WIRELESS BUS INTERCONNECTS FOR FLEXIBLE AND RELIABLE CUBESAT SIGNAL INTEGRATIONS
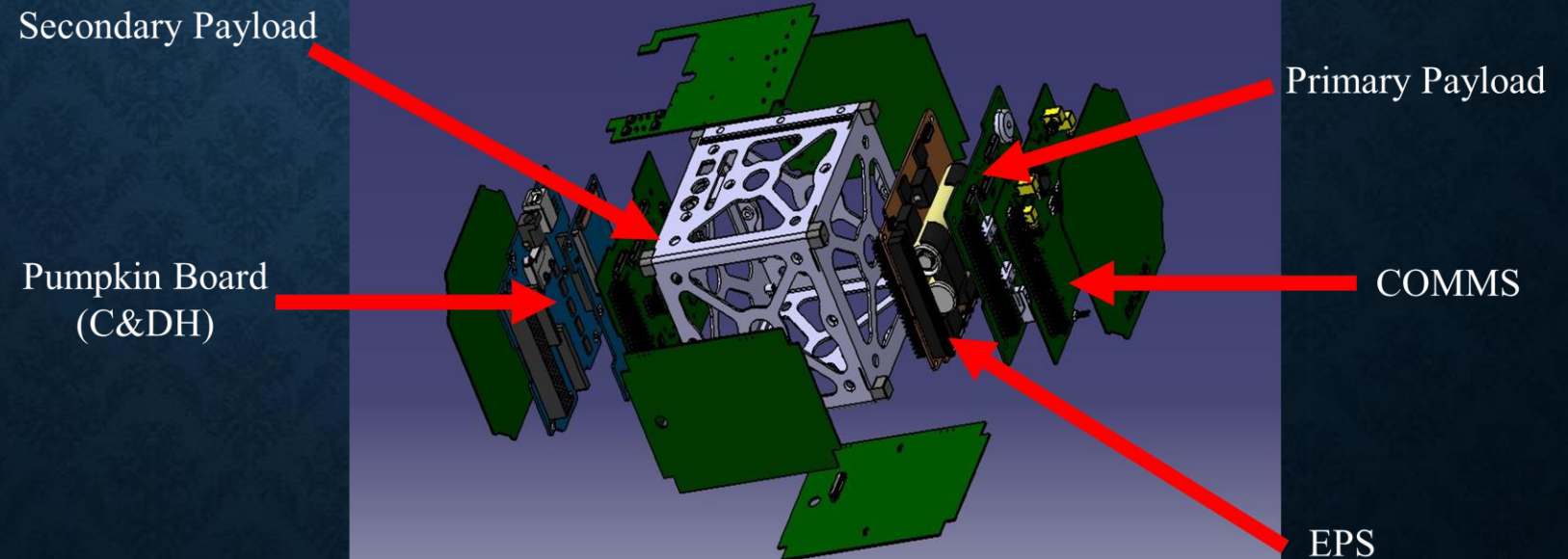
Russell Trafford and Adam Fifth

Rowan University

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OUR CUBESAT EXPERIENCE

- MEMSAT
  - 1U CubeSat designed to test new memory technologies in space applications.
  - Custom Payload and External Panels

Secondary Payload

Primary Payload

Pumpkin Board (C&DH)

COMMS

EPS

OUR ~~CUBESAT~~ INTEGRATION EXPERIENCE

- One of the largest issues faced during the entire process was integrating all the subsystems together.

- No prevailing standard in the allocation of pins within a PC104 pin header.

Is there some differences between the PC/104 standard specifications (see above) and the PC/104 CubeSat specifications? Are the products on CubeSatShop fully PC/104 'Compliant'?   —

PC/104 "Compliant" refers to "PC/104 form factor" devices that conform to all non-optional aspects of the PC/104 specification, including both mechanical and electrical specifications. Most of the products on CubeSatShop are PC/104 "Bus Compatible": some specifications may differ slightly from the PC/104 standard specification (such as the position of the connector etc.), but a male or female PC/104 bus connector that meets both the mechanical and electrical specifications related to bus connector is provided. Moreover, there is no real "standard" in terms of the allocation of the pins used. Some differences may occur between different manufacturers and CubeSat products.

THE NEED FOR A WIRELESS INTERCONNECT

- If the amount of wiring and routing causes integration issues within the PC104 header, then what about removing the wires?

- Minimal Physical Connections → Minimal Physical Integration Issues

- Utilize a standardized protocol to communicate between subsystems

- Leverage existing modules to build examples

CUBESAT INTERCONNECT

- Provides a means for a CDH-centric architectures to allow the control and communication between subsystems.

- Allow multiple subsystems to communicate to one another in a distributed architecture.

- Provide power to multiple subsystems.

- Be flexible for many different designs.

Semi-Distributed Architecture (a)

Distributed Architecture (b)
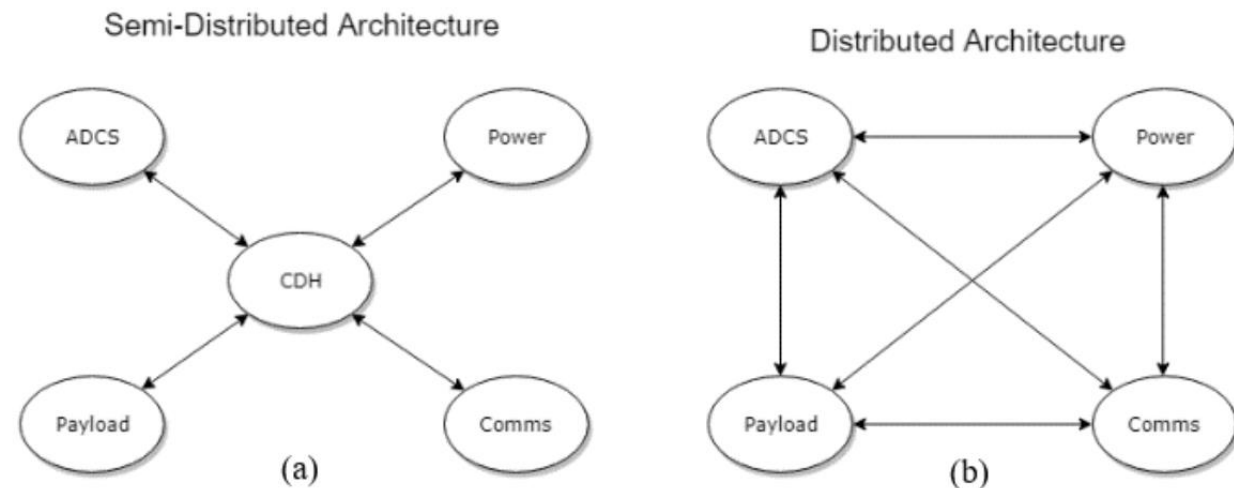
COPPER VS "ETHER": PC104

- Pros
  - Connection is reliable
  - Provides some mechanical benefit
  - De-facto standard in COTS subsystems
  - Can deliver signals and power

- Cons
  - Large Volume commitment
  - Signal routing can be difficult
  - Effectively fixed position on board if using COTS subsystem
 - Too many pins for some architectures
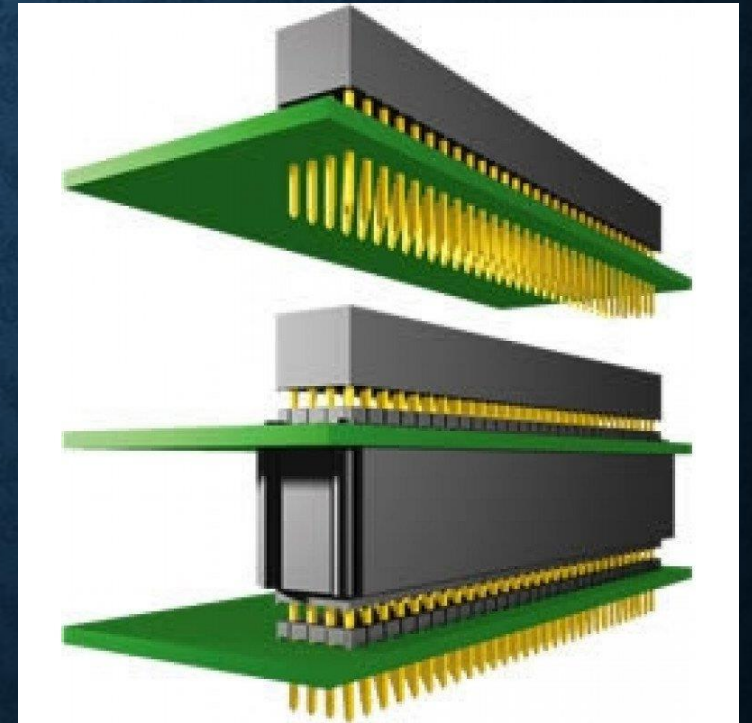
COPPER VS "ETHER": WIRELESS

- Pros
  - Existing standardized protocols
  - Low profile, small modules with simple routing designs.
  - Can provide information about the subsystem
  - Flexible for multiple architectures/physical designs.
- Cons
  - Requires power
  - Increased risk of failure
  - No method of power delivery
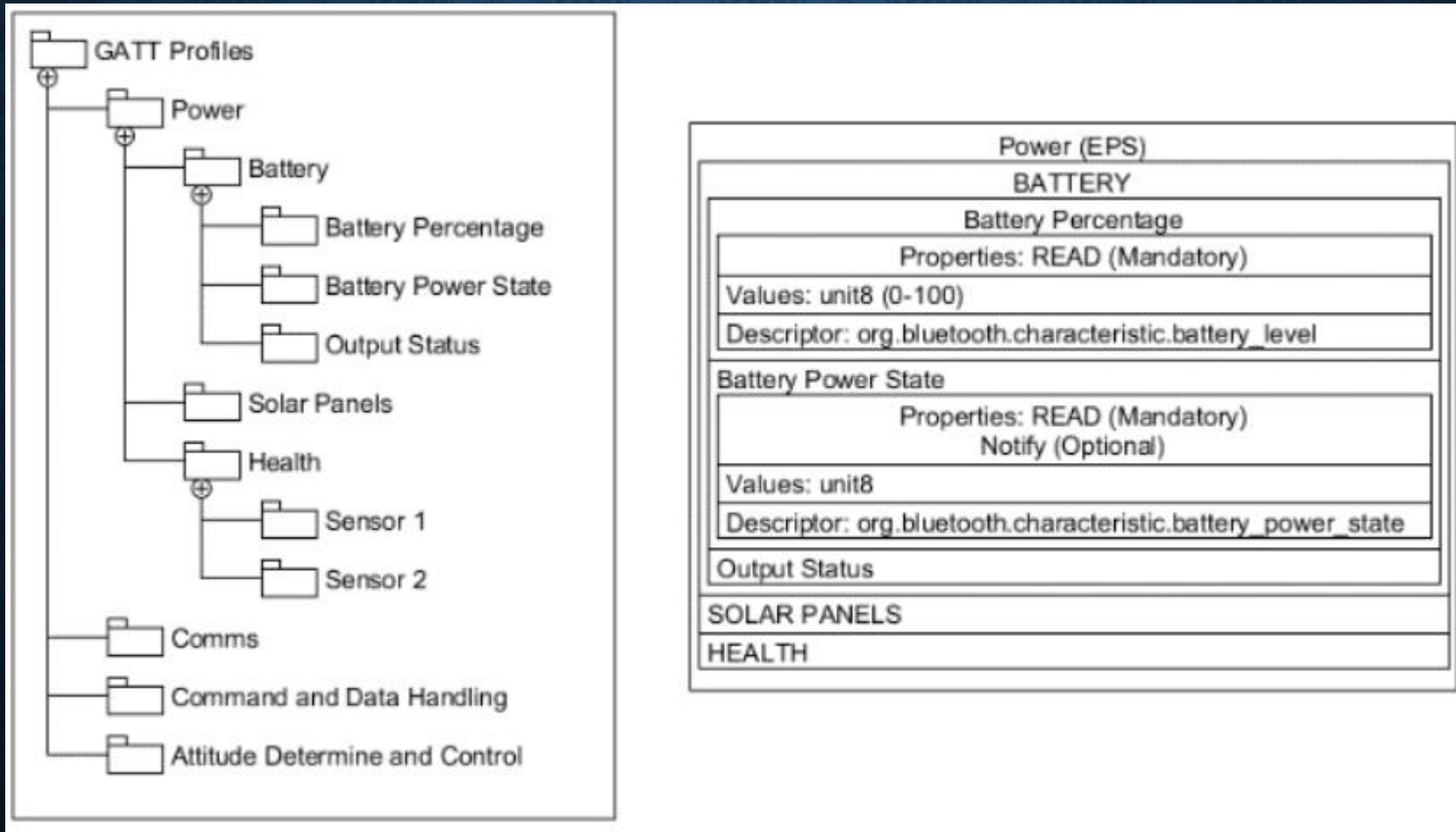 - Possible Licensing
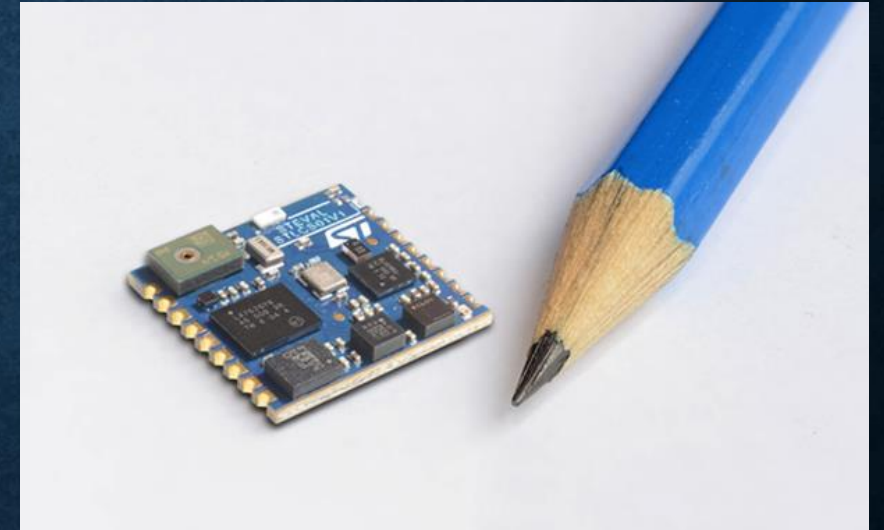
EXAMPLE: BLE WITH GATT

- Utilizing BLE for lower power consumption.

- GATT Protocol allows for specification of services and characteristics.

Payload   CDH   Comms

PROFILE
SERVICE
CHARACTERISTIC
CHARACTERISTIC
CHARACTERISTIC

SERVICE
CHARACTERISTIC
CHARACTERISTIC
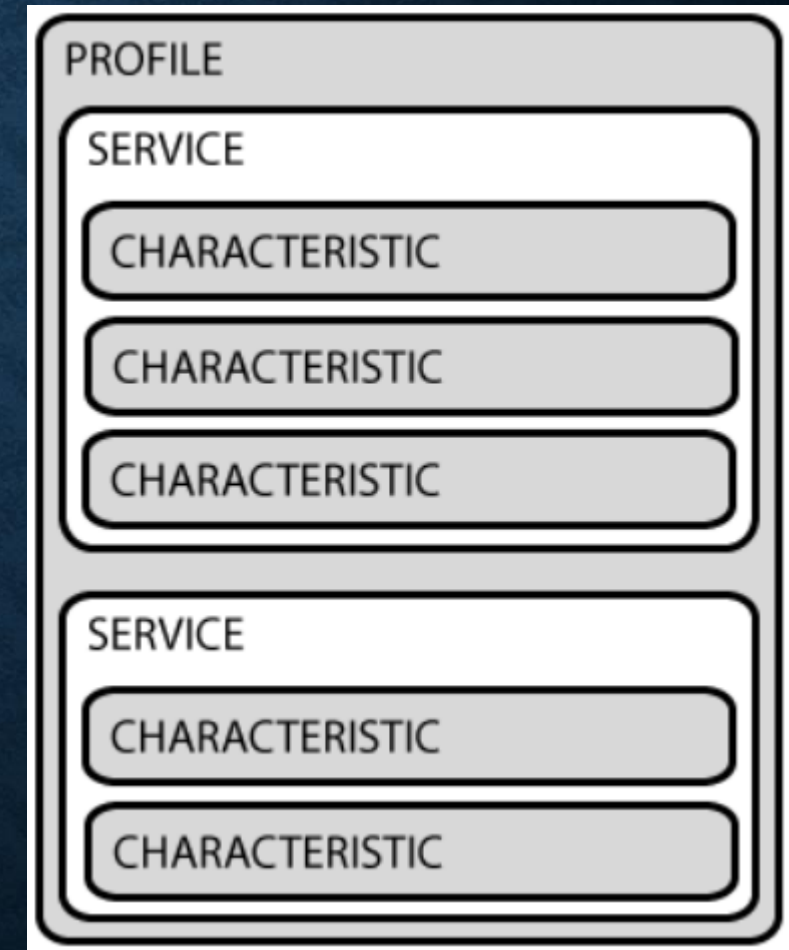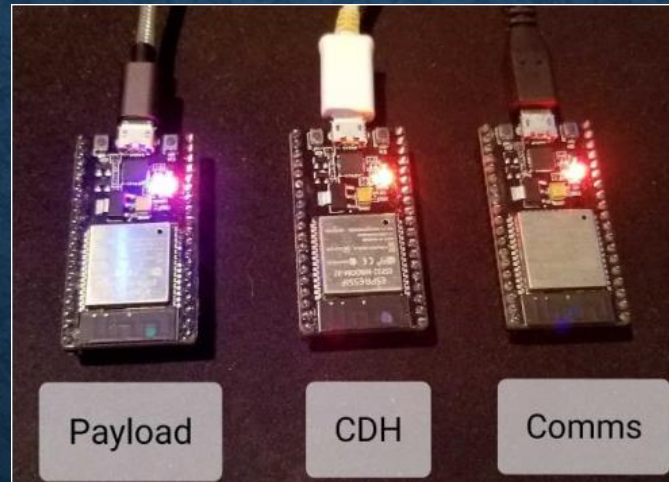
GATT CLASSIFICATION

FUTURE WORK

- Simplified CubeSat Physical Interconnect
  - Utilizing one or more common serial protocols to provide backup/redundancy.
  - Can be used to debug radio issues.

- Multi-master Architecture
  - In the event of a CDH failure, could another subsystem become CDH.

- Adaptable Architectures
  - Can a subsystem adapt based on the GATT profiles of other subsystems in the satellite.

QUESTIONS?