Closing the Loop...
with the PI System

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Chief Engineer
Symboticware

Closing the Loop…
with the PI System

Traditional Mining Processes
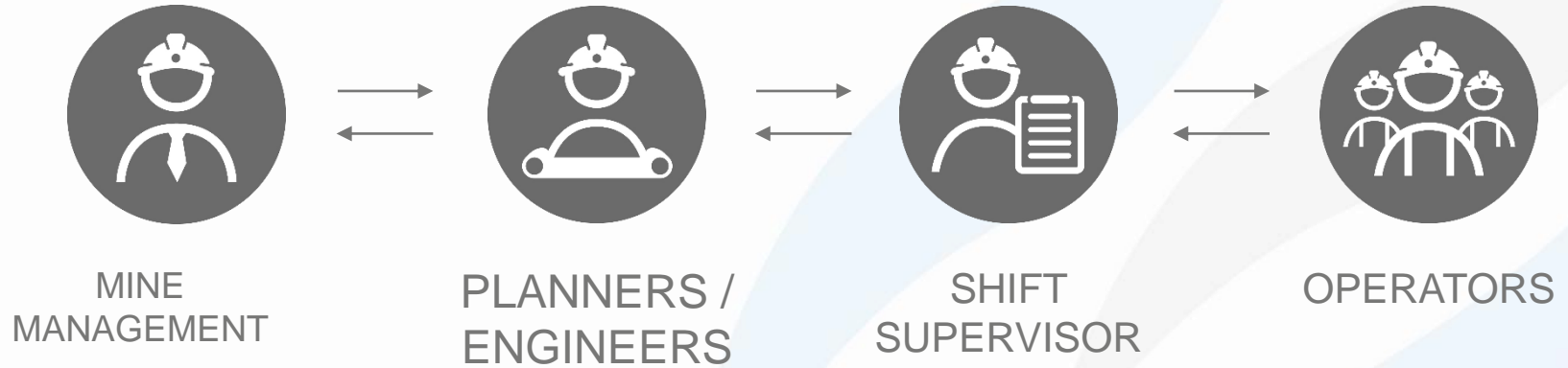
Digitalization Strategy

Digitalized Loop Connectivity

How does the PI System help?

Digital Loop Examples

Traditional

MINE MANAGEMENT → PLANNERS / ENGINEERS → SHIFT SUPERVISOR → OPERATORS

Traditional

SHIFT
SUPERVISOR

New Tasks

Daily

OPERATORS

Traditional

PLANNERS / ENGINEERS — New Plans → / ← Progress Report (Weekly) — SHIFT SUPERVISOR — New Tasks → / ← Shift Reports (Daily) — OPERATORS

Traditional

MINE MANAGEMENT

New Instructions

→

Monthly

←

Progress Reports

PLANNERS / ENGINEERS

New Plans

→

Weekly

←

Progress Reports

SHIFT SUPERVISOR

New Tasks

→

Daily

←

Shift Reports
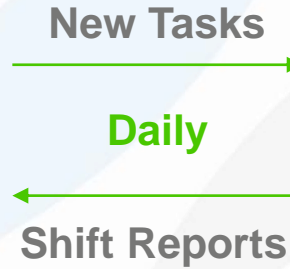
OPERATORS

What if we were to digitalize these loops?

Digitalizing These Loops

MINE MANAGEMENT → PLANNERS / ENGINEERS → CONTROL ROOM → VEHICLES

Digitalizing These Loops

New Tasks

Near Real-Time

CONTROL ROOM

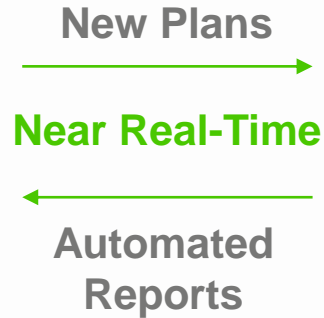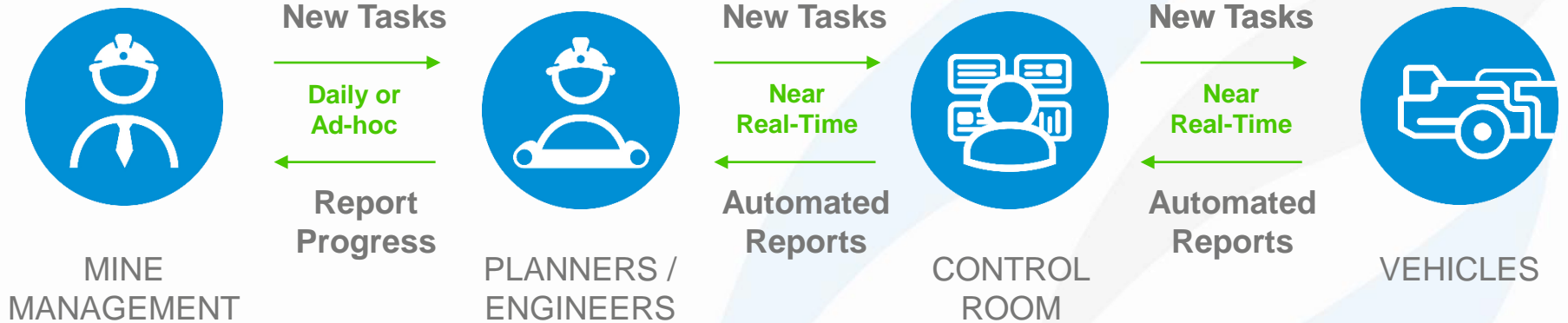VEHICLES

Digitalizing These Loops

PLANNERS / ENGINEERS
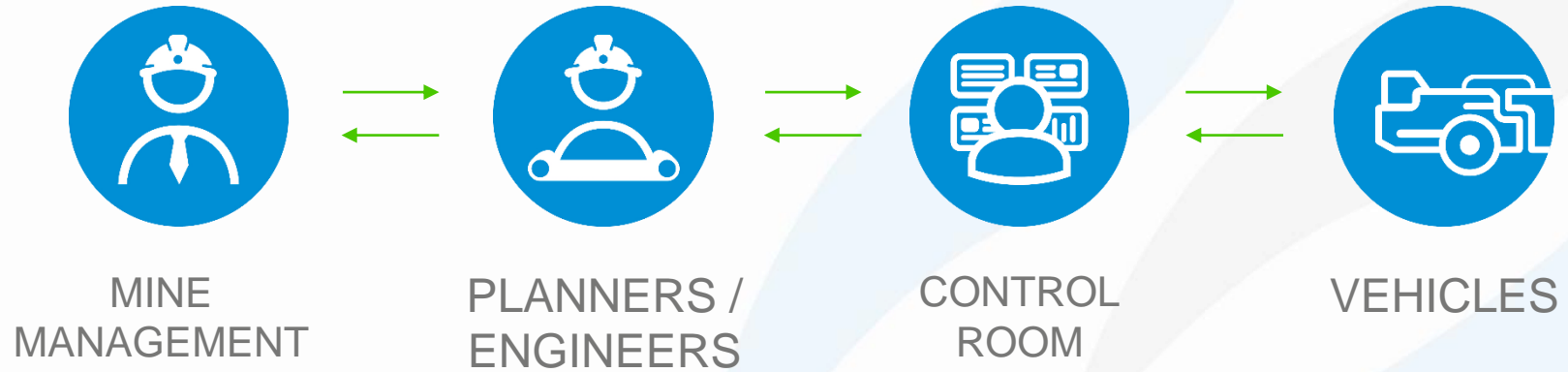
New Plans →
Near Real-Time
← Automated Reports

CONTROL ROOM

New Tasks →
Near Real-Time
← Automated Reports

VEHICLES

Digitalizing These Loops

New Tasks → | **New Tasks** → | **New Tasks** →

Daily or Ad-hoc ← | Near Real-Time ← | Near Real-Time ←

Report Progress | Automated Reports | Automated Reports
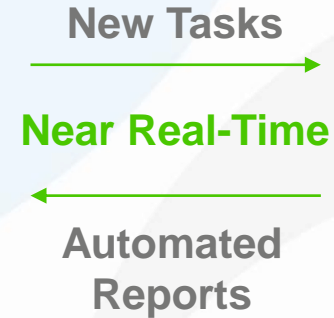
MINE MANAGEMENT | PLANNERS / ENGINEERS | CONTROL ROOM | VEHICLES
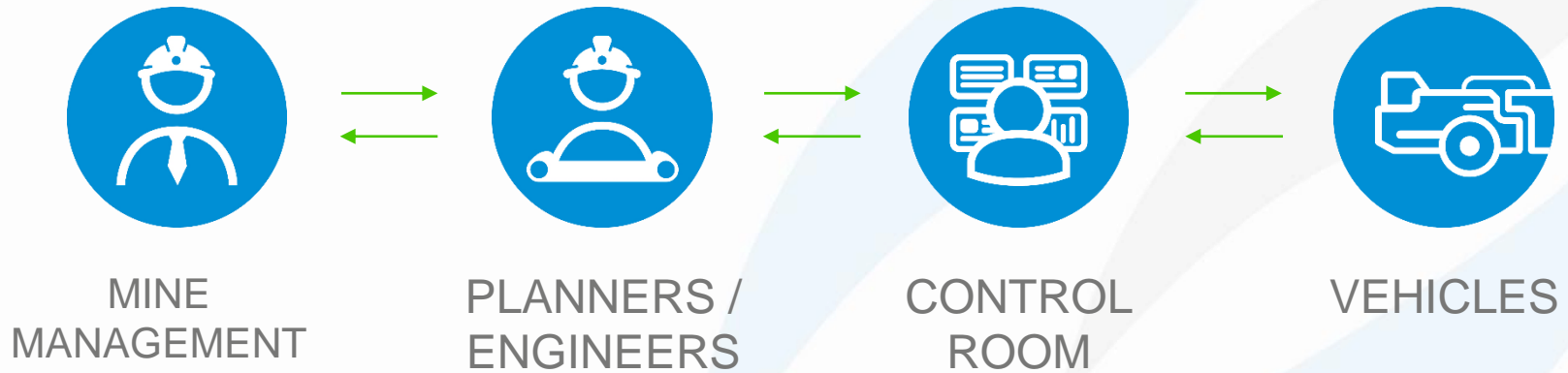
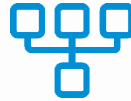# Digitalized loops are connected with a smaller loop allowing for quicker task assignment.

MINE MANAGEMENT

PLANNERS / ENGINEERS

CONTROL ROOM

VEHICLES

How are these digitalized loops connected?

How are these digitalized loops connected?

Wired

Wireless

MINE MANAGEMENT → PLANNERS / ENGINEERS → CONTROL ROOM → VEHICLES
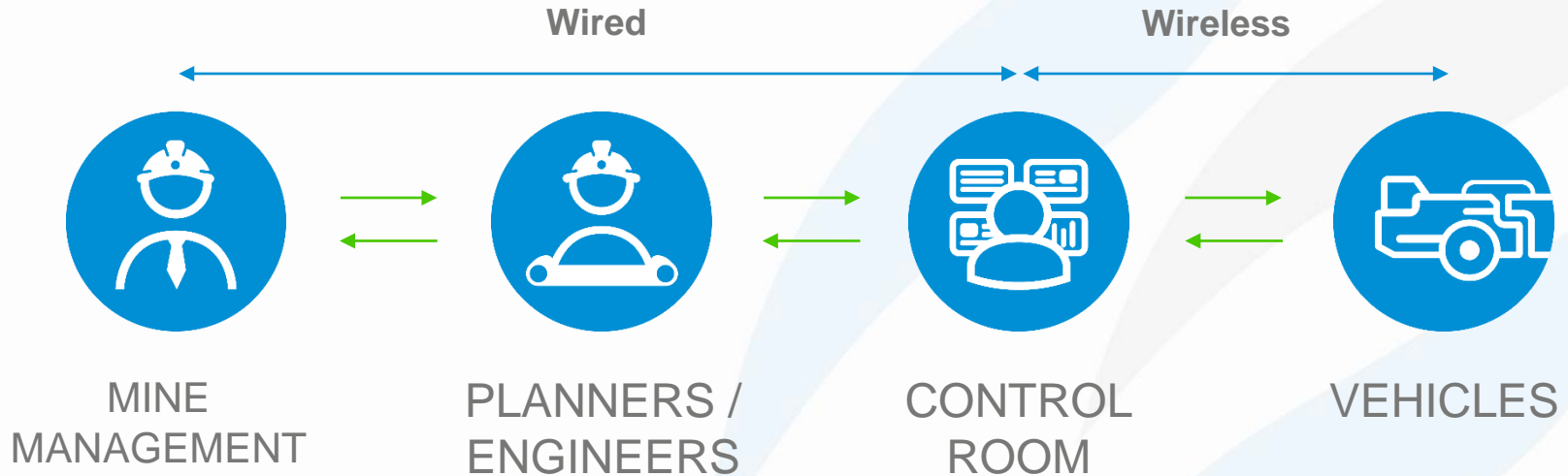
Wired Infrastructure
(with dashboards, reports and notifications)
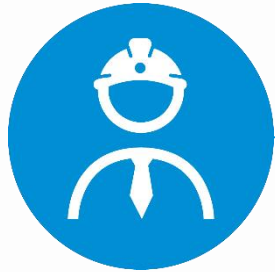
MINE MANAGEMENT

PLANNERS / ENGINEERS

CONTROL ROOM

Wireless Underground Infrastructure*
(LTE underground, WiFi, etc...)

* = SUBJECT TO AVAILABILITY

CONTROL ROOM

VEHICLES

Wireless Underground Infrastructure

Not always available, why?

Infrastructure not extended to the face, or only in strategic areas

Changing map (advancing/abandoning drifts) means dynamic and challenging propagation characteristics, on a macro scale

Maintenance & upkeep of infrastructure: collisions or damage due to rock movement

OSIsoft.

Wireless Underground Infrastructure

Addressing with a physical solution?

Ad hoc network extenders (mobile repeaters)

Ruggedized enclosures

Redundant network elements

Wireless Underground Infrastructure

Address with a software solution?
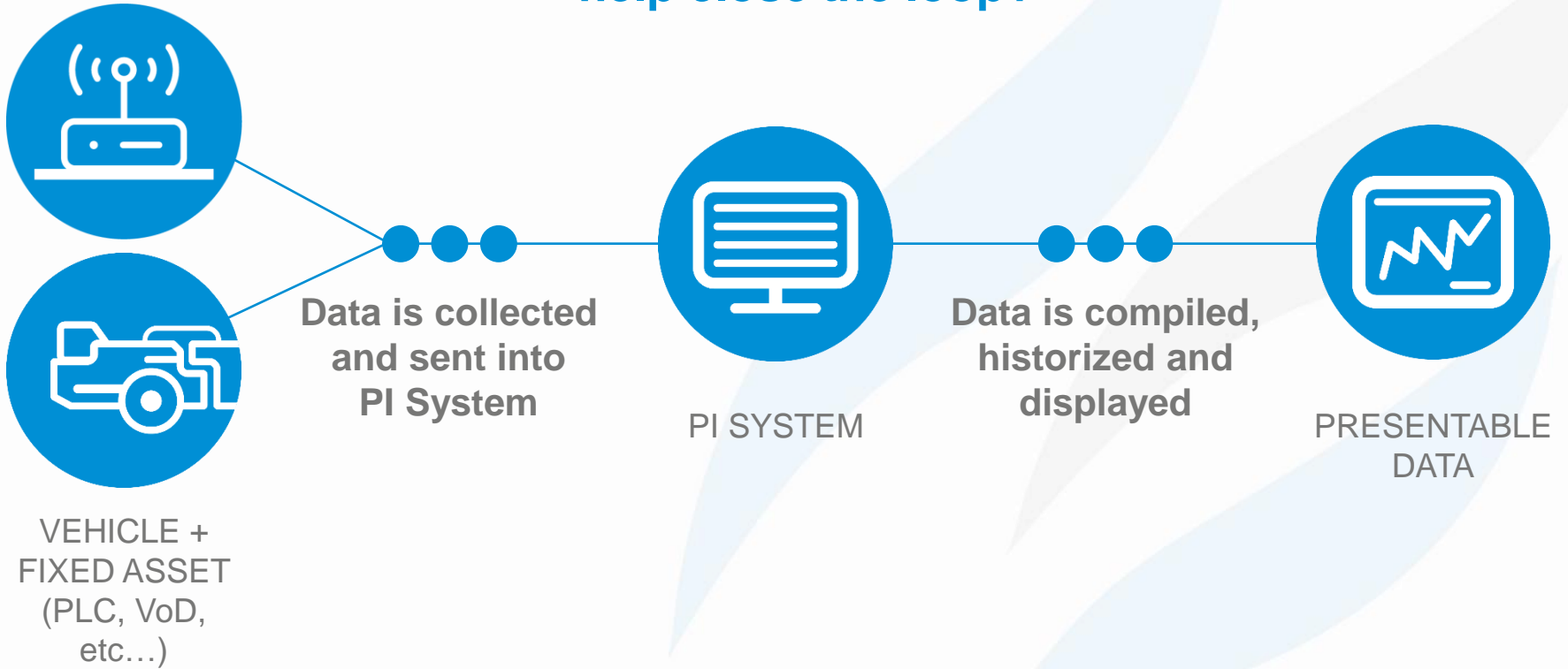
Offload as much data as possible in a small window

Recent advances in Symboticware technology have yielded an order of magnitude improvement in offload rate while under coverage

Typically retrieve 8000 datapoints per minute, offload rate over 100 times that

How does the PI System help close the loop?

How does the PI System help close the loop?

Data is collected and sent into PI System

VEHICLE + FIXED ASSET (PLC, VoD, etc…)

PI SYSTEM

Data is compiled, historized and displayed

PRESENTABLE DATA

How does the PI System help close the loop?

This previously used the PI Interface for UFL

VEHICLE + FIXED ASSET (PLC, VoD, etc…)

CSVs take too long to be parsed

PI SYSTEM
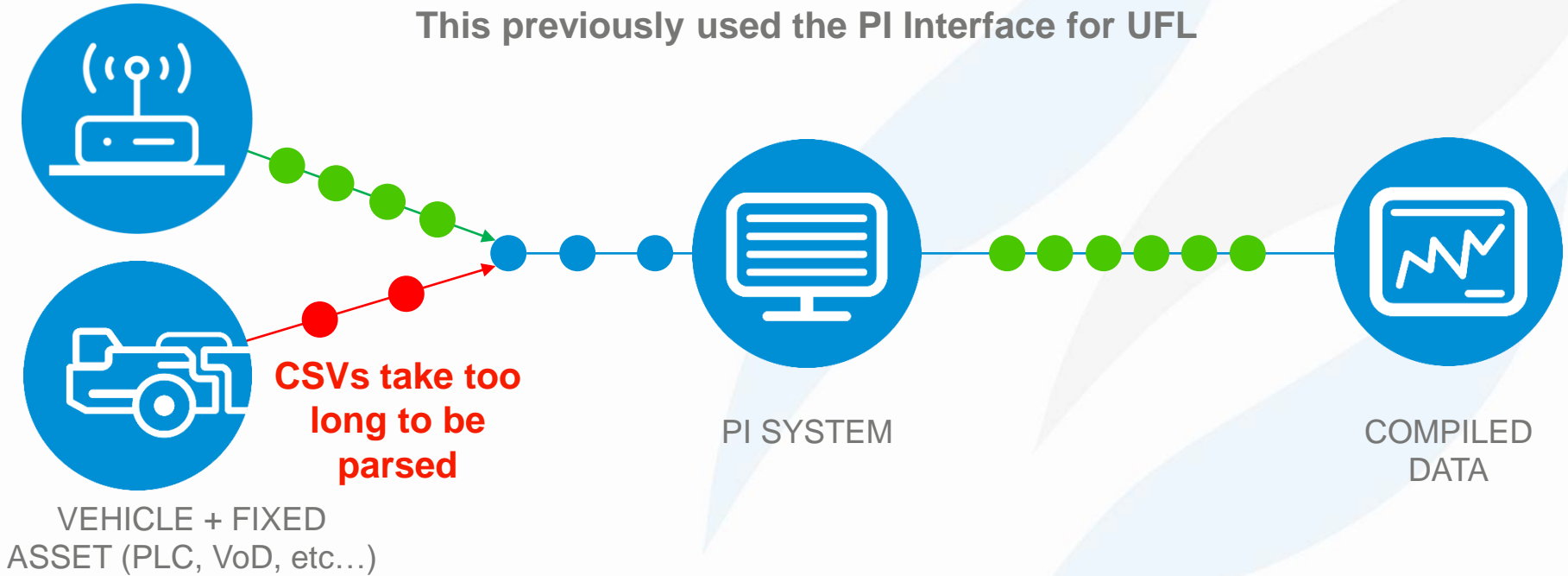
COMPILED DATA

How does the PI System help close the loop?

Moved to PI JDBC which made insertion into PI System fast… too fast.
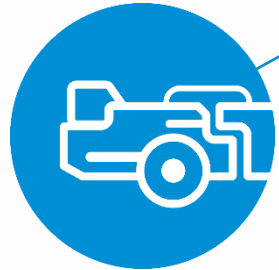
VEHICLE + FIXED ASSET (PLC, VoD, etc…)

PI SYSTEM
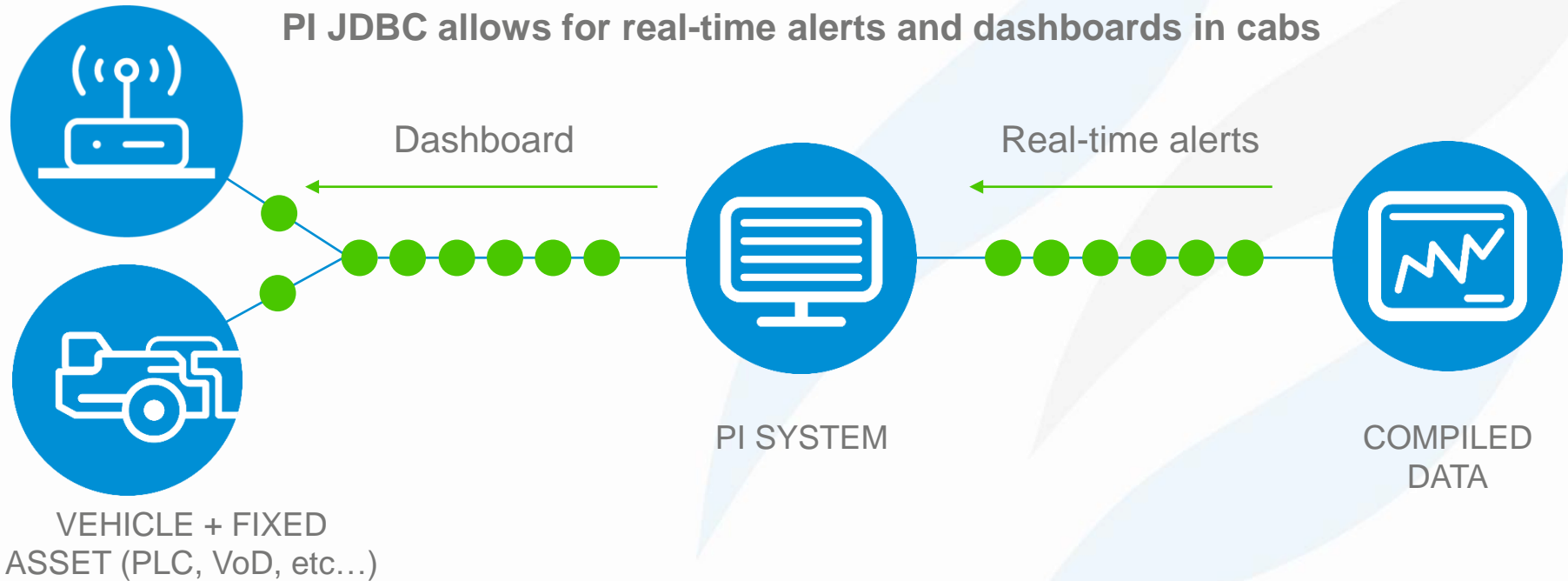
COMPILED DATA

How does the PI System help close the loop?

PI JDBC allows for real-time alerts and dashboards in cabs

Dashboard

Real-time alerts

VEHICLE + FIXED ASSET (PLC, VoD, etc…)

PI SYSTEM

COMPILED DATA

Digital Loop Examples

Underground Hard Rock Mine

Heavy vehicle fleet needed health monitoring for **maintenance and safety**, with near real-time notifications and reports.

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collect ∙ connect ∙ act

BUSINESS CHALLENGES	SOLUTION	RESULTS AND BENEFITS
WiFi is not available everywhere	**PI DataLink Reports >** Seatbelt infractions and maintenance alarms	Seatbelt policy monitored through SymBot reports
Operator safety is paramount	**KPI Dashboards >** Excessive idle, seatbelt infractions	Dashboard review part of daily routine
Maintenance queues need to be monitored	**Notifications >** Tire pressure, engine coolant	30% annual savings from tire monitoring alone

Surface Smelting Operations

Ladle haulers retrieving molten smelted material and dumping in appropriate storage area looking to improve **repeatability and timeliness** of their process, as well as **automatically populate** their inventory system

BUSINESS CHALLENGES	SOLUTION	RESULTS AND BENEFITS
WiFi only near converter	**PI DataLink >** LUT identifying origin and destination	All goals achieved
High heat in aisle, extreme cold outside	Payload weight retrieved without operator interaction	Process improvement imminent
GPS obstructed	Operator input of payload type retrieved upon loading of ladle	Expansion of functionality forthcoming
	Reverse tracking through choke points	

Surface Aluminum Processing Operation

Interior aluminum processing plant with anode and crucible haulers running 24/7, seeking an opportunity to **improve manual process** of entering process markers and of retrieving vehicle data while **providing feedback** to the operator in near real-time.

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collect ▪ connect ▪ act

BUSINESS CHALLENGES

Short interval control

Constant uptime of WiFi (high reliability)

Huge data retrieval with near real-time review

SOLUTION

Reverse tracking leads to automated process interval indication

Data collected sent to PI System for immediate dashboard replay

In-cab display powered by PI System

RESULTS AND BENEFITS

Operator no longer records transactions manually

Transaction processing sped up fivefold, with less likelihood for errors

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

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谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

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