



ERDM240 DYNAMIC RAILWAY DIAGNOSTIC SYSTEM

# European Railway Vision 2050

## Strategic goals of operators

- Increase productive utilization of assets
- Increase safety
- Increase reliability, availability
- Reduce total cost of ownership
- Optimization of maintenance

## Intelligent asset lifecycle management

- Self diagnostic and self healing assets
- Real time monitoring of asset health
- Predictive maintenance data for decision making
- Artificial Intelligence and Machine learning

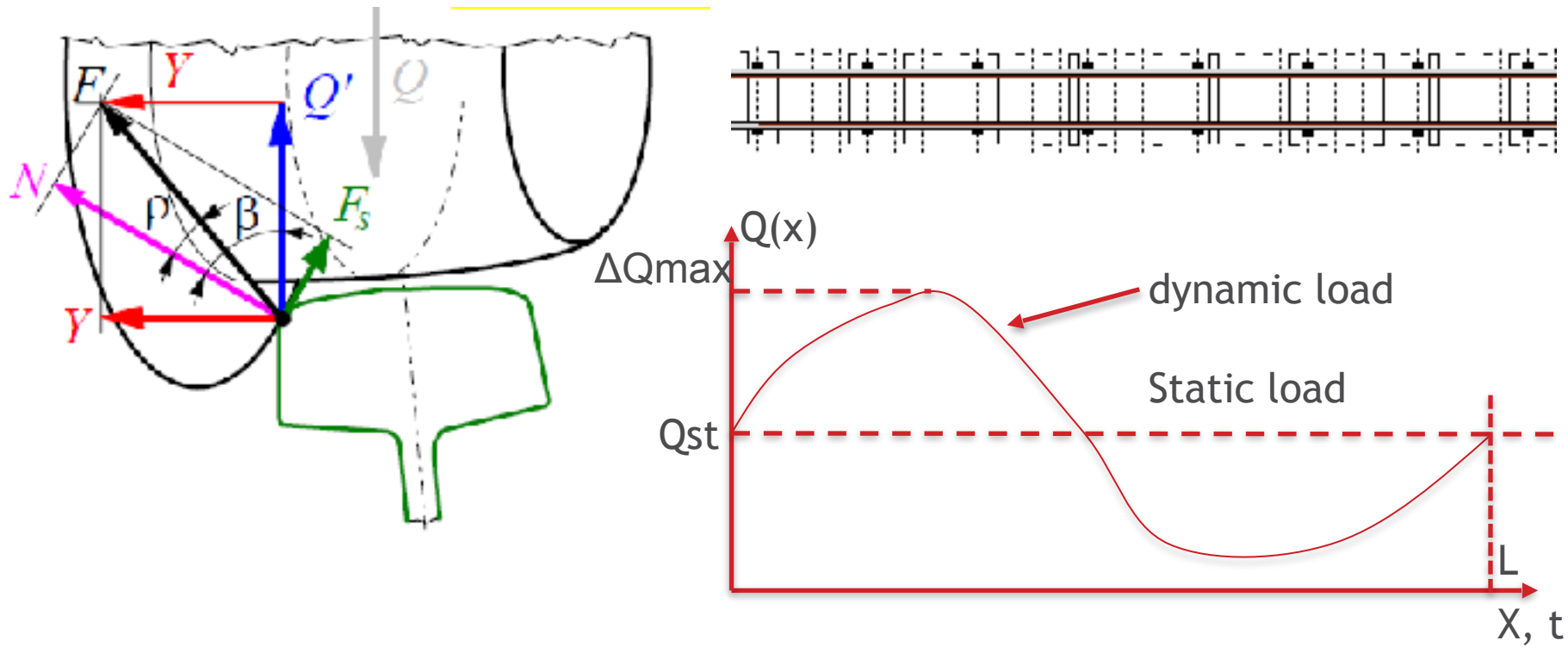
## Digitalization

- Instrumentation of assets
- Sense, detect, transmit data
- Secure reliable ubiquitous networks
- Internet of Railway Things
- Distributed cognitive computing

<https://errac.org/publications/rail-2050-vision-document/>



# Dynamic load measurement (wheel impact load)



- $Q(x(t))$  measurement for each wheels
- $Q$  static load calculation on the a measurement section
- dynamic load calculation

# Impact of monitoring on the safety

## Risks leading to derailment

- High dynamic loading -> increase of track defects
- Uneven and Overloading -> failures in switches
- Track geometry problem + significant asymmetric loading causes derailment
- Flat wheels, oval wheels
- Bogie suspension problems

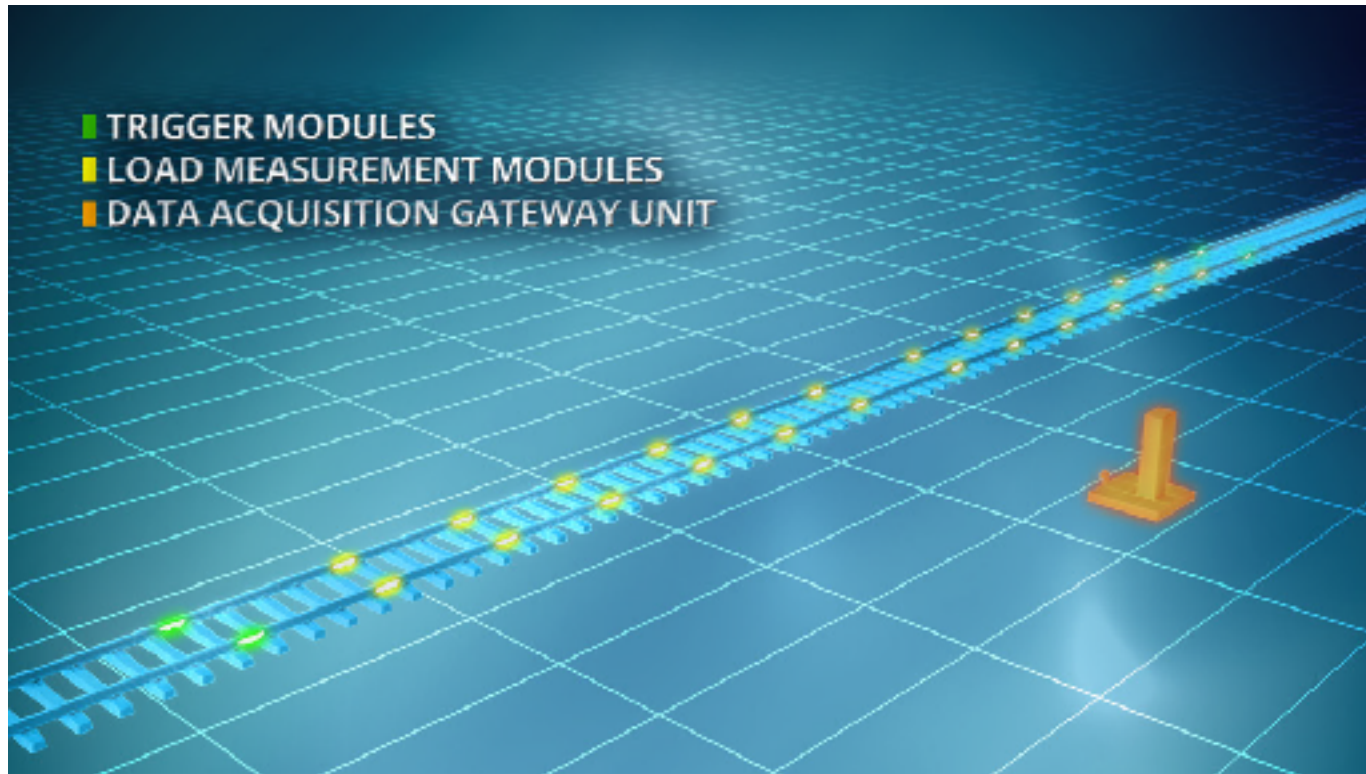
Cause	Monitoring method	Reduction of derailment
Wheel defects	Dynamic load measurement	10.3%
Incorrect loading	Dynamic load measurement	5.9%
Carriage problems	Dynamic load measurement	5.6%

Using **Dynamic Load Measuring** systems  
20 % of derailments  
can be prevented.

eRDM Dynamic load measurement system

eRDM240 system

High speed in-motion load measurement



Innovation Grand Prize  
2015



Hungarian Product Prize  
2014

# eRDM240 main parameters

## ■ Measured parameters

- Wheel load 10 kN...400kN or 40t
- Axle load 20 kN...800kN or 80t
- Wagon load
- Wagon load meas. accuracy: 2%
- Speed meas. 1%
- Train speed: 5km/h ... 160 km/h
- Rail type: 48, 49, 54, 60

## ■ Train identification

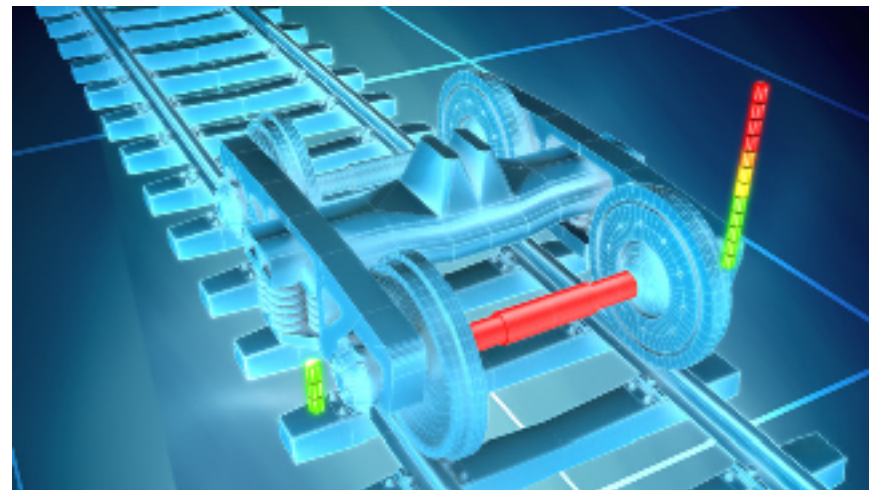
- High resolution digital load response
- Remote operation and diagnostics
- Integration into operators IT system



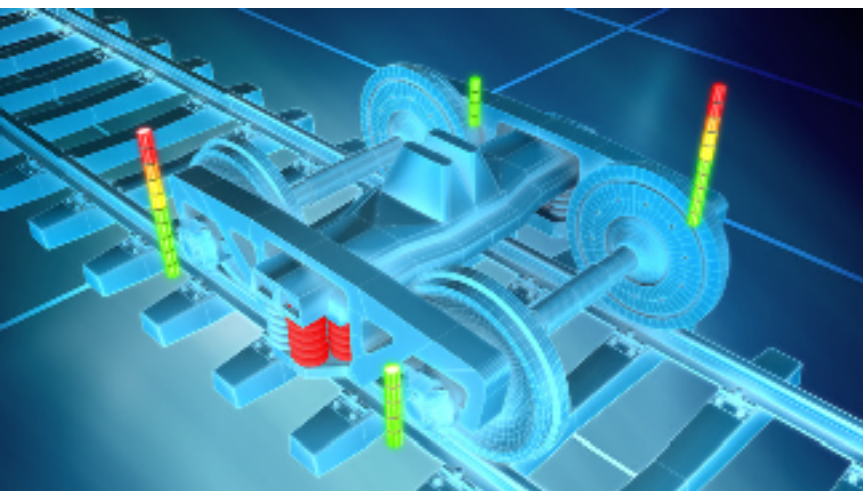
# eRDM240 diagnostic features



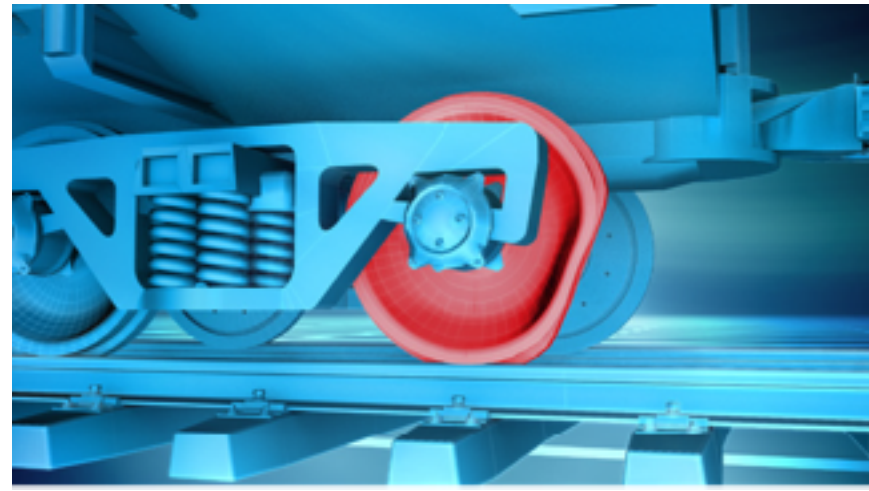
Detection of asymmetric loading conditions



Axle rupture detection



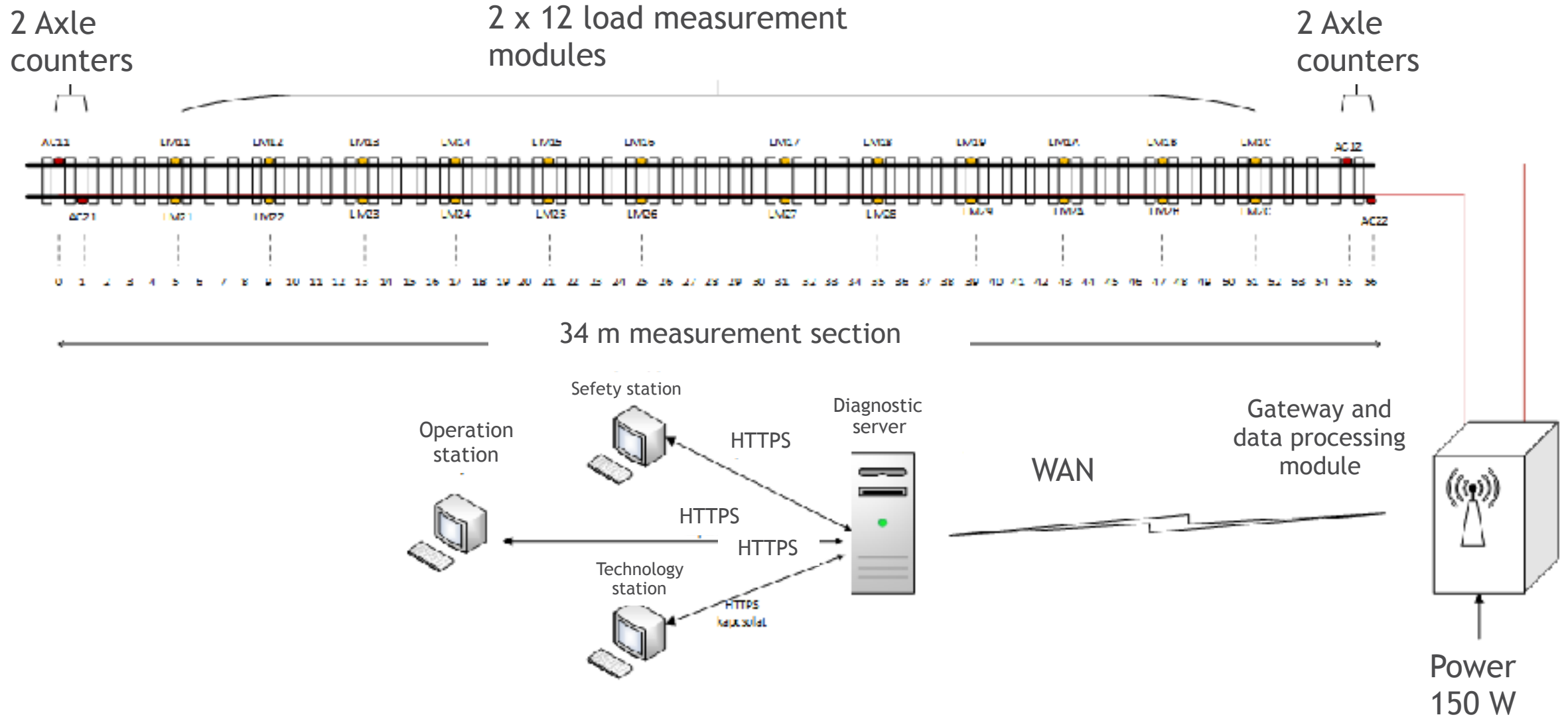
Detection of vehicle suspension problems



Detection of flat wheels



# ERDM240 system diagram



## Picture of an eRDM240 measurement section



# Load measurement modules



# eRDM240 installations in Hungary

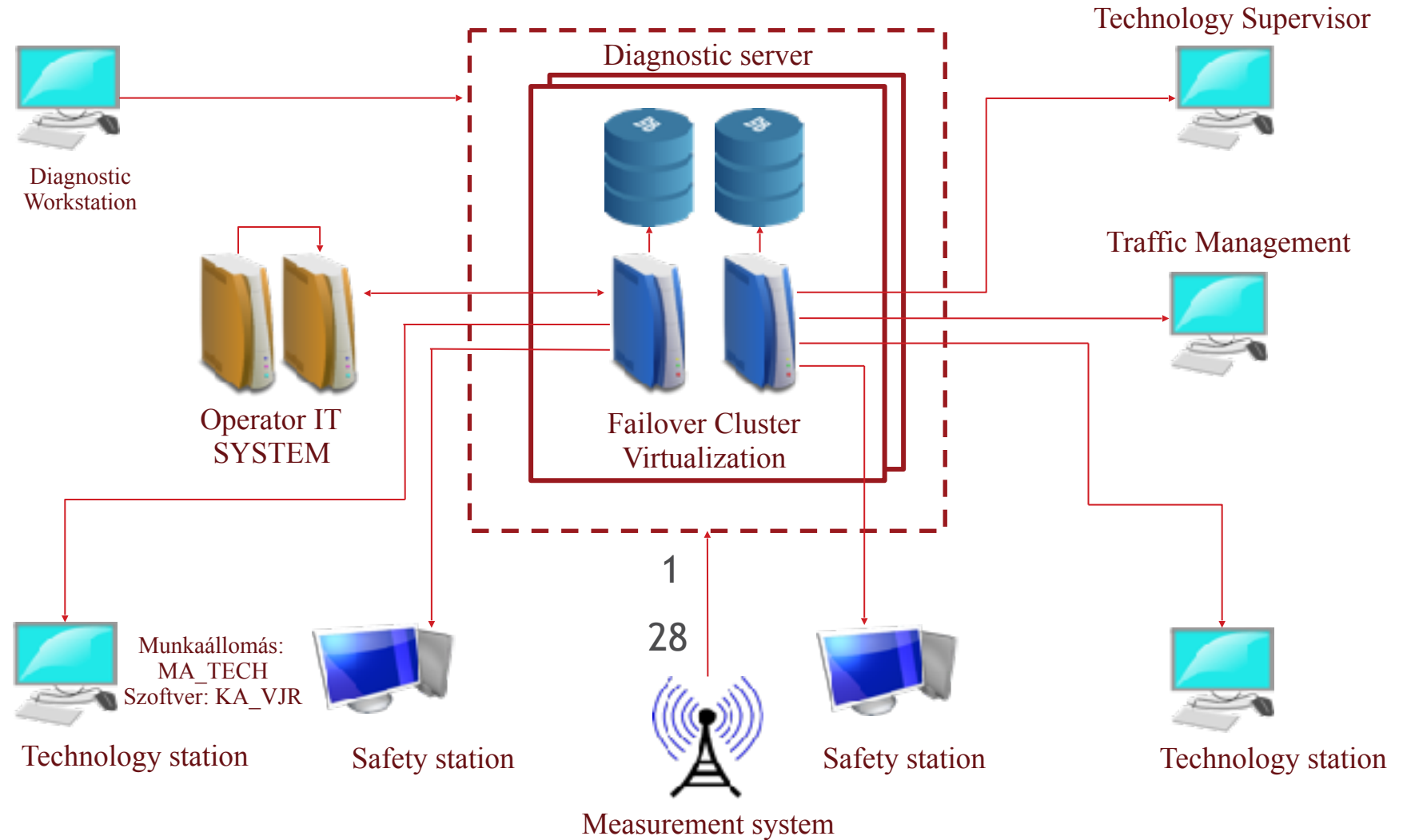
- 500.000 wagon/months
- 150 alarm signals/months
- 7/24 operation since 2015



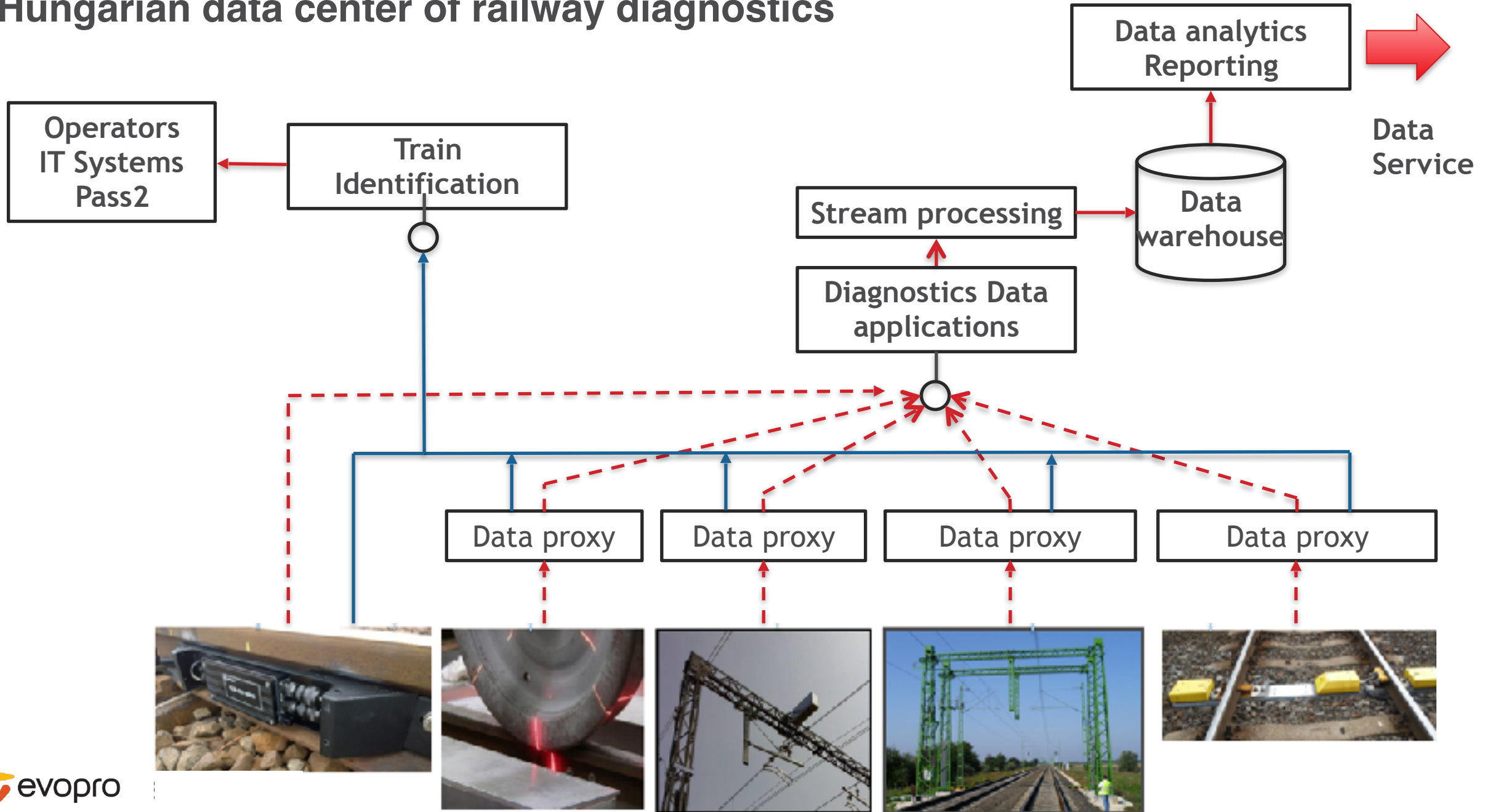
# eRDM240: Central server for data processing and storage

## Technologies

- JDK 7-8
- Maven
- Spring Boot
- REST web service
- Apache HTTP
- Java Server Faces
- JPA, Hibernate
- Apache Tomcat
- MySQL



# Hungarian data center of railway diagnostics



# User interface – visualization of data

Státusz: Kész

Mérőállomás: Soroksár

2015.05.02 2015.05.04.

**231 mérési találat**

- [2015.05.02. 01:34 \(109832\)](#)
- [2015.05.02. 02:36 \(109834\)](#)
- [2015.05.02. 03:36 \(109838\)](#)
- [2015.05.02. 04:07 \(109040\)](#)
- [2015.05.02. 04:19 \(109842\)](#)
- [2015.05.02. 04:46 \(109848\)](#)
- [2015.05.02. 08:02 \(109849\)](#)**
- [2015.05.02. 05:09 \(109052\)](#)

Vonat		Mérőállomás	
Azonosító	109849	Időpont	2015.05.02. 05:02:33
Indulás időpontja	Nincs adat	Hely	Soroksár
Sebesség	67 km/h	Szakasz	NA

Riasztások				
Időpont	Kézbekítés ideje	Nyugtázás ideje	Gépnév	Leírás
Nem található riasztás.				

**Grafikonok** **Részletes adatok**

Kiemelt riasztások: R1

Súlymérő adatok: 0 R3 (24480 kg), 1 R4T (31 %)

Tengely	Térfogat
1	21
2	21
3	21
4	21
5	8
6	9
7	8
8	8
9	8
10	8
11	9
12	9
13	9
14	9
15	8
16	8
17	9
18	9
19	9
20	9

List of trains  
Bars for axles

# Measured and declared axle load

Kiemelt riasztások

Súlymérő adatok: 3 R1 (21930 kg), 3 R2 (22950 kg), 7 R3 (24480 kg), 3 R4 (31 %, 200 %, 300 %)





# Operational station

### Riaszlások

Sorokvár 101183 2015.04.30

Trains with alerts

R4T

Nyugtérés

### Üzenetek

Trains without alerts

Megtekintés

### Tengelyterhelési adatok

Dátum: 2015.04.30 Vonalazonosító: 5107 Mérés ideje: 2015.04.30 15:51 Mérés helye: Sorokvár

Riasztási kód: R4T Rbiteságlipont: Bp. Sorokvári út Haladási irány: Sorokvár Budapest Sorokvári út

Tengelysz.	Tengelyterhelés	Riasztási kód
1.	9,51	
2.	9,21	
3.	9,11	
4.	9,01	
5.	9,81	
6.	9,61	R4T
7.	8,71	
8.	8,91	
9.	9,41	
10.	9,51	
11.	8,71	
12.	8,61	
13.	9,61	
14.	9,51	
15.	9,01	
16.	9,01	
17.	20,21	
18.	20,51	
19.	20,21	
20.	20,61	

Axle load data

Tejjes VTK Intézkedés Nyomtatás


FRDM rendszer állapot: Rendben

Következő mérések: 2015.04.30. 15:57

System state

Készlet állapot: Rendben

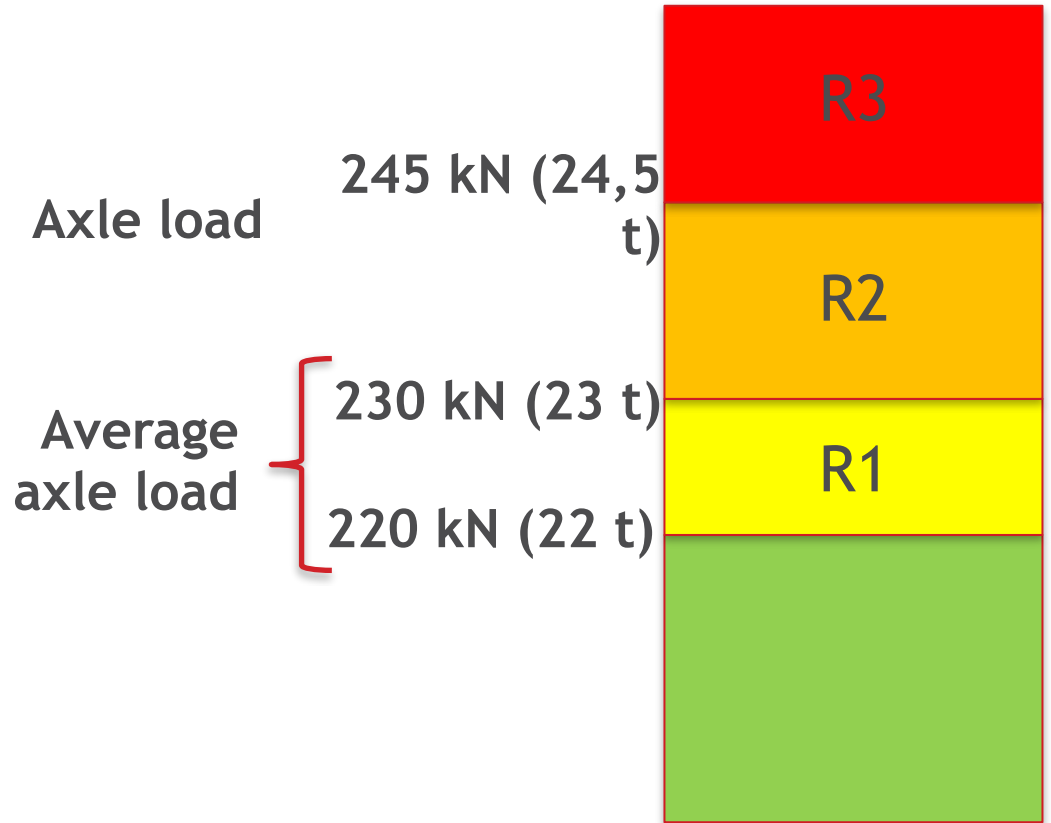
Szerver állapot: Rendben



Hitelesítés: 06 1 111 1111

**Alarm conditions**  
**Overloading**

- **R1:** 219,3 kN (21,93 t) < average axle load per wagon  $\leq$  229,5 kN (22,95 t),
- **R2:** 229,5 kN (22,95 t) < average axle load per wagon  $\leq$  244,8 kN (24,48 t)
- **R3:** measured axle load > 244,8 kN (24,48 t),
- **R4:** asymmetric load conditions
  - R4(A): left-right for wagon 1:1,31
  - R4(B): front-rear for wagons of 2 axles 1:2, front-rear for w. of 4 axles 1:3,
  - R4T: left-right within an axle 60%.



## R4

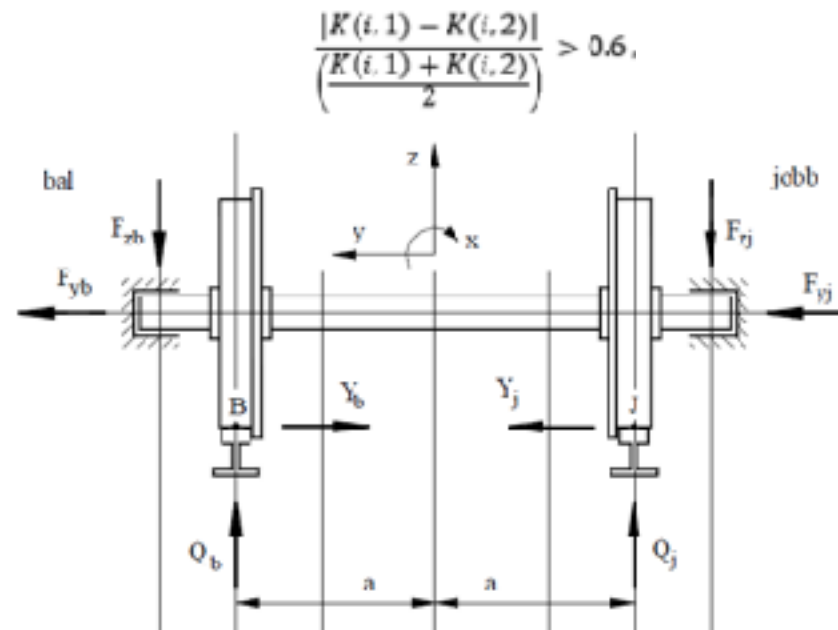
Left-right: 1:1.31

Front-rear: 1:2 / 1:3

### ■ R4T within axle

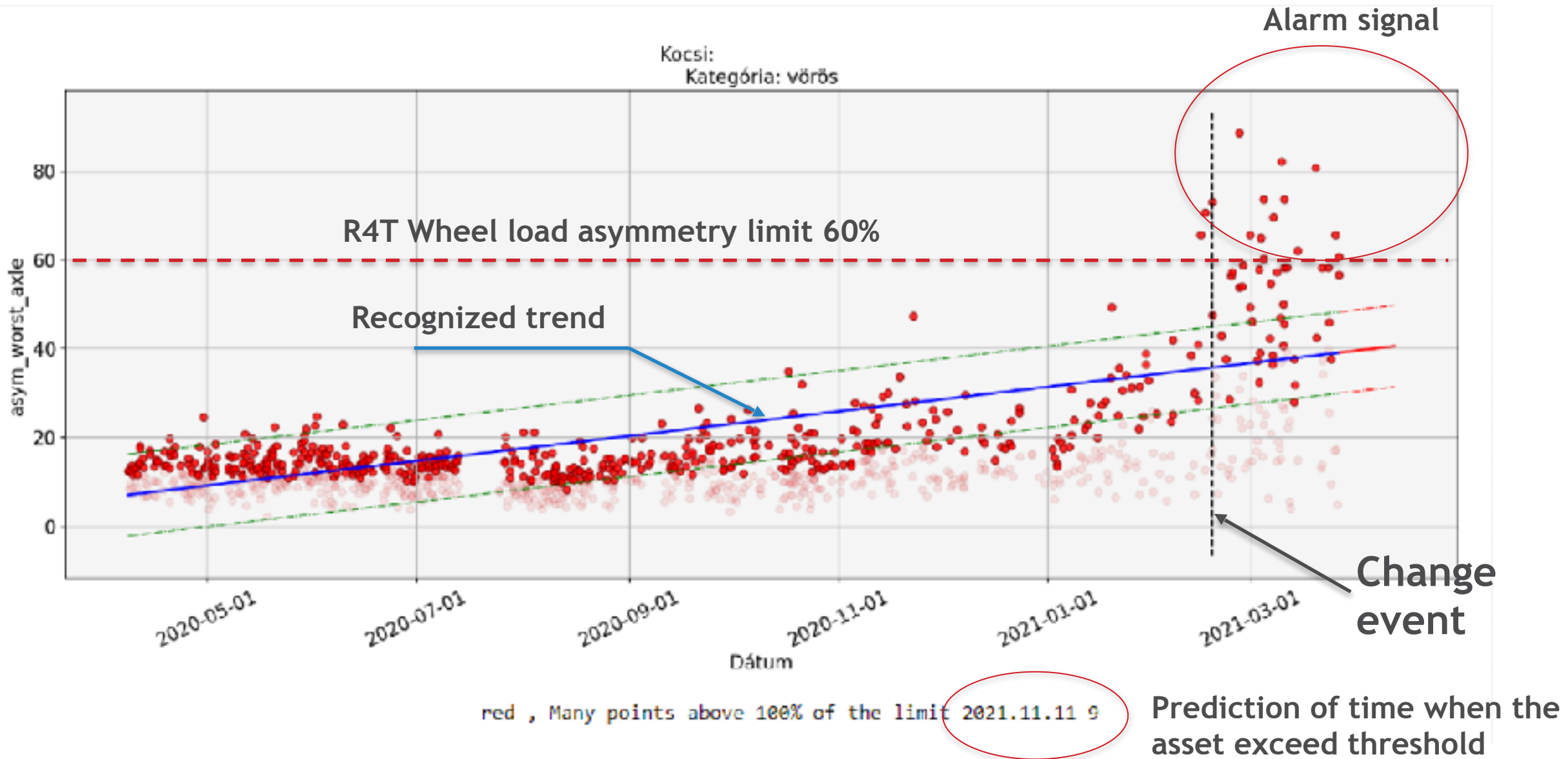
- Wheel left-right:

- 60%



### ■ R5 wheel or bogie defect

# Trend analysis and change detection



# Periodic assessment of vehicles automatic diagnostic reports

Diagnostic service for stakeholders

- Cargo partners
- Fleet managers

**Category**      **Meaning**

<b>Normal</b>	No significant change in condition
<b>Green</b>	Slight deterioration, alarm level expected in 3 months
<b>Yellow</b>	Moderate deterioration, alarm level expected in 2 months
<b>Orange</b>	Strong deterioration, alarm level in one month
<b>Red</b>	Dangerous condition, alarm levels have been exceeded

# Summary

## Challenges of railway infrastructure

- Increase safety and reliability
- Increase availability
- Optimization of maintenance
- Reduce lifecycle cost

## Technology trends

- Digitalization of railway
- Instrument infrastructure and rolling stock
- Predictive maintenance
- Data analytics and service
- Qualitative diagnostics

## evopro solutions

- Wheel load measurement
  - Wheel defect detection
  - Track temperature monitoring
  - Vibration analysis
  - Data analytics and machine learning
- 
- Central European engineering partner

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