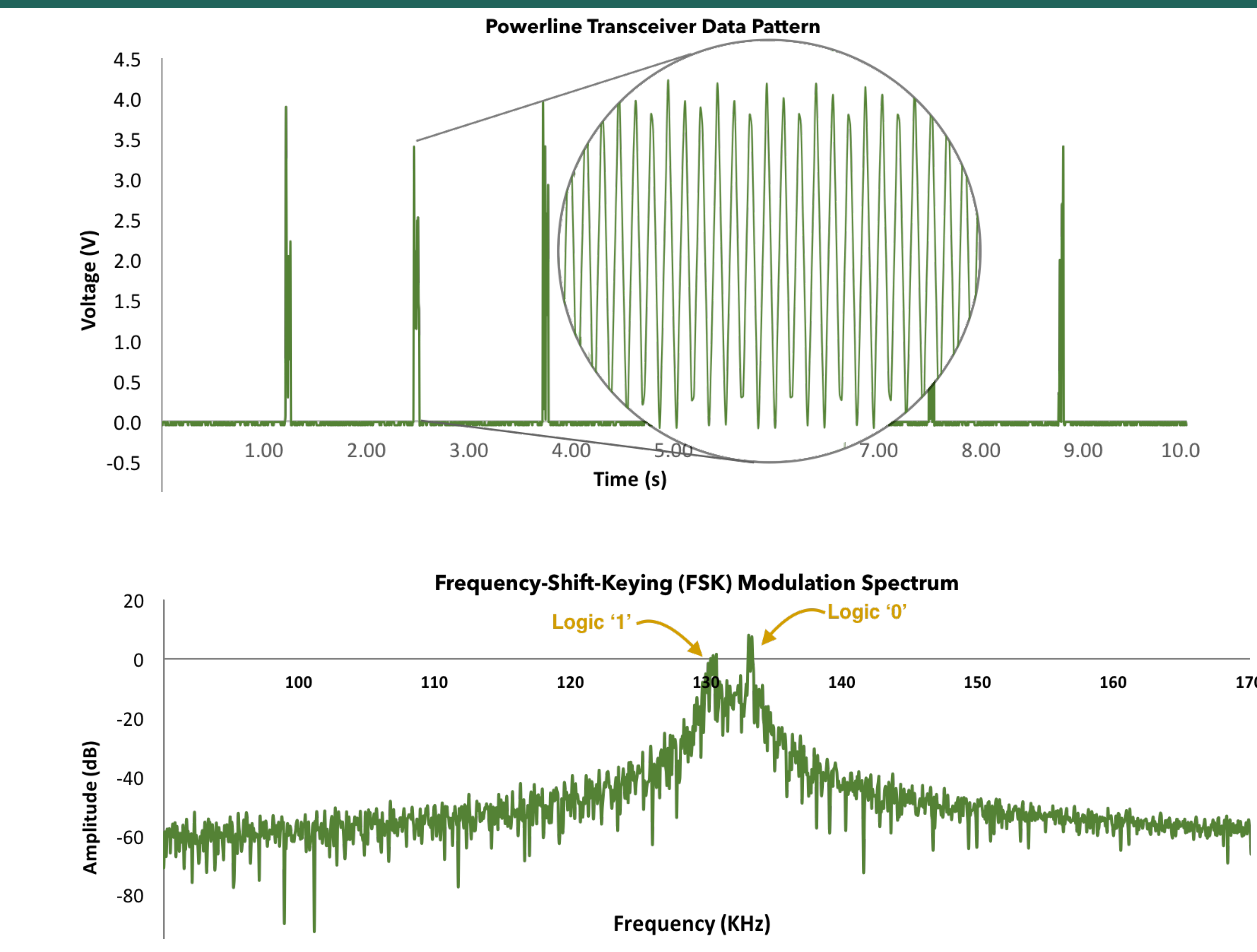
Communication Protocol

- PLC devices support half-duplex communication at 2.4 kbps
- Handshake protocol executed between connecting Node and Hub
- Each Node communicates its device type and unique ID [1]
- Hub assigns each unique Node a logical address to be used as an identifier for all future communication
- After the handshake is complete, the Hub or the Node can initiate communication to issue control requests or data transfers

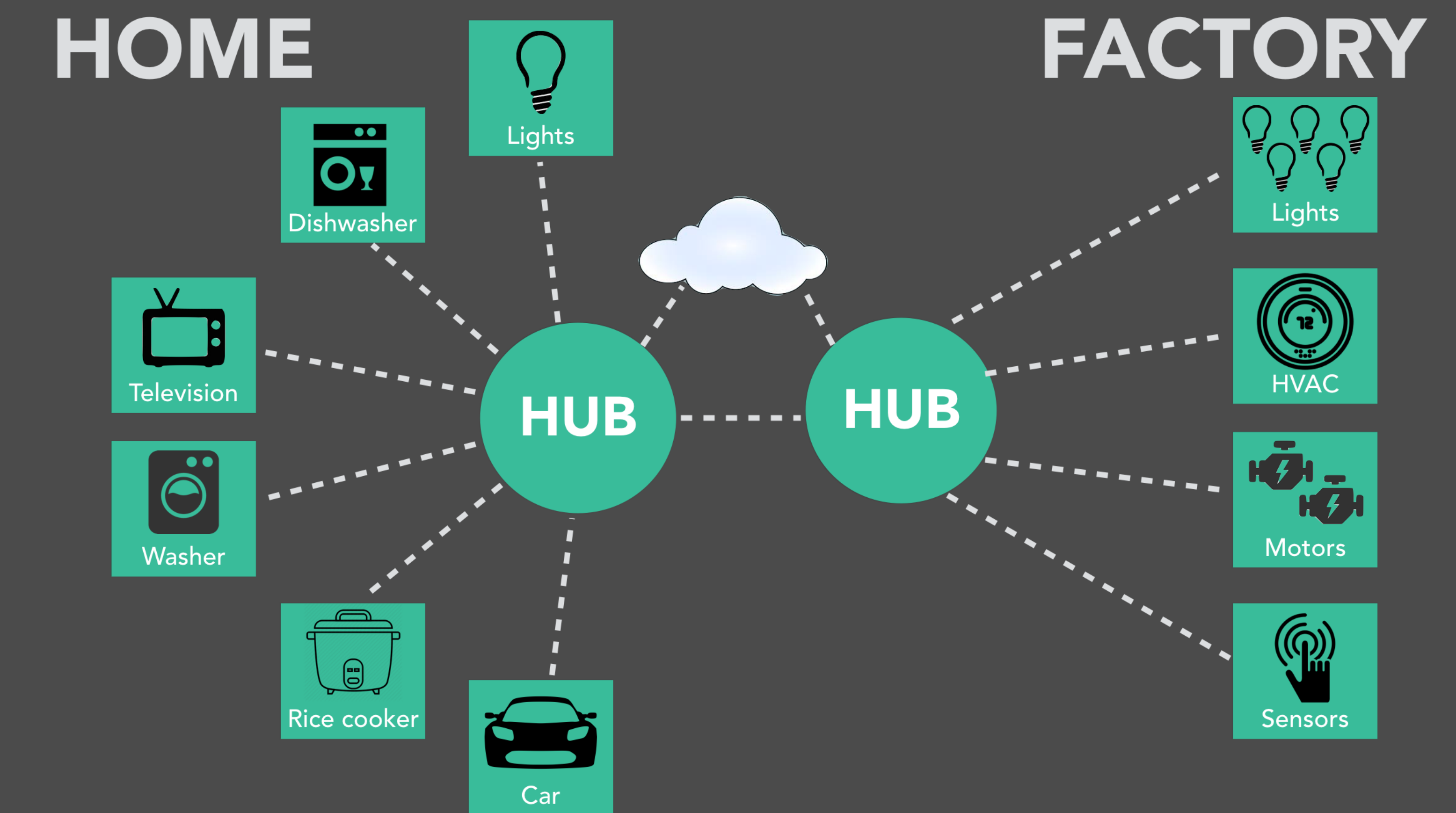
Detailed Block Diagram



PLC Communication



High-Level Network Diagram



Power Analysis

Table 1: Power Consumption of the PLC Chip

PLC Chip Blocks	VDD (V)	Current (mA)
CPU Current	5	9.384
Digital Block Current	5	8.714
GPIO	5	31.052
Analog Blocks	5	17.008
Total Current	5	66.612
Total Power (mW)	V x I = 5 x 98 = 333	

Table 2: Power Consumption of the Hub Controller

	Voltage (V)	Current (mA)	Power (mW)
PLC Chip	5	97.69	488.5
TX Amplifier	12	16	192
BeagleBone μ Controller	5	400	2000
12 V to 5 V Loss		59% Loss	1437
120 AC to 12 VDC Loss		15% Loss	622
Total Consumption			4739

References

- [1] Cypress Semiconductor. (September 2014). CY8CPLC20 Datasheet [Online]. Available: <http://www.cypress.com/?docID=50840>
- [2] Lumenpulse. (November 2014). Lumenpulse Technologies [Online]. Available: <http://www.lumenpulse.com/en/pages/technologies>
- [3] Maxim Integrated. (November 2014). Powerline Communications (PLC) [Online]. Available: <http://www.maximintegrated.com/en/products/comms/powerline-networking.html>