Industry Session 5: Energy Harvesting

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Power Sources Manufacturers Association
The Multinational Power Electronics Association

Vibrational energy harvester system integration use cases & commercialization considerations

Presented By

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Introduction

- Wireless Sensor Nodes (WSN) have exceptional benefits for IOT
    - Power with Batteries or Energy Harvesters
- Maintenance Free Energy Harvesters are viable in many applications
- EH eliminates the reliability and maintenance issues of batteries
- Examples of successful high volume applications

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I.o.T. Characteristics

- Sensor
- Microprocessor
- Self Powered - Energy Harvester (no batteries)
- Mobile Platform (to make it more difficult)
- Wireless Data Transmission to Cloud Server
- Automatic alarms
- Information available over the internet

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Energy Harvesting Requirements

- Suitable source of energy to be harvested
  - Vibration
  - Light
  - Heat
  - Transmitted Power
- Power Management
  - Extraction of Power from Harvester
  - Energy Used by WSN
- Duty Cycle Energy Storage

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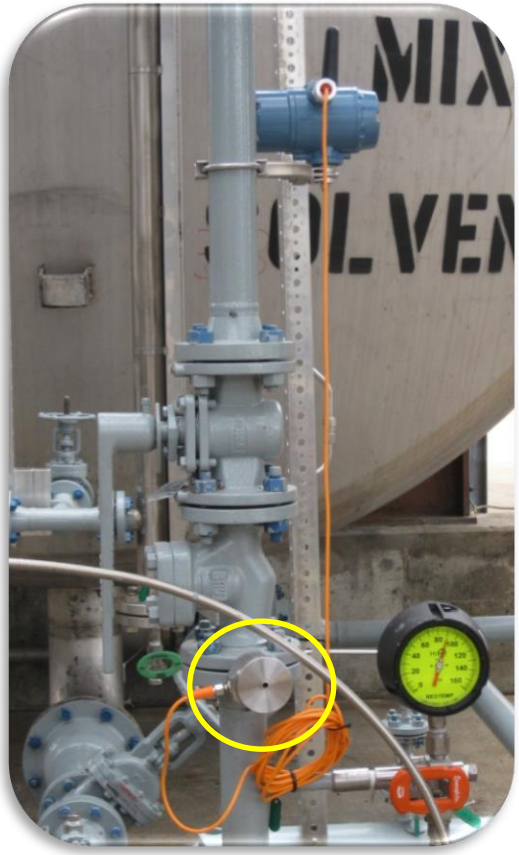
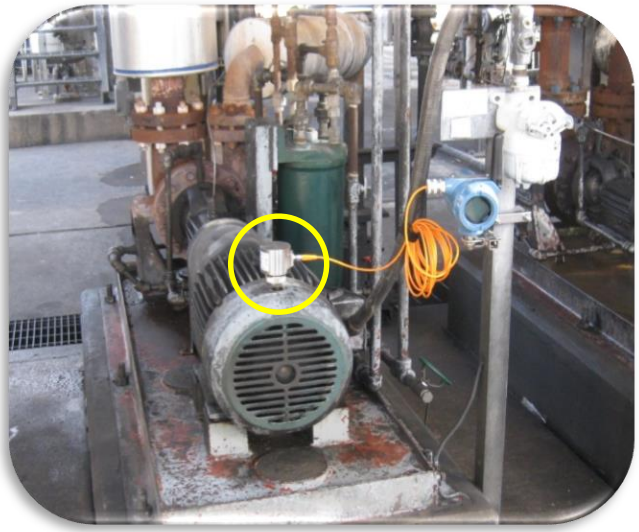
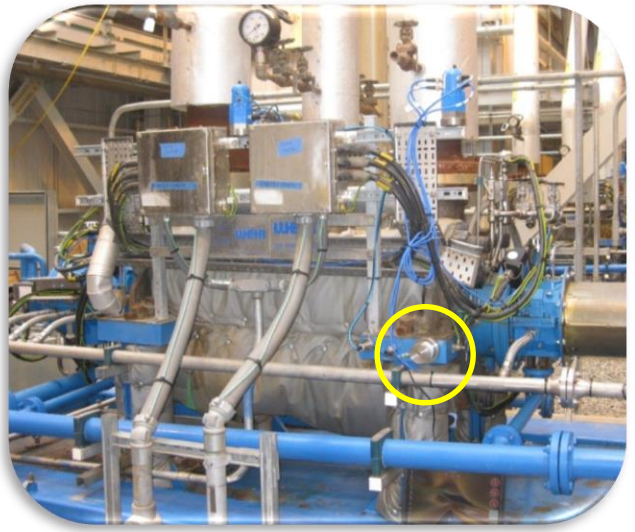
Example Installations – GE, Emerson WSNs







mW to Monitor MW - Power Generation Plant

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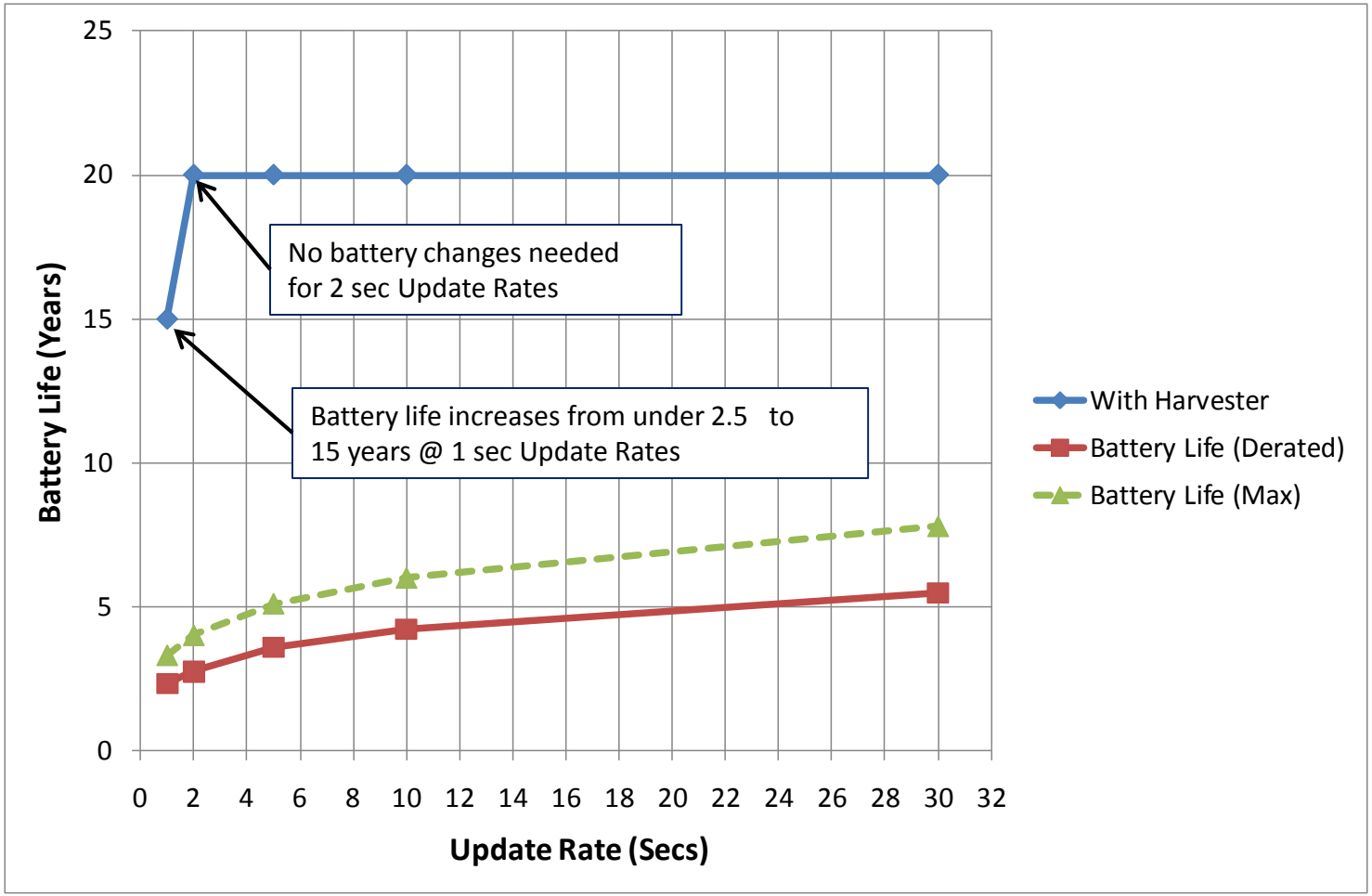
Impact of Using Harvesters



Important Improvements using Energy Harvesters

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System Design Steps

- Select Energy Source
  - Thermal
  - Vibration
  - Solar
  - etc.
- Determine Power Required
  - Duty Cycle Energy/Frequency
- Laws of Physics?

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Harvester Interchangeability

- WSNs can be powered by different types of EH
- Needed Interchangeability
  - Isa 100.18 Power Sources for WSNs
- Now IEC 62952Power sources for a wireless communication device –
  - Part 3: Generic energy harvesting adapter module published June 2017

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Intelligent Power Module

Enables interface of WSN wireless transmitter to multiple external energy harvesting sources and 24V DC power.

Standard OEM Battery Module (Emerson)

Energy Harvesting Adaptor Module

Integrate GEHAM into OEM Battery Module

Intelligent Power Module (IPM)

- **Capability:** Battery powered WSN's to use external power sources
- **Flexible Voltage:** Wide range of input voltage levels: 8V – 24V.
- **Power Available:** Integrated robust capacitive storage
- **Intelligent:** Intelligent Power Management circuitry
- **Safe:** Intrinsic safety designed in. Zone 0, Class 1 Division 1
- **Convenient:** Same form, fit & function as original OEM battery module
- **Economics:** Eliminate battery change costs & logistics for > 10 years

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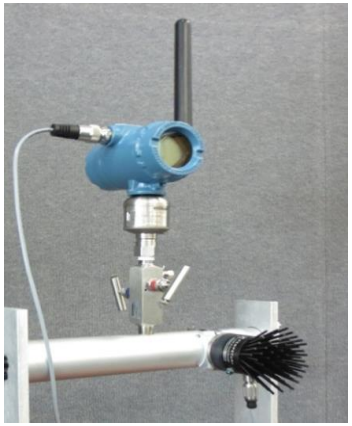
PERPETUA®

Power Puck® Energy Harvesters

Power Puck®
Model 9-IS

Thermoelectric power solutions for

Emerson Rosemount 3051S Transmitters



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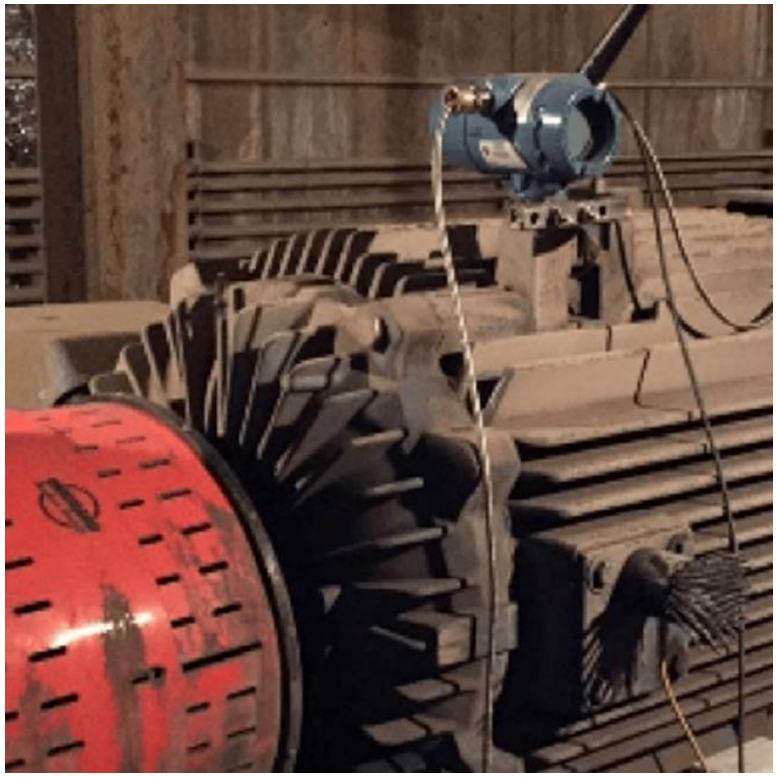
Thermal Harvester Applications



Design Issues

- Extracting Sufficient Power
  - Max Power Point Tracking
  - Rectification
  - Impedance
- Energy storage
  - Charge/discharge cycle life
  - Storage life
  - Capacity
  - Leakage
  - Temperature range

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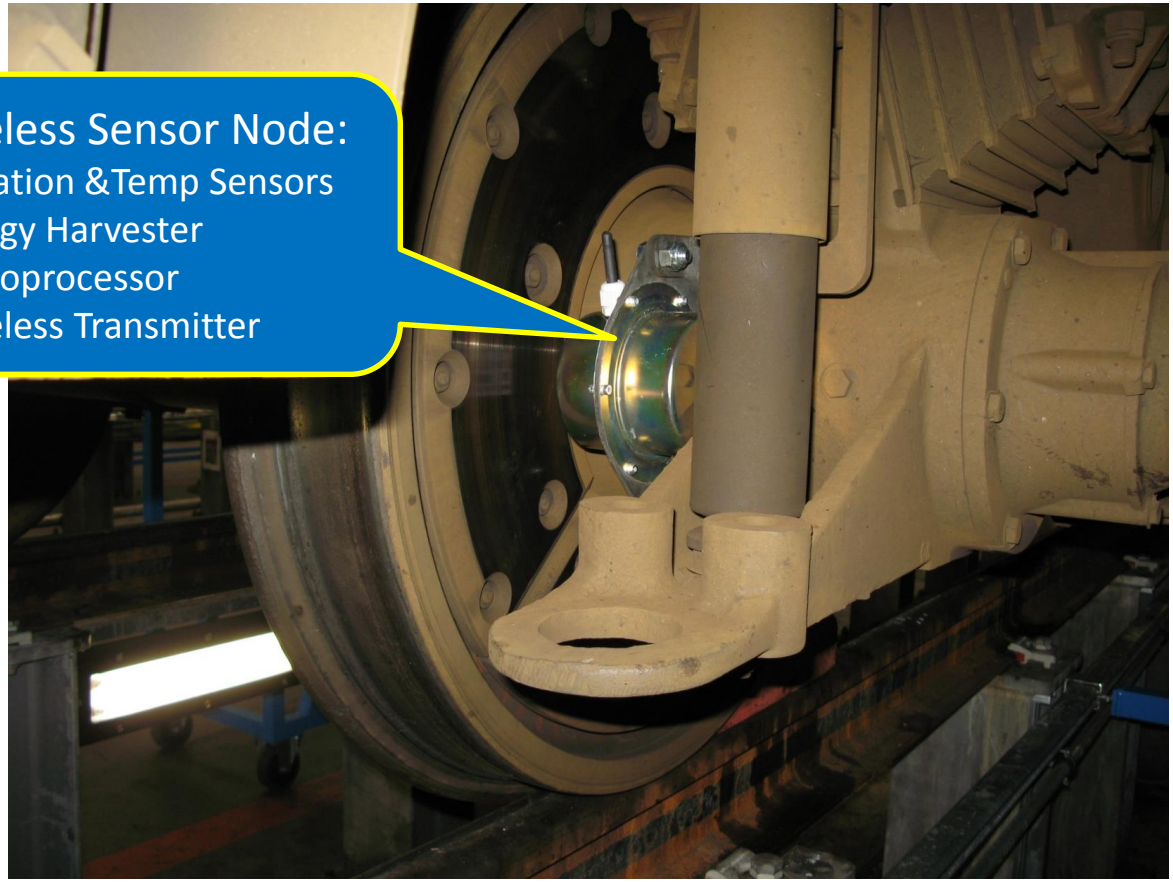
Challenging Application - Trains



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Objective – Condition Based Maintenance

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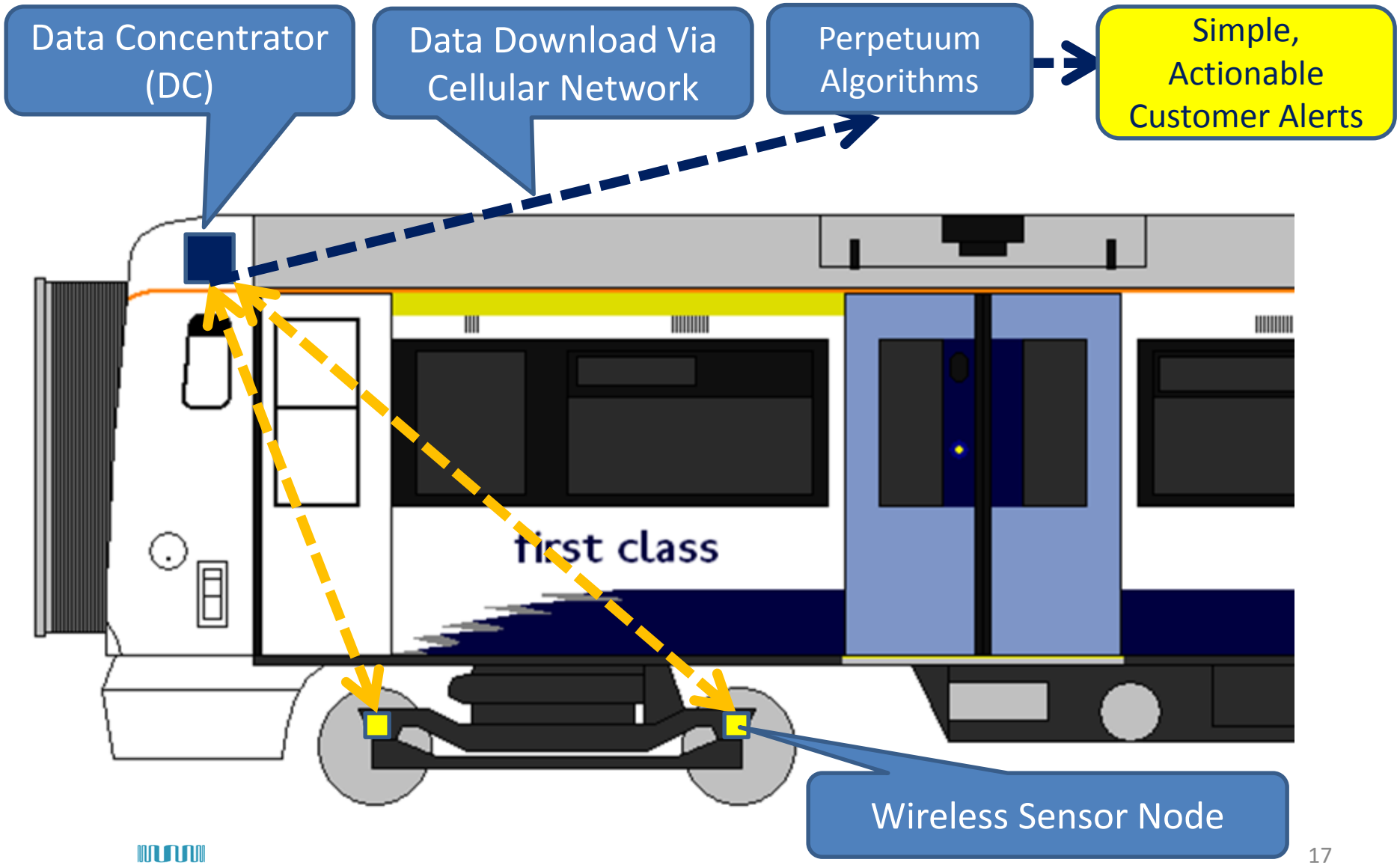
Higher Power Implications

- Mature Energy Harvesting Technology
  - High harvested power
  - Reliability in high shock environment
- High power enables Rich Data
  - Frequent measurements to give better trending for fast & accurate fault identification
  - Margin for when train is slow moving of stationary
  - Better positional accuracy
  - Better safety and reliability of the rail network
- High power provides Future Proofing
  - Provision of channel for additional 3rd party sensors
  - More data transmission to server allows better algorithm development
  - Spare power for future applications

Communications



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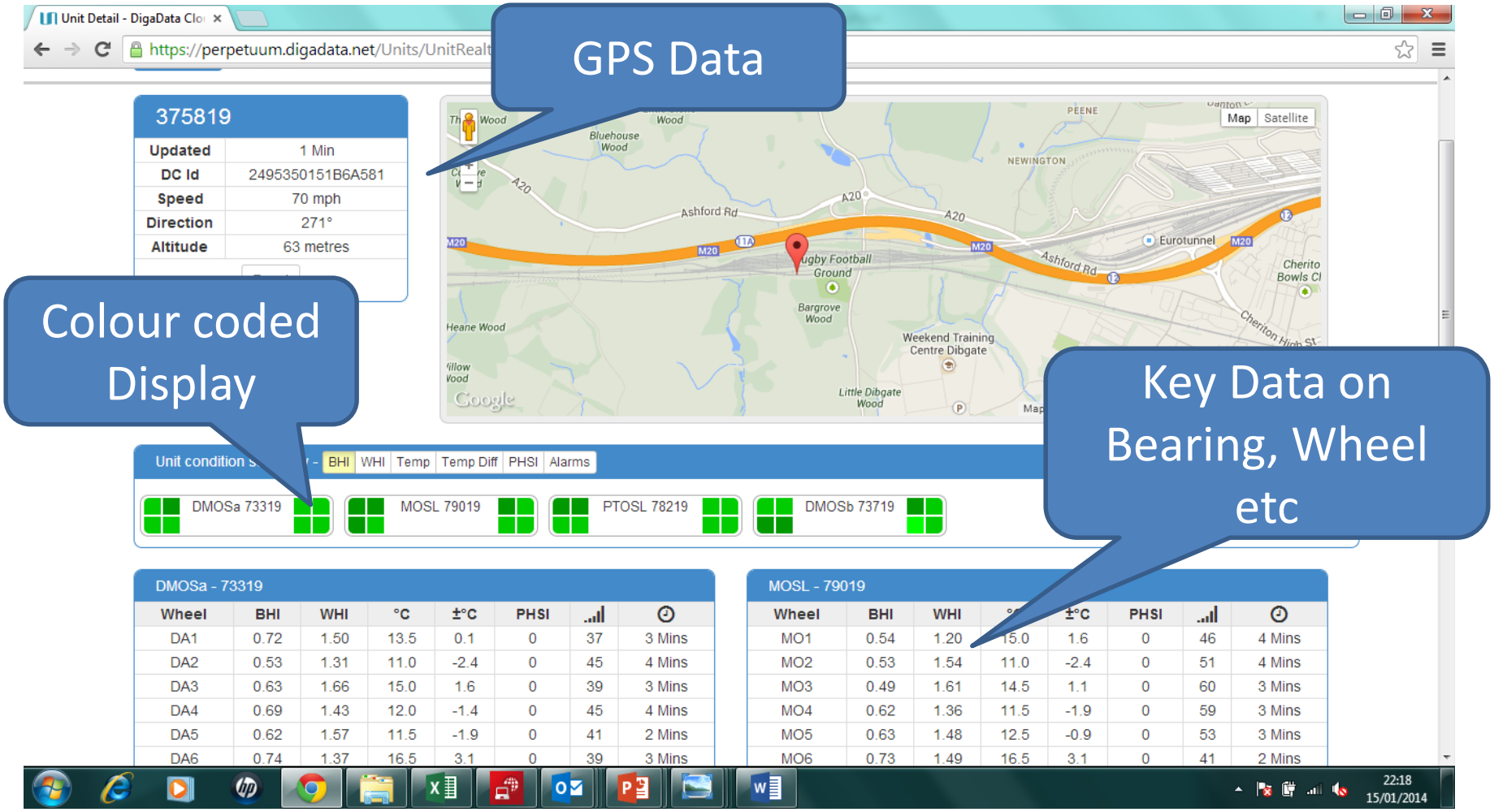
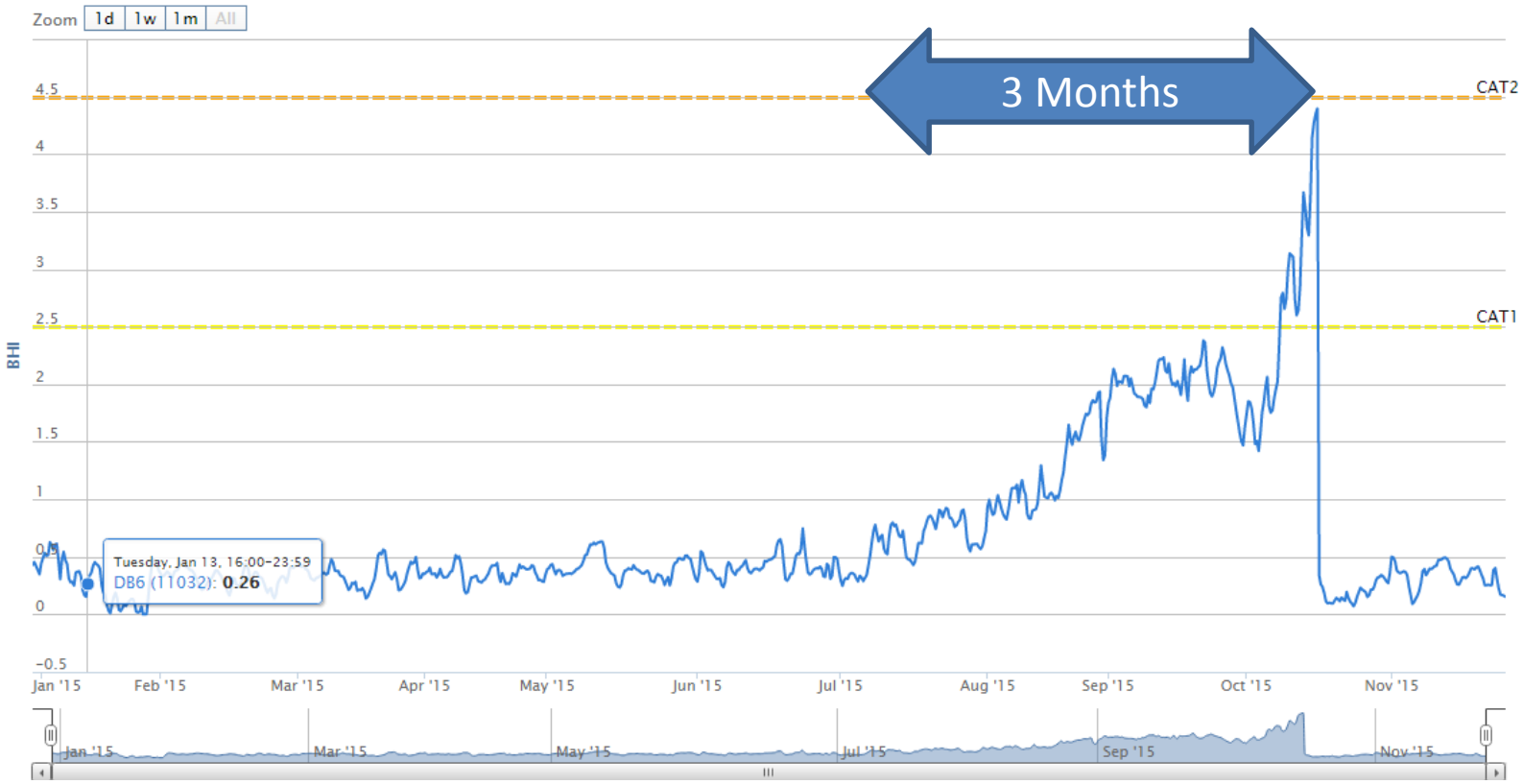
Simple Display of Key Information



Bearing Degradation



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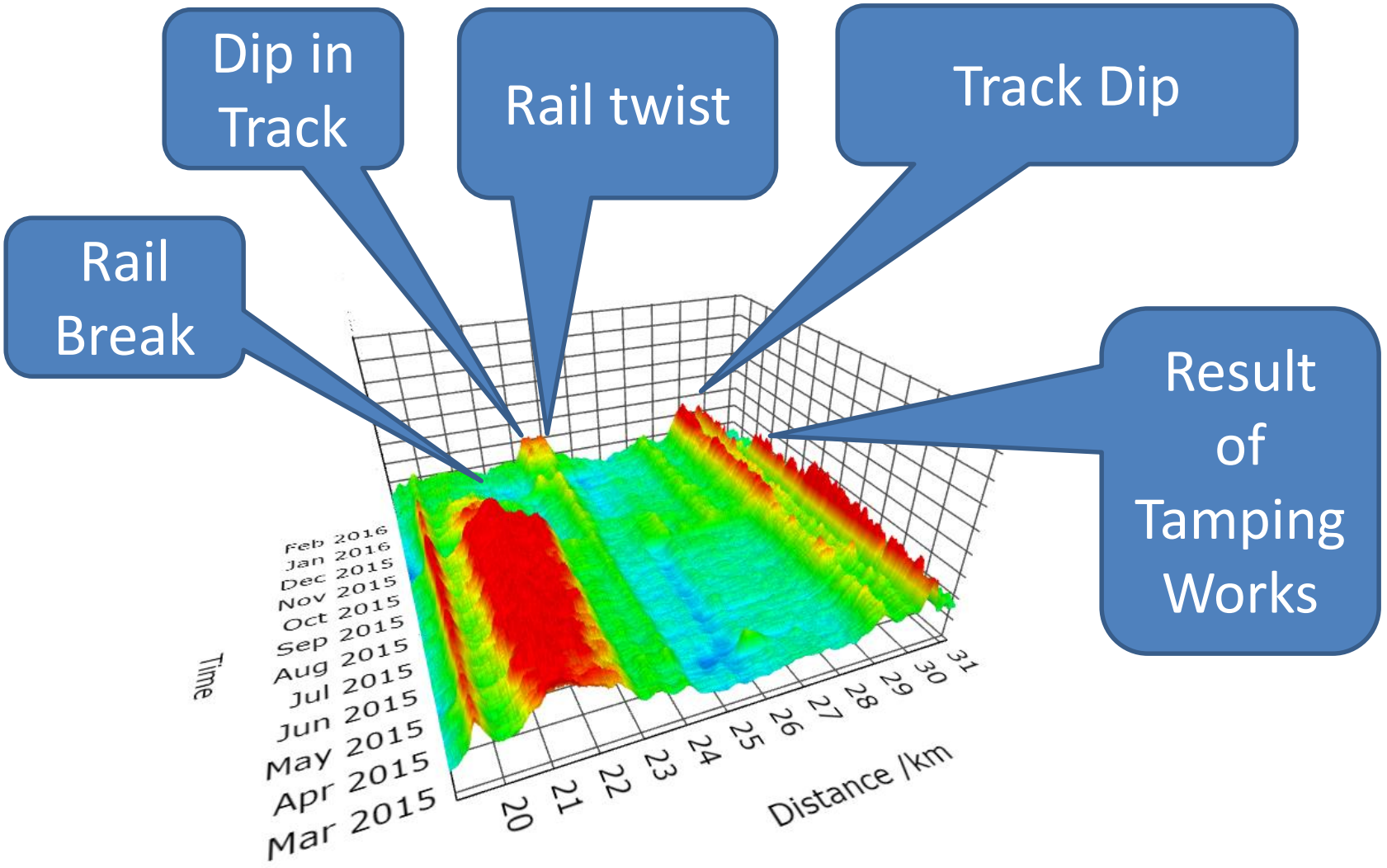
Track Features



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Live Monitoring on Trains

- Axle Bearings

- Wheels

- Gearboxes

- Traction Motors

- Track

- Cows

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Energy Harvesting

- Now mature technology
- High Volume Applications
- Maintenance Free I.o.T.
- Keys to Success
  - Adequate Power Generation
  - Management of power
  - Storage of Energy

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Cow on Track – Train in Field