

# IoT and Big Data

**BNSF Railway**

Sunny Bajaj

# BNSF at a Glance

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32,500 mi of track

28 States/ 3 Canadian Provinces

1600 trains/ day

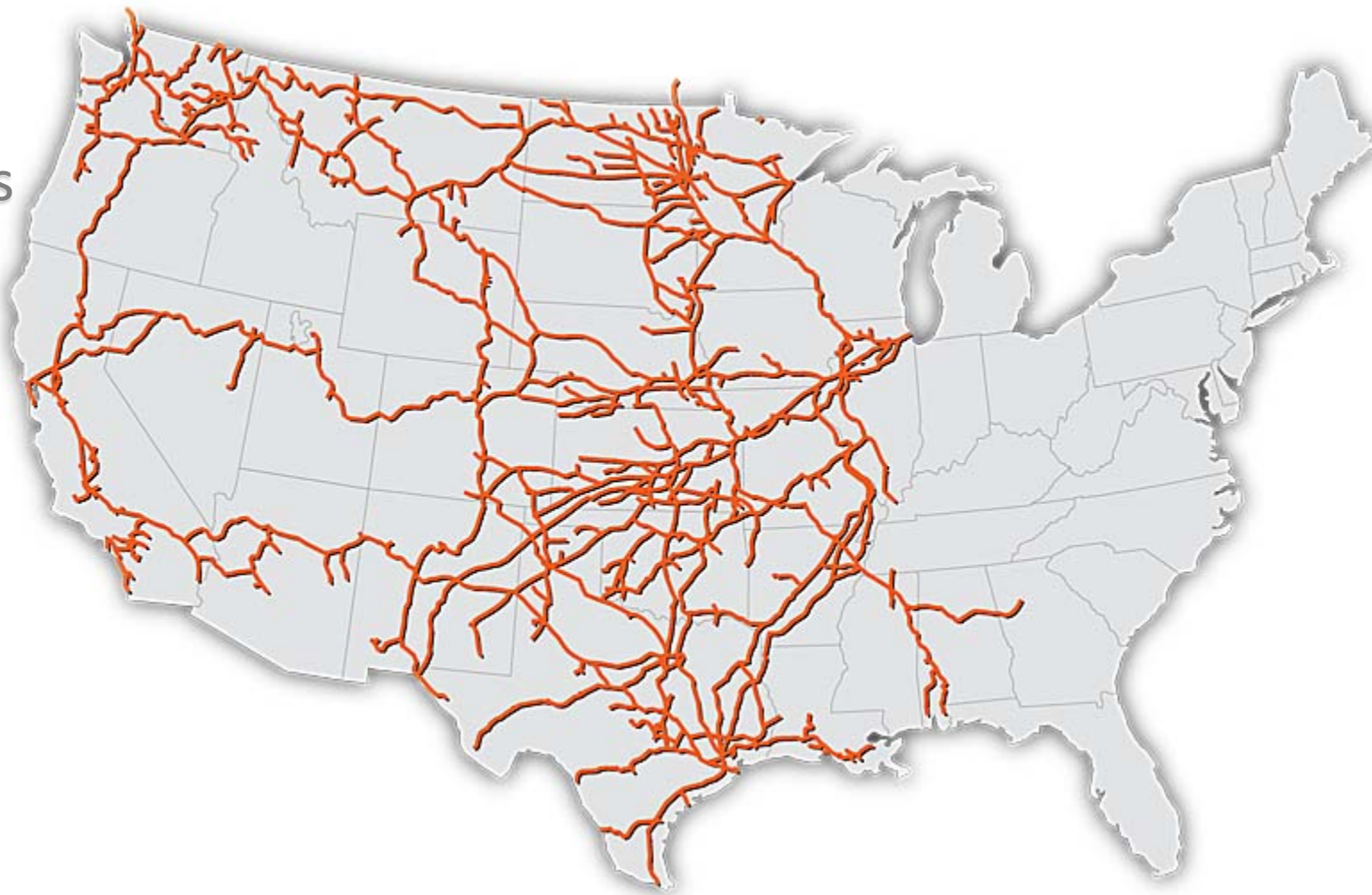
8000 Locomotives

13,000 Bridges

89 Tunnels

25,700 Grade Crossings

10m Carloads Shipped in 2014



# Internet of Things

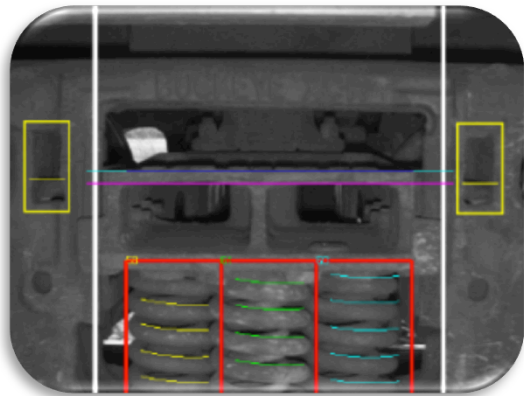
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## Wayside Detectors

# Why Wayside Detection?

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- Improve **Safety, Availability, Reliability and Velocity** of rolling stock
- Augment manual inspections
- Reduce train delays associated with setouts
- Proactively identify “Bad Actors”



# Detector Types

## 5 Types of Technologies

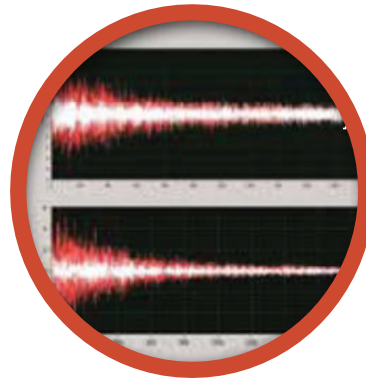
13 Types of Detector Systems

2000+ Individual Detectors



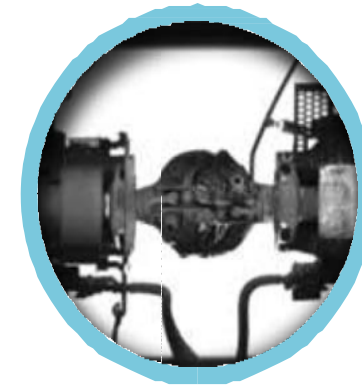
### Infrared Technology

*Excessive friction in wheels and bearings generates elevated temperatures that indicate a defect that, if not addressed, can result in catastrophic failure.*



### Acoustic Sensors

*Harnessing sounds of a target component as it operates under load and speed can provide early warnings about defects in a component that may not be visible, like a crack or an internal defect.*



### Vision Cameras

*Recording images of components operating at track speed is proving an effective and modern way to spot defects that are hard to identify while a car is sitting in a yard.*



### Force Detectors

*It is normal for railcars to impart stable and balanced forces to the rail, but excessive impact forces or imbalanced forces in curves or straightaways indicate issues that may result in component damage or derailment.*



### Laser Technology

*Measuring position of components can provide useful information. Most recently, this information is being used to plan maintenance for locomotive wheels that require attention and to monitor freight-car braking capabilities.*

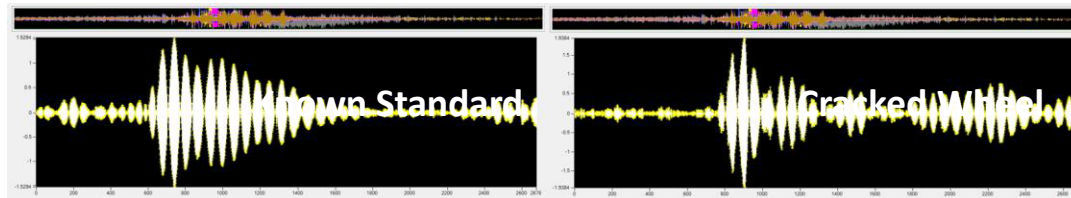
# Detector Examples



- **Acoustic Bearing Detector (ABD)**  
– acoustic systems used to evaluate sounds generated by specific bearing component defects



- **Hot Box Detector (HBD)** – evaluates bearing temperature history for statistical outliers; brake issues, burned off journals



- **Cracked Wheel/Axle Detector (CWAD)** – Rail mounted sensors capable of detecting the difference between tones generated by normal vs. flawed wheels and axles

# The Results

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300%\* reduction in Mechanical-caused reportable train derailments

\* Since 2000, normalized by train miles

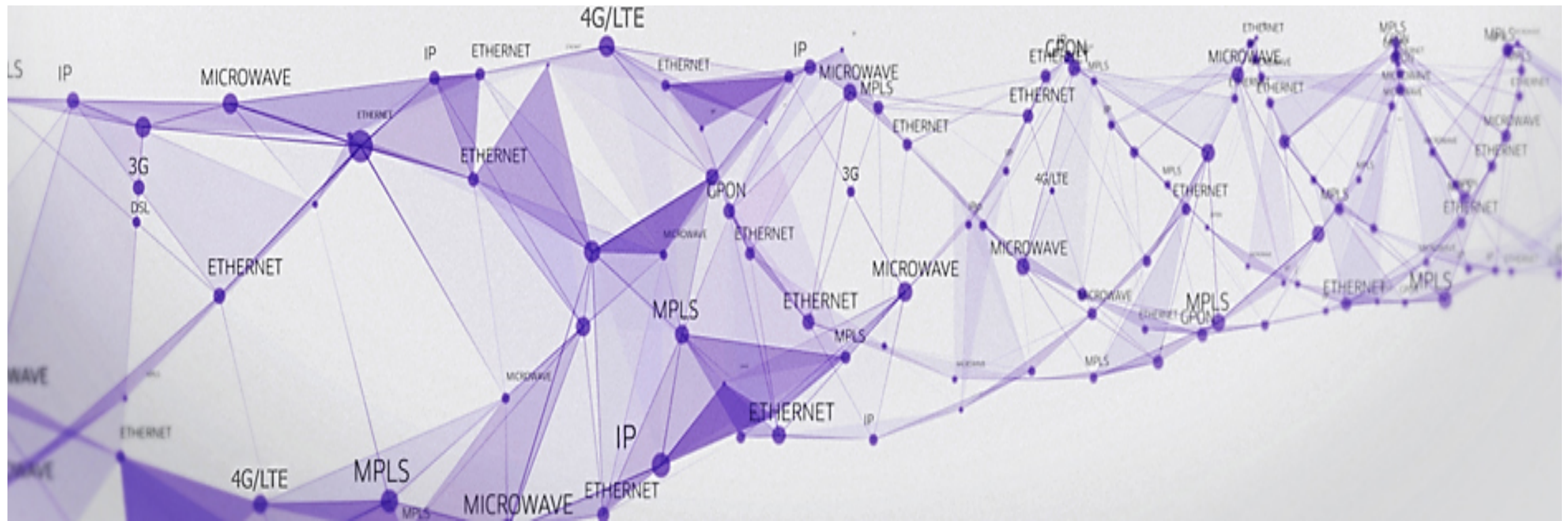
# Internet of Things

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## The Connectivity



# The Connectivity



**Establishing a Big Data Platform...**

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**and Exploring the Possibilities...**

# Big Data Platform – Any Data, Any Where, Any Time

Analytics



IBM InfoSphere BigInsights  
Bring the power of Hadoop to the enterprise.



WEKA, R, etc.



Standard Reporting

Data



Predictive & Prescriptive Analytics

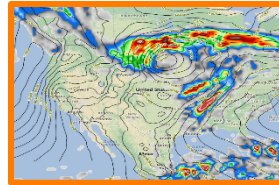
Sources



Mechanical Detectors



Engr. Geo Cars



Weather



Drones



Asset Mgmt



Industry Data



Discovery



Visualization



Video & Audio



Structured Data



Internet & Log Data



Real-Time Streams

# Potential Business Applications...



## Business Case

What is the impact of weather on Detector readings?



What is the correlation between Track Quality and Truck/wheel condition?



Can we predict engineering track defects in advance?

## Analysis

Map weather patterns and history to BNSF Network. Use Detector data to run predictive models.

Use Geo/Detector Car & Mech. Sensor data to determine correlations

Combine Geo-Car EAM and drones data to predict engineering track defects in advance

## Platform

Hadoop  
IOC  
DB2  
SAS/R/SPSS

Hadoop  
IOC  
DB2  
SAP  
SAS/R/SPSS

Hadoop  
GIS  
Teradata  
SAS/R/SPSS