E-Truck Electrical Architecture

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The E-Truck Challenge

- The goal of this 4-year capstone project is to convert a class-7 diesel fueled medium duty Peterbilt 337 truck into a battery electric truck.
- We are cross collaborating with 3 other E-Truck capstone teams: **Controls** Architecture, Retrofit Packaging & Optimization (**Retrofit**), and the System Definition & Modeling team (**Systems**).
- We also collaborate with the E-Truck RSO.

Objective

- Create electrical schematics for the existing low voltage (**LV**) systems and high voltage (**HV**) systems.
- Design a new HV system with new BEV (**Battery Electric Vehicle**) components.

Assumptions & Requirements

- **650 - 800V** is our power requirement for our HV systems based on future 4-year BEV trend research.
- No modifications on current **12V** LV systems.
- **CCS1** charger port.
- **~400 kWh** battery capacity.
- **262kWh** total power consumption.
- Components are not finalized and subject to change based on requirements/design decisions.

Approach and Implementation

- The first step of this project was to gain familiarity with electrical vehicles by research and dissecting wiring harnesses and components in the truck to create a detailed bill of materials consisting of LV components.
- Component research focused on powertrains, batteries, and thermal management.
- We created the first iteration of a high-level block diagram shown in **Figure 1**.

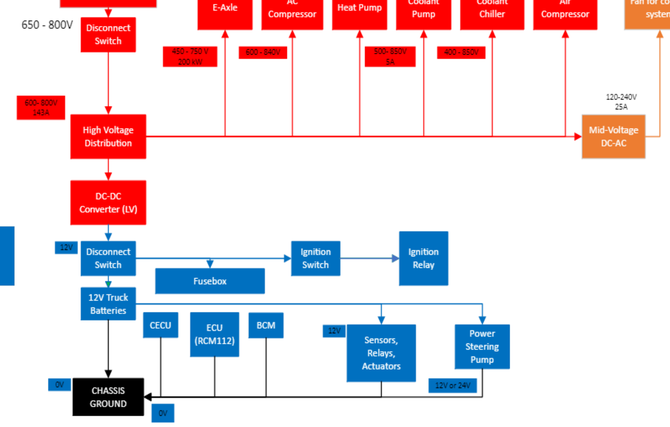

Figure 1: High Level Block Diagram

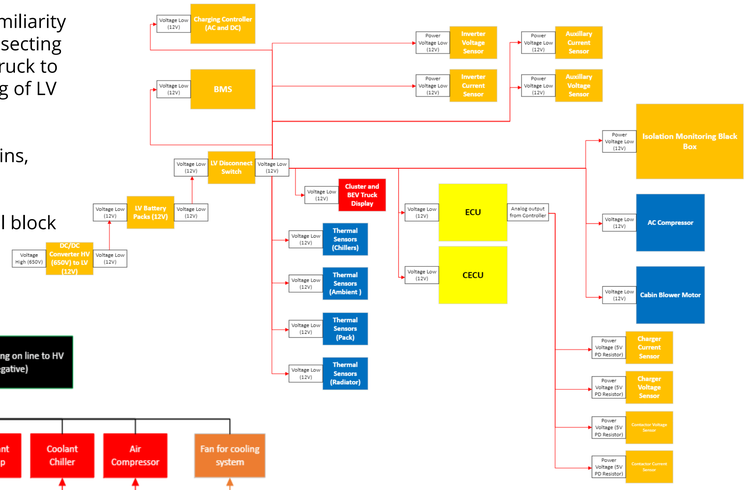

Figure 2: LV Distribution Diagram

- Our next step was to produce a detailed input/output list of every new component on the truck. This list included *Controller Area Network* (**CAN**) signals being sent between components as well as the inputs for power distribution.
- From our I/O list, we were able to produce our LV distribution diagram (**Figure 2**) and our HV distribution diagram (**Figure 3**).
- Finally, we began to consider the routing strategies needed for future years. Our high-level routing diagram is shown in **Figure 4**.

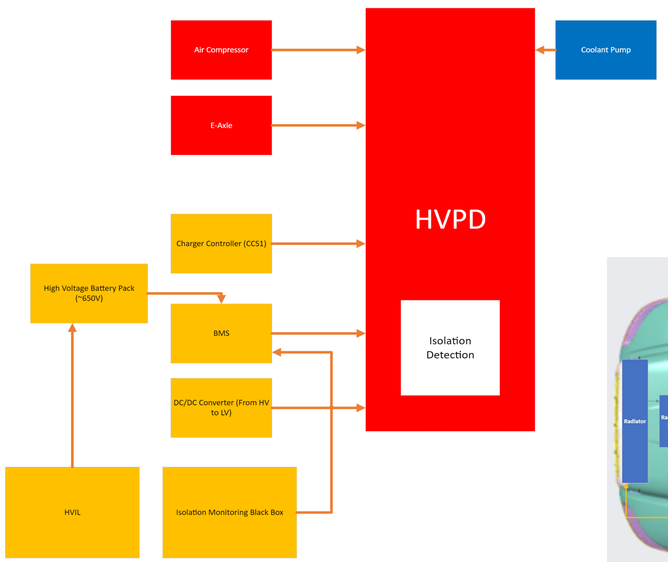

Figure 3: HV Distribution Diagram

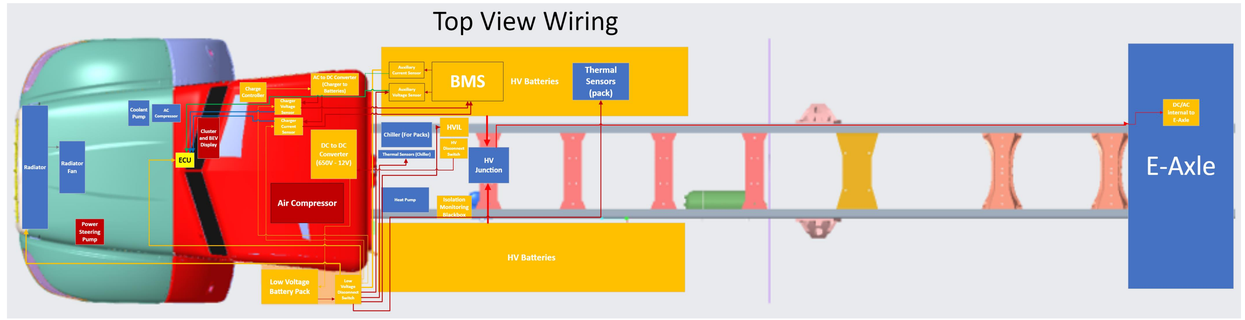

Figure 4: Routing Diagram

Verification

- Our team built a physical testbench prototype to verify our proposed CAN architecture which tests the continuity of analog and CAN signals through DB9 ports (**Figure 5**).

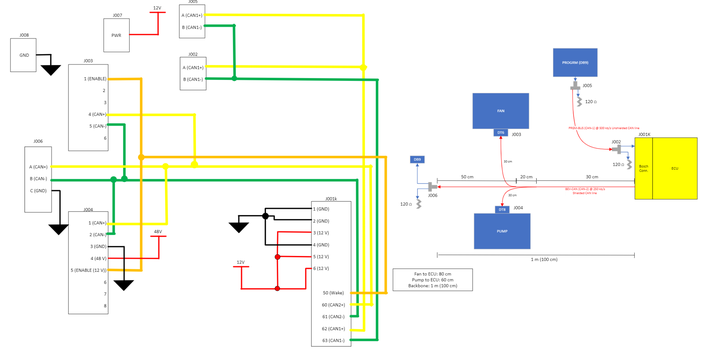

Figure 5: Prototype Testbench Diagram

Figure 5 shows an input/output for each pin (left) and a wiring schematic (right).

Challenges & Constraints

- 4-year project with an initial difficulty distinguishing deliverables between teams.
- Large amount of technical knowledge needed to create diagrams.
- Communication: four teams working together on one larger project.
- No defined list of new components; we were not able to include pin inputs/outputs in our diagram.

Future Work

- Build physical wiring harnesses for the truck's new EV components.
- Dive into routing methodology of selected components.
- Verification of connection between the controller and each component via testbenches.

References & Acknowledgement

- **Industry Mentors:** Shweta Hardas, Yudong Lin, Jeff Spaulding, and Stephen Oi
- **Faculty Mentors:** Professors Sep Makhsous and Per Reinhall
- **Teaching Assistant (TA):** Rose Johnson
- **All E-Truck Teams**: Controls, Retrofit, and Systems.
- **Retrofit** team for the 3D CAD model of the truck (**Figure 4**).

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