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Improving Traceability With IoT-Enabled Smart Trailers

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Problem Statements

- LTL carriers lack visibility of loads and the critical safety systems on board their trailers
  - LTL carriers would like to know where loads are picked up and delivered in real time.
  - Fleet owners and drivers need a solution that monitors trailer safety systems with a user-friendly driver inspection tool.

Industry Issues

- Lack of active load tracking
- 53% of all roadside disablements are for tire failures - 80% occur on the trailer
- Drivers are not performing pre and post trip inspections of trailers
- Department of Transportation (DOT) Inspections
- Braking system failures cause 36.1% of accidents

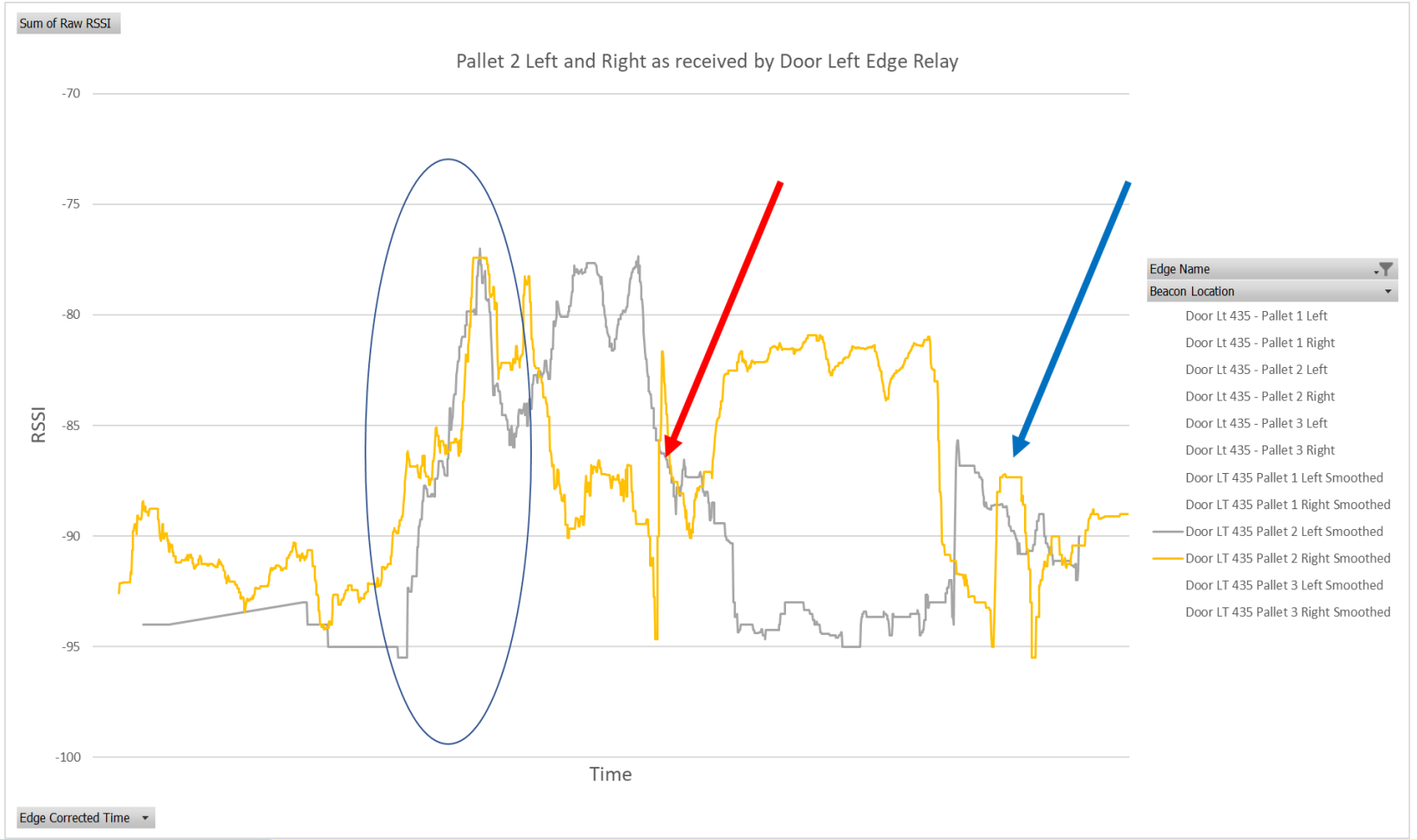
Load Tracking

- Research completed last Spring
  - Paper awaiting publication
- Bluetooth® enabled pallets of beer
- Door threshold detection
  - What is on the dock?
  - What is on the truck?
- Positioning

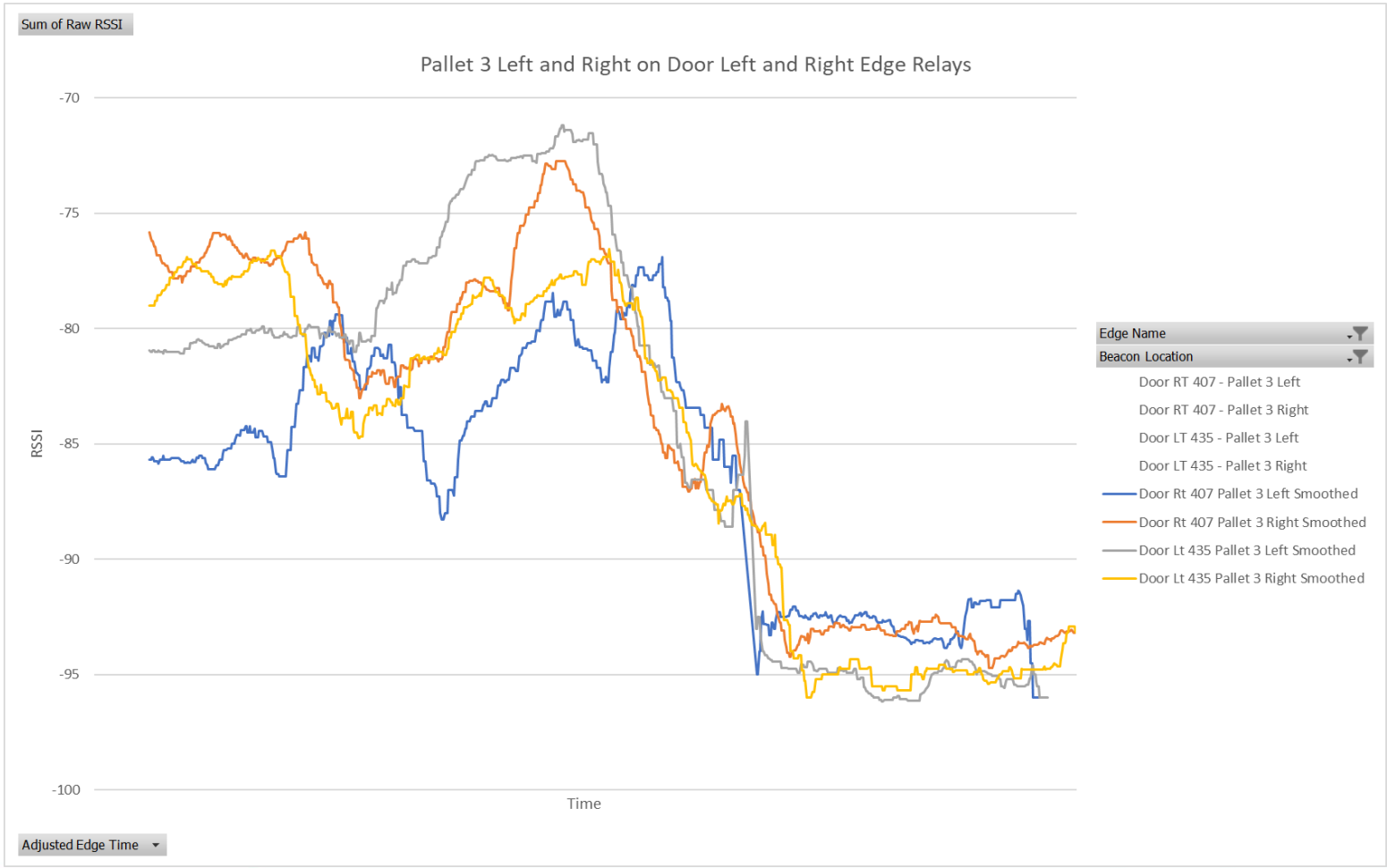
Threshold Detection

- Placed 4 Bluetooth® Readers in a trailer
  - Two inward facing at the door
  - One central
  - One in nose of trailer
- Movement of material on and off the trailer
- Promising results

Loading of pallets



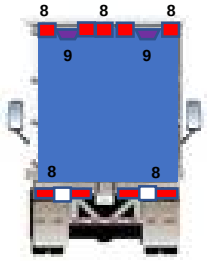
Unloading of Pallets

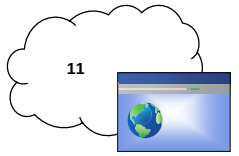


Trailer Monitoring

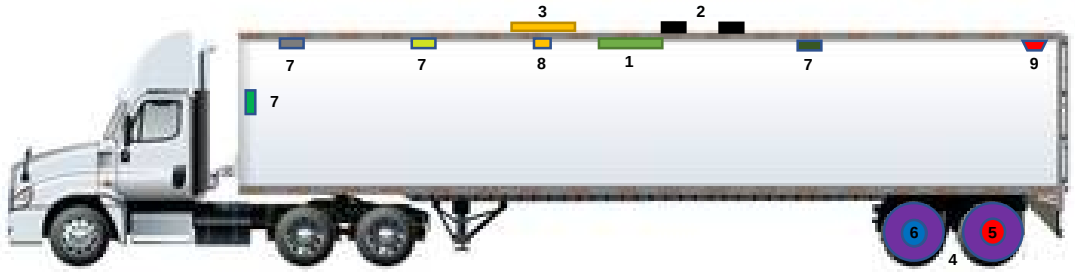
- Monitor safety systems
- Gather events
  - Door open
  - Movement in/out of cargo
- Communicate with driver
- Communicate with maintenance department

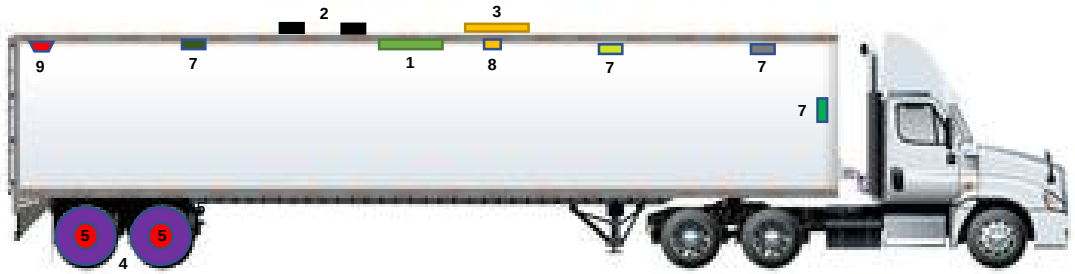
1. IoT Gateway
2. Antennas – LTE & GPS
3. Solar Panel
4. Tire Pressure and Temp
5. Brake Air Pressure and Temp
6. Hub Odometer
7. Sensors
   a) Temperature
   b) Humidity
   c) Barometric Pressure
   d) Motion
   e) Shock
   f) Acceleration
   g) Presence of Cargo
   h) Motion of Cargo
   i) Door Open/Close
   j) Tilt
   k) Location (GPS)
   l) Additional Sensors
8. Trailer Lights
9. Portal for Load Monitoring
10. Driver Application
11. Web Application

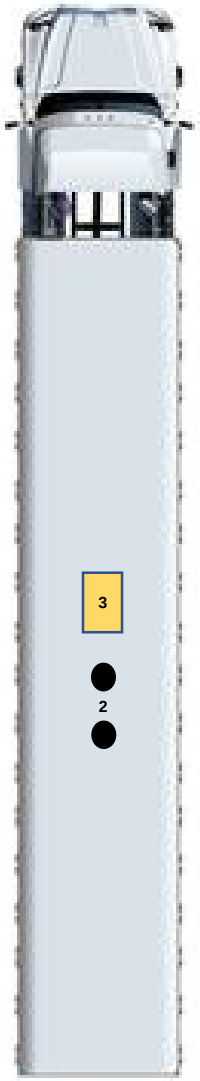




User Interface







Research Challenges

- Off-the-shelf Bluetooth® beacon sensors
  - Not generally available
  - Some proprietary sensor devices in the market
- Bluetooth® Readers
  - Not industrialized
  - Not Optimized for solar power
- LTE Carriers are slow to approve new LTE M1 modules

Research Approach

- Bluetooth® Technology
  - Bluetooth® beacon technology was chosen because of RF range and opportunity to create sensors
  - Relatively inexpensive
- Trailers have to be autonomous (LTE, solar, GPS)
  - There are 4 trailers in the US for every power unit
- Google IoT Core/Google Cloud
  - Existing IoT platform
  - Powerful

Research Status

- Team of 7 undergraduate students
  - Computer Science
  - Electrical Engineering
  - Mechanical Engineering
  - Mechatronics Engineering
- Developed a prototype of the system
  - Sending MQTT packets to Google IoT Core
  - Developing sensors with Zephyr RTOS on Nordic NRF 52840
  - Creating a Bluetooth® Gateway w/solar, GPS, LTE-M

THANK YOU

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