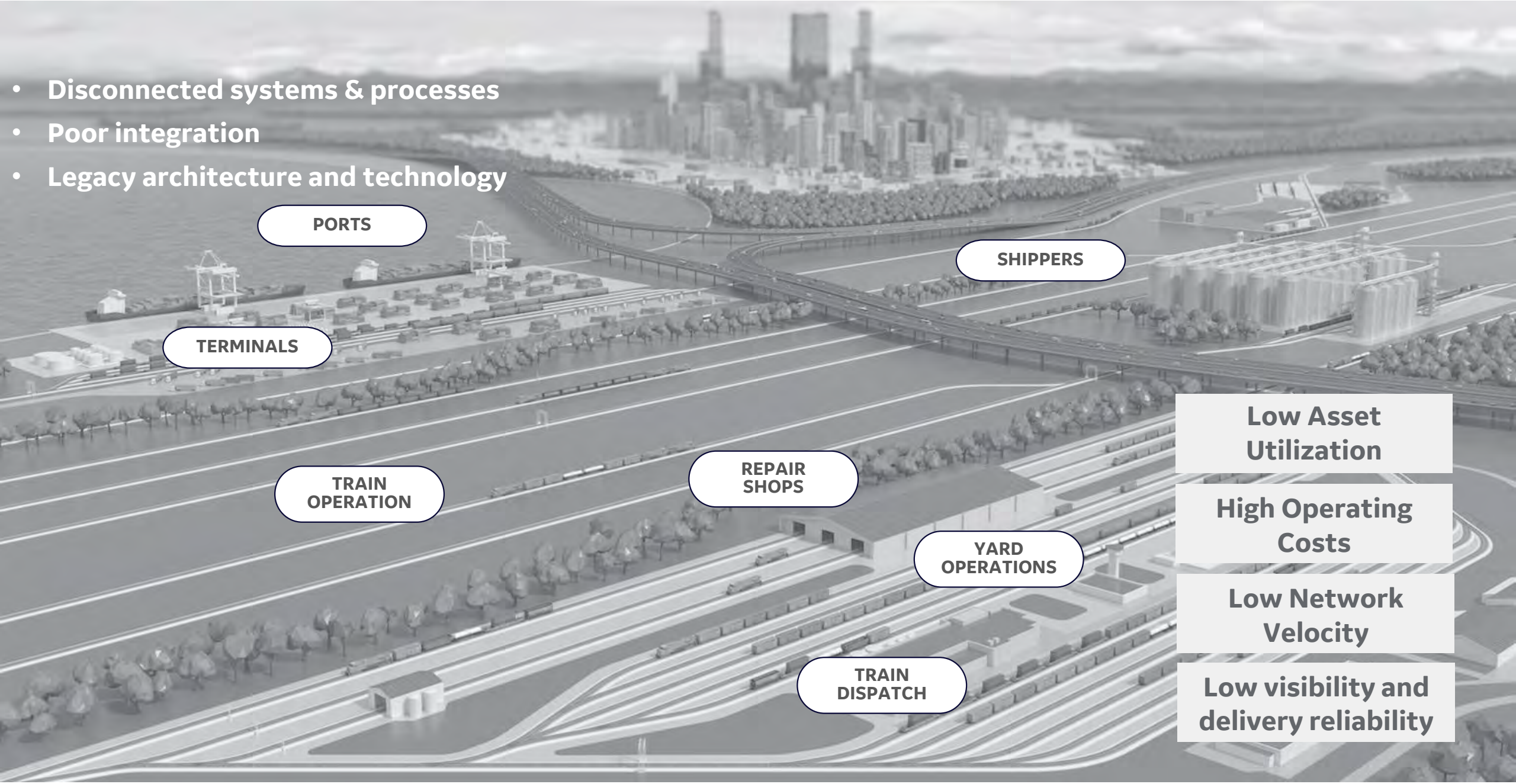
Leading the digital transformation of the rail industry

March 1, 2018

We are GE Transportation.
We move the world.

The rail transportation industry faces unprecedented challenges

- **Disconnected systems & processes**
- **Poor integration**
- **Legacy architecture and technology**



Low Asset Utilization

High Operating Costs

Low Network Velocity

Low visibility and delivery reliability

North America

~500,000 Unexpected Train delays a year

20+ HOURS terminal dwell

~20 miles per hour average train speed

$10B Yearly fuel costs

India

91% Op Ratio

104 # of Accidents in 2016

~24 km per hour average train speed

$2.5B Yearly diesel costs

Brazil

11.6 Accidents per million train km

~12 km per hour average train speed

$1.0B Yearly diesel costs

Sub-Saharan Africa

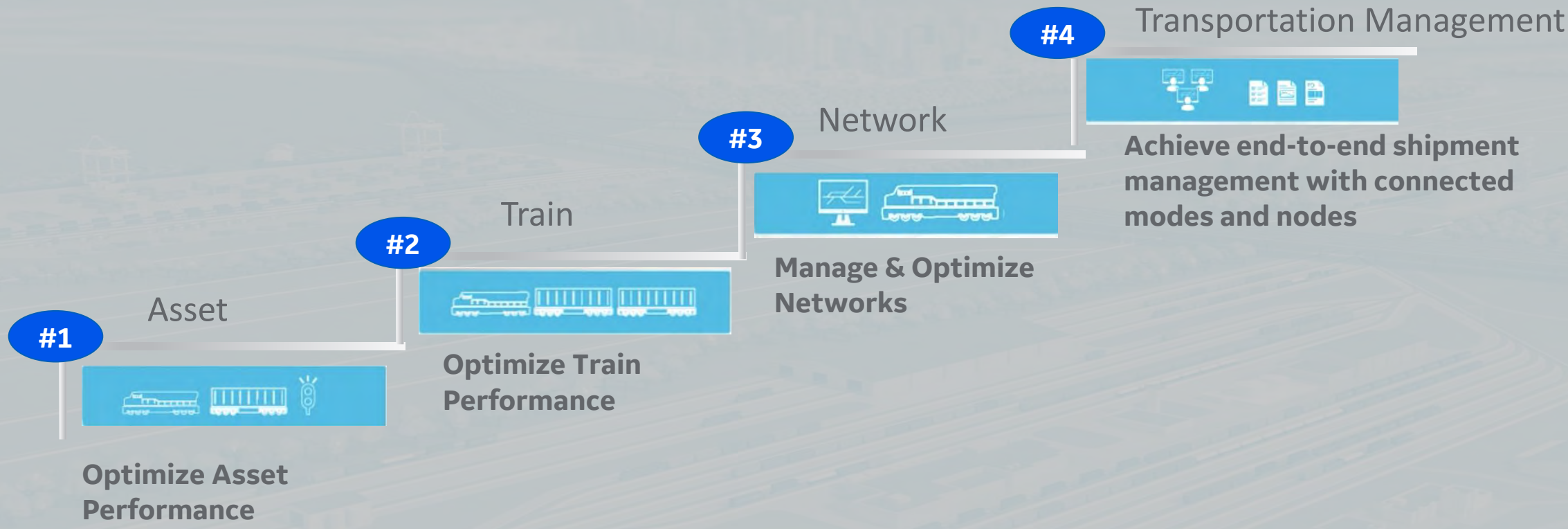
11 days Freight wagon (dwell)

~20 km per hour average train speed

$2.3B Yearly fuel costs

Digital solutions: driving the transformation

The components of transformation



Many of the Pieces Available Now

Installed base Highlights
- 17,000 locomotives monitored
- 20,000 LOCOTROL systems
- 10K GoLINC Edge Devices
- 10,000 Trip Optimizer Systems
- 500+ short lines on TMS system
- 70 Terminals, 20 Million Lifts/year

#4 Transportation Management
-Railroad TMS
-Shipper TMS

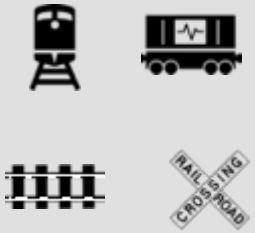
#1 Asset Performance Management (APM)
-APM: Locomotives
-APM: Railcar
-APM: Track/Wayside
-ServiceMax

#2 Train Performance Optimization
-LOCOTROL Distributed Power
-Yard & Road RCL
-Trip Optimizer

#3 Network Optimization
-Precision Dispatch
-Movement Planner
-Yard Planner Systems
-Smart Intermodal & Auto Ramp Management

Examples of Digital Solutions

APM



- Enterprise asset management
- **25%** reduction in failures

▲ Reliability

Train Performance

- Smart cruise control for trains
- **10%** ↑ fuel eff., ~900K gallons fuel saved per week; 9000 units IB
- Vale Mozambique – 1st implementation In Africa

▲ Fuel Efficiency

Network Optimization

- Real-time line-of-road planning
- 2 Class 1 + 1 Int'l installs
- 10-15% ↑ in velocity

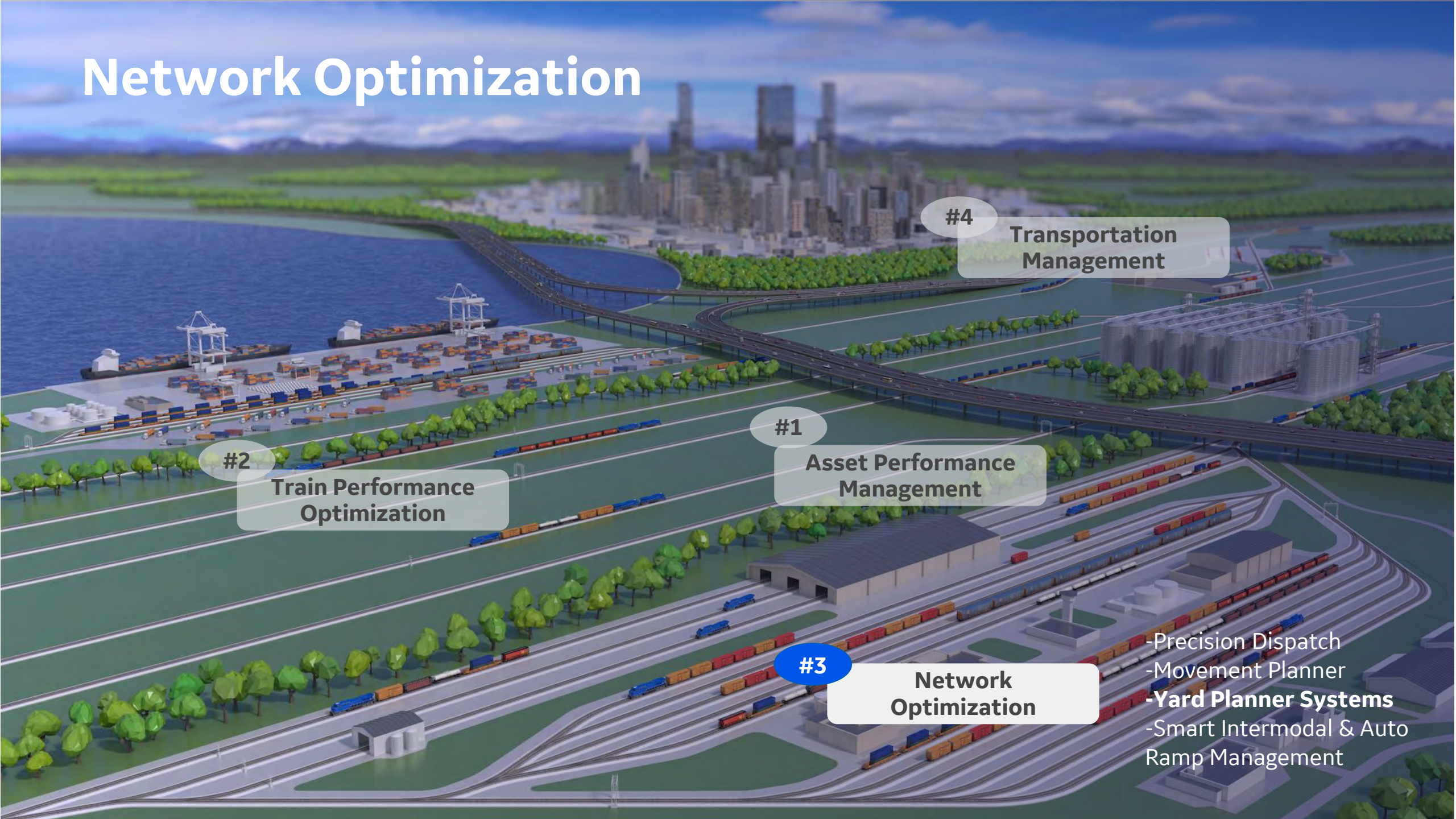
▲ Velocity

Transport Logistics

- Unlocks power of big data at one of the world's largest ports
- Delivers fast, data-driven insights
- Improves cargo visibility, increases efficiency

▲ Visibility, Productivity

Network Optimization

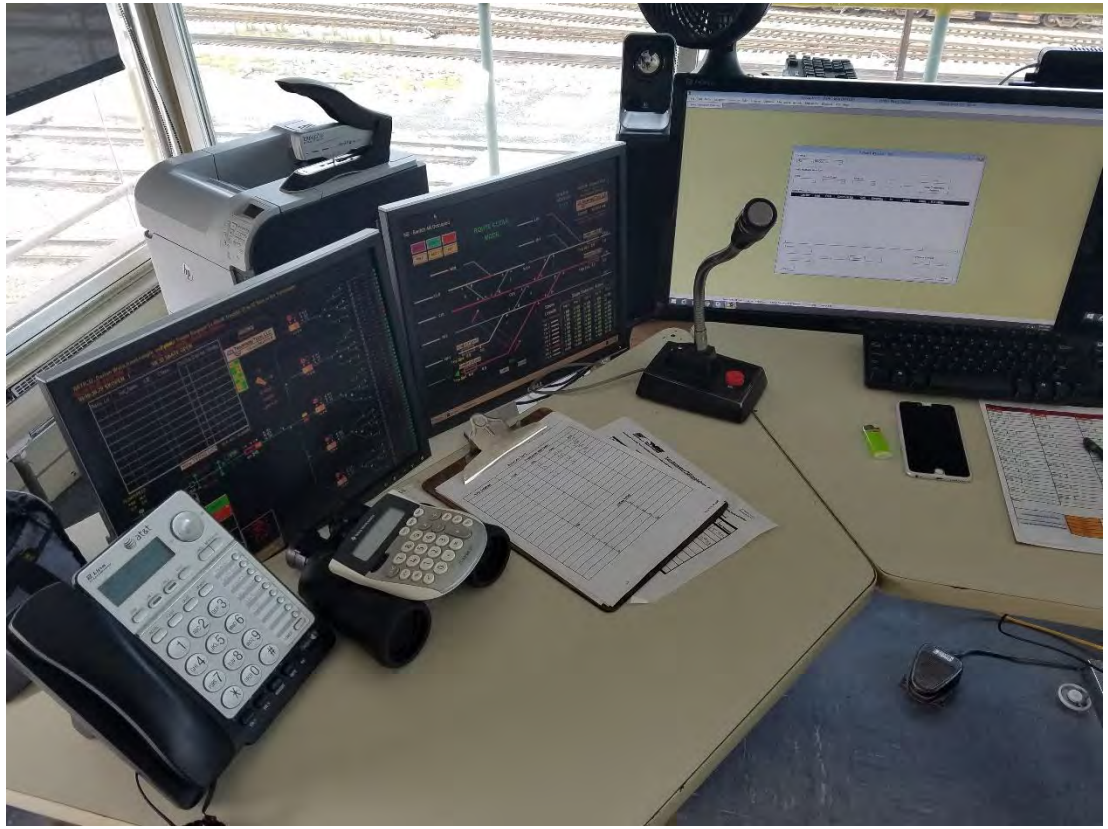


The opportunity for rail yards

YARD OF THE FUTURE

The rail yard of today

- Typical workstation



- Selected automation
- Minimal decision support
- Localized planning and execution
- Minimal real-time asset tracking
- Ad-hoc network considerations

The rail yard of the future: objectives

Anticipate & prevent problems

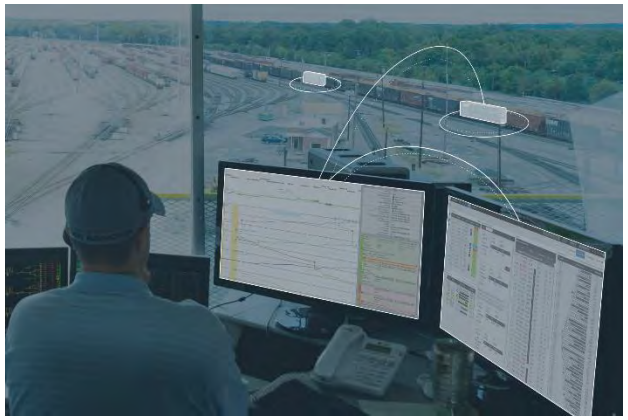
- Predictive maintenance
- Proactive decision-making
- Informed recommendations

Enhance network productivity

- Automation (as much as possible)
- Remote control
- Optimizing asset utilization

Develop new opportunities

- Multidisciplinary, team-based planning
- Improved customer experience



The high-level yard of the future roadmap

- **TODAY** — Consistent Data & Control
- **SHORT TERM** — Proactive Network Planning
- **LONG TERM** — Autonomous Yards
- **LONGER TERM** — Decentralize Yard Activities

SUPPORTING INPUTS

HUMANS AND THE VETERAN KNOWLEDGE BASE
As automation and AI are introduced, the role of humans shift from reactive to strategic. Veterans will play an important advisory role to a data-empowered strategic team.

DATA INSIGHTS AND COLLABORATIVE HUBS
Sensors, data, analytics, and new predictive tools will support multi-disciplinary teams, working together on bigger problems. The workforce will likely shift into central planning environments.

POLICY CHANGES AND LABOR RELATIONS
To level the competitive playing field and defend against under-regulated emerging technologies, a consistent effort will be required, to enable labor and technology changes.

CARRIER AND MODE PARTNERSHIPS
The walls between "us" and "them" need to be torn down within today's connected world. Share data and compete as a uniform, customer-centered shipping experience.

Hump yard planner system

Decision support for hump yard operations

Train arrival → Inbound inspection → Hump → Pull-back → Outbound inspection → Train departure

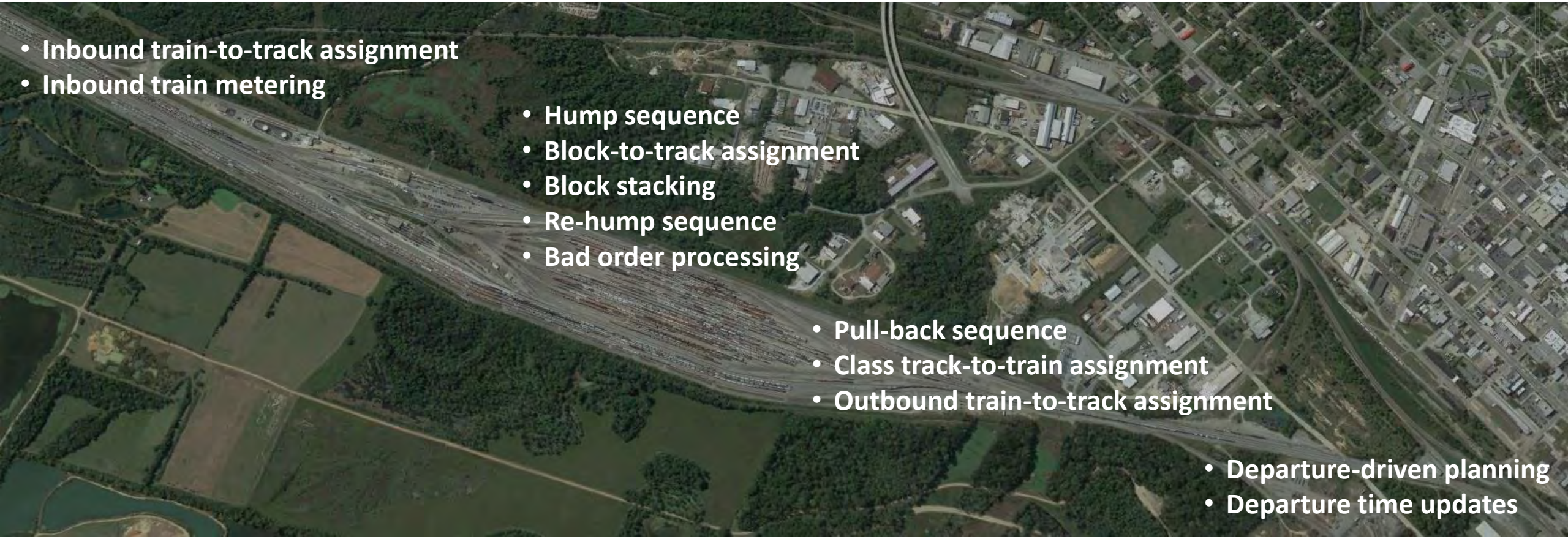


Image source: Google Earth

Three cool things our engineering team has done

There are many more…

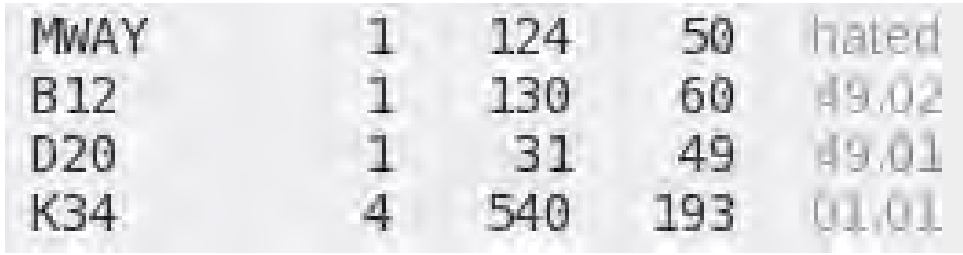
Class Scoring

Planning insights

Clear UI

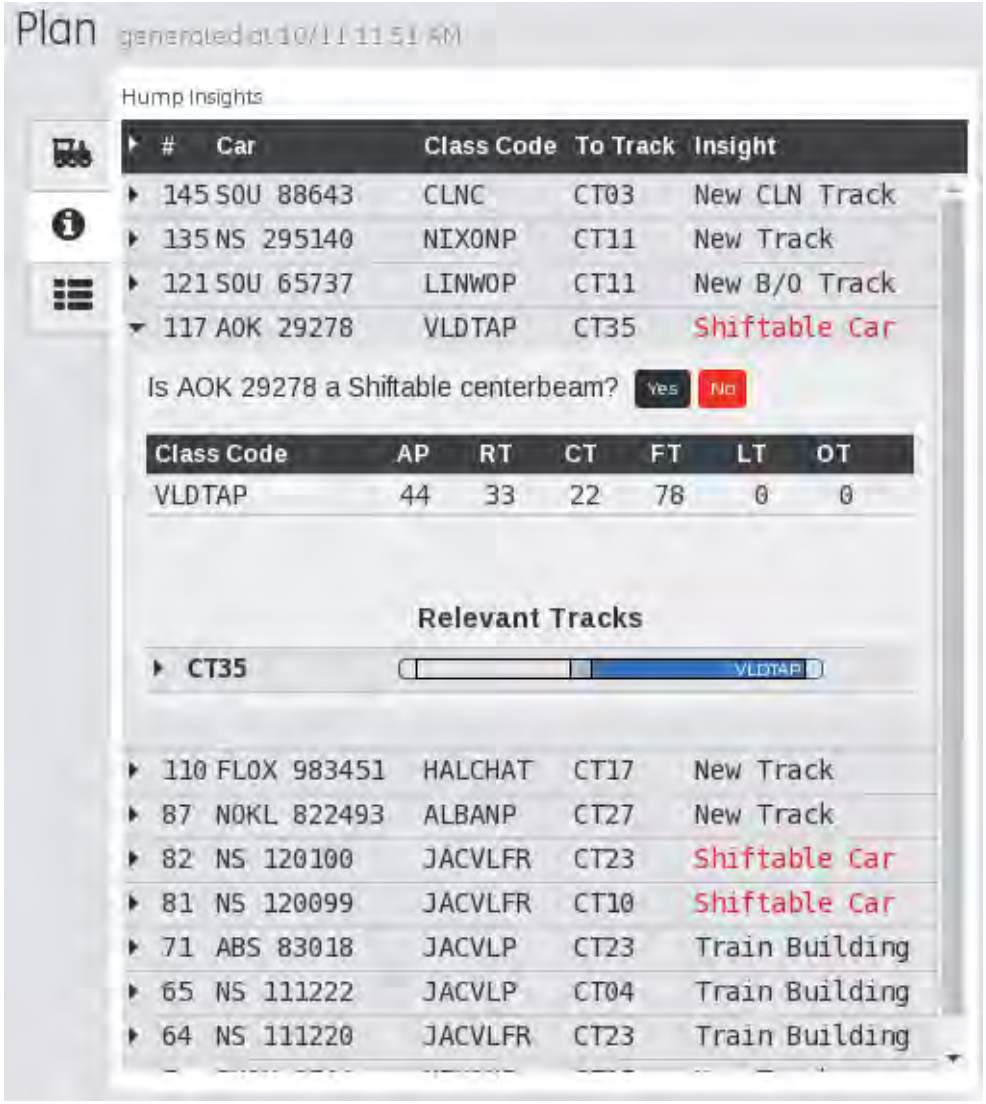
Class scoring

- The planning algorithm is driven by outbound demand
- Cars are evaluated against each other
  - -Desired standing order
  - -Target outbound train
  - -The train's departure direction
- An integer value is created to represent the demand
- This allows cars to be easily compared with each other



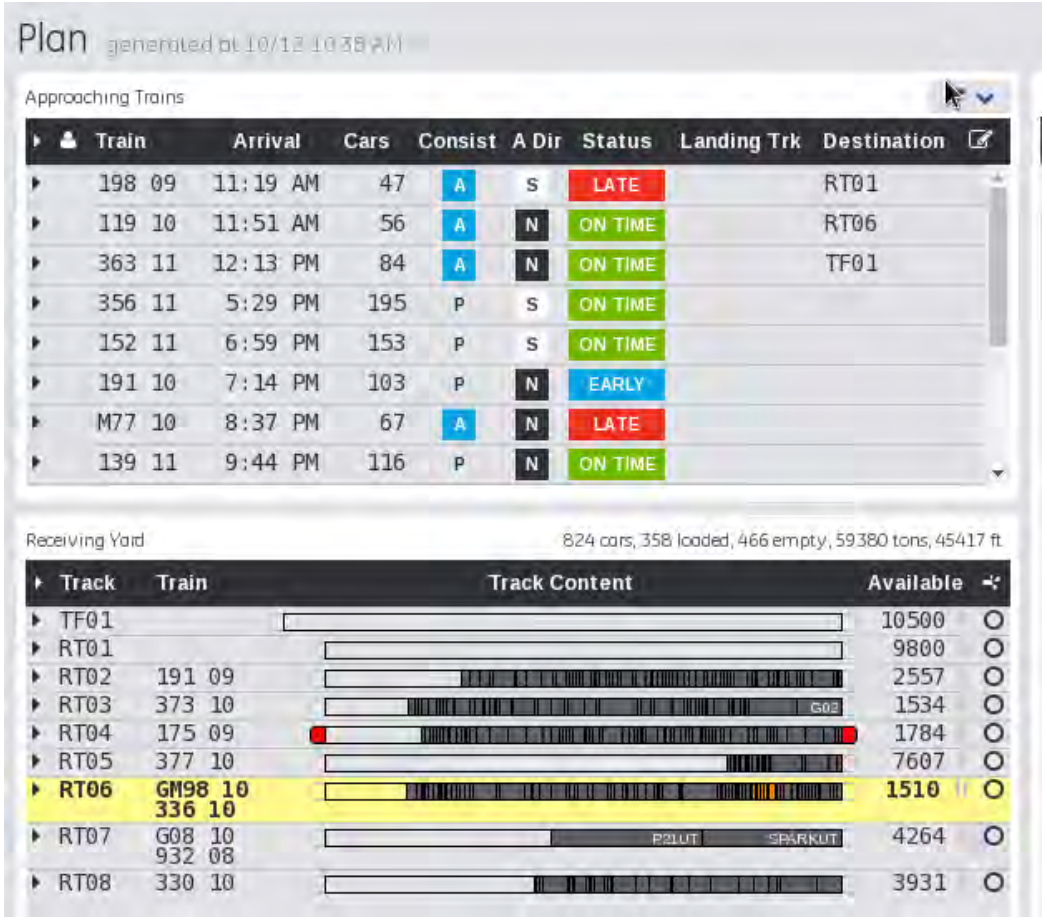
MWAY	1	124	50	hated
B12	1	130	60	49.02
D20	1	31	49	49.01
K34	4	540	193	01.01

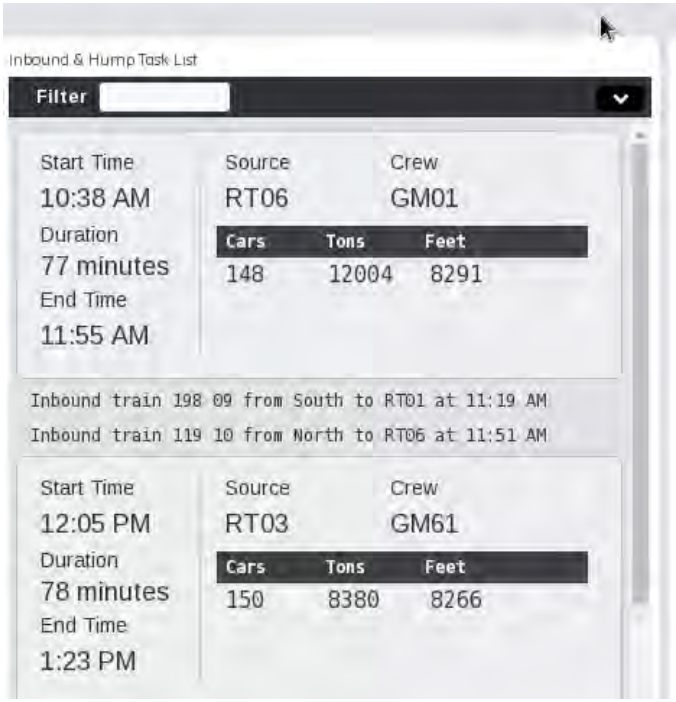
Planning insights



- Goal: Let users know that planner is going to do something that may not be intuitive
- Also for user input that will affect decisions
- Eliminate the “flying blind” feeling

Clear UI





Wrap-up

Our vision: integrate across solutions

For more information:

https://www.getransportation.com/digital-solutions

Read the GE Transportation white paper:
“Transportation’s Evolution: A Promising Future”
http://www.getransportation.com/whitepaper

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