

Denver Transit Operators

Operations Systems Integration for Commuter Rail Operations & Maintenance

June 12, 2018



Denver Commuter Rail Network



System Statistics

- ❑ 66 Hyundai Rotem Electric Multiple Units Cars
- ❑ 65 Track Miles of Main Line Track
- ❑ 57 Turnouts from #9 to #20
- ❑ 37 Grade Crossings (29 Highway/Rail)
- ❑ 40 Railroad Bridges – Box Culverts with 10-ft Spans
- ❑ 25kV Overhead Catenary System
- ❑ Positive Train Control and Automatic Train Control

O&M Scope of Work – Revenue Service Period

- Operate Trains
- Dispatch
- Report to RTD
- Maintain Rolling Stock
- Maintain Track, ROW and Bridges
- Maintain Facilities – Stations/CRMF
- Maintain Systems
 - Communications
 - Signals and Train Control
 - Traction Power



Service and Operations Plan

	Univ of Colorado A Line	B Line	G Line
Running Time	37 minutes	12 minutes	26 minutes
Headways	15 minutes	30 minutes	15 minutes



Performance Standards - Availability

- 97.7% Availability Required for 100% Payment
- Availability Components
 - Rolling Stock Availability =
 - Actual Compliant Car Miles/Scheduled Car Miles
 - On-Time Availability =
 - % of Arrivals at Time Points within 5 minutes of Schedule.
 - Station Availability = % of Station Days with:
 - Elevators operational
 - More than 75% Lights Working
 - Access routes safely clear of snow and ice
- Additional Performance Deductions Apply for
 - Failure to respond to and remedy defects within limits

Performance Standards – Service Task Orders

- Up to 5% of payment can be deducted based on total STO Points each month

Problem	Response Time	Remedy Time	STO Points
Elevator Shutdown	2 hours	12 hours	5
Foul Odor or Heavy Litter	4 hours	4 hours	2
Rolling Stock PMs Late		None	5
CCTVs not Functional		12 hours	2
Graffiti Tags: Offensive or > 12” in diameter		8 hours	2
Parking Lot Lights Out or Flickering		24 hours	2
...			

Reporting Requirements

DENVER TRANSIT OPERATORS (DTO)
Attn: Denver South & West Station

On Time Availability Details
 Date Range: 05/11/2018 - 05/11/2018
 Statistics For: 11-May-18 to 11-May-18

5/12/2018
 4:34 AM

Friday, May 11, 2018

EAST CORRIDOR		Arrival				Departure				OTP	
Symbol	Station	Sched Time	Actual Time	Total Delay (mm:ss)	Excused Delay (mm:ss)	Sched Time	Actual Time	Total Delay (mm:ss)	Excused Delay (mm:ss)	Unexcused Delay (mm:ss)	Status
167-11	DUS TRK1	-	-	-	-	12:00:00	12:00:14	0:14	0:0	0:14	OT
167-11	Central Park TRK1	12:13:00	12:14:01	1:1	0:0	12:13:00	12:14:39	1:39	0:0	1:39	OT
167-11	40th & Airport TRK1	12:22:00	12:23:15	1:15	0:0	12:22:00	12:23:48	1:48	0:0	1:48	OT
167-11	DIA TRK1	12:37:00	12:43:45	6:45	0:0	-	-	-	-	6:45	TMT
168-11	DIA TRK1	-	-	-	-	12:57:00	12:57:09	0:9	0:0	0:9	OT
168-11	40th & Airport TRK2	13:10:00	13:10:42	0:42	0:0	13:10:00	13:11:11	1:11	0:0	1:11	OT
168-11	Central Park TRK2	13:19:00	13:20:04	1:4	0:0	13:19:00	13:20:45	1:45	0:0	1:45	OT
168-11	DUS TRK1	13:34:00	13:46:51	12:51	0:0	-	-	-	-	12:51	TMT
169-11	DUS TRK1	-	-	-	-	12:15:00	12:15:06	0:6	0:0	0:6	OT
169-11	Central Park TRK1	12:28:00	12:29:25	0:25	0:0	12:28:00	12:29:09	1:9	0:0	1:9	OT
169-11	40th & Airport TRK1	12:37:00	12:37:33	0:33	0:0	12:37:00	12:38:11	1:11	0:0	1:11	OT
169-11	DIA TRK1	12:52:00	12:52:09	0:9	0:0	-	-	-	-	0:9	OT
170-11	DIA TRK1	-	-	-	-	13:12:00	13:12:07	0:7	0:0	0:7	OT
170-11	40th & Airport TRK2	13:25:00	13:25:37	0:37	0:0	13:25:00	13:26:10	1:10	0:0	1:10	OT
170-11	Central Park TRK2	13:34:00	13:34:38	0:38	0:0	13:34:00	13:35:35	1:35	0:0	1:35	OT
170-11	DUS TRK1	13:49:00	13:51:24	2:24	0:0	-	-	-	-	2:24	OT
171-11	DUS TRK1	-	-	-	-	12:30:00	12:30:22	0:22	0:0	0:22	OT
171-11	Central Park TRK1	12:43:00	12:43:05	0:5	0:0	12:43:00	12:43:32	0:32	0:0	0:32	OT
171-11	40th & Airport TRK1	12:52:00	12:51:39	0:0	0:0	12:52:00	12:52:25	0:25	0:0	0:25	OT
171-11	DIA TRK1	13:07:00	13:04:35	0:0	0:0	-	-	-	-	0:0	OT

On-Time Performance

- By time point
- Over 1,000 measurements per day
- Today's OTP available in real time
- Reported daily to RTD
- Shows excused and unexcused
- Incidents: Who, What, When, Where, Why by Cause

FRA Compliance

- Records - Hours of Service, Record of Train Movement
- Efficiency Testing
- Many required documents - (e.g., PTEPP, Drug & Alcohol Compliance Plan, etc.)

Reporting Requirements - Examples

- Maintenance Performance
 - Mean Distance Between Failures
 - Rolling Stock failures by type
 - Compliant Car Miles
- Compliance with Preventive Maintenance Schedule



On-Time Performance

On-Time Performance (Monthly)

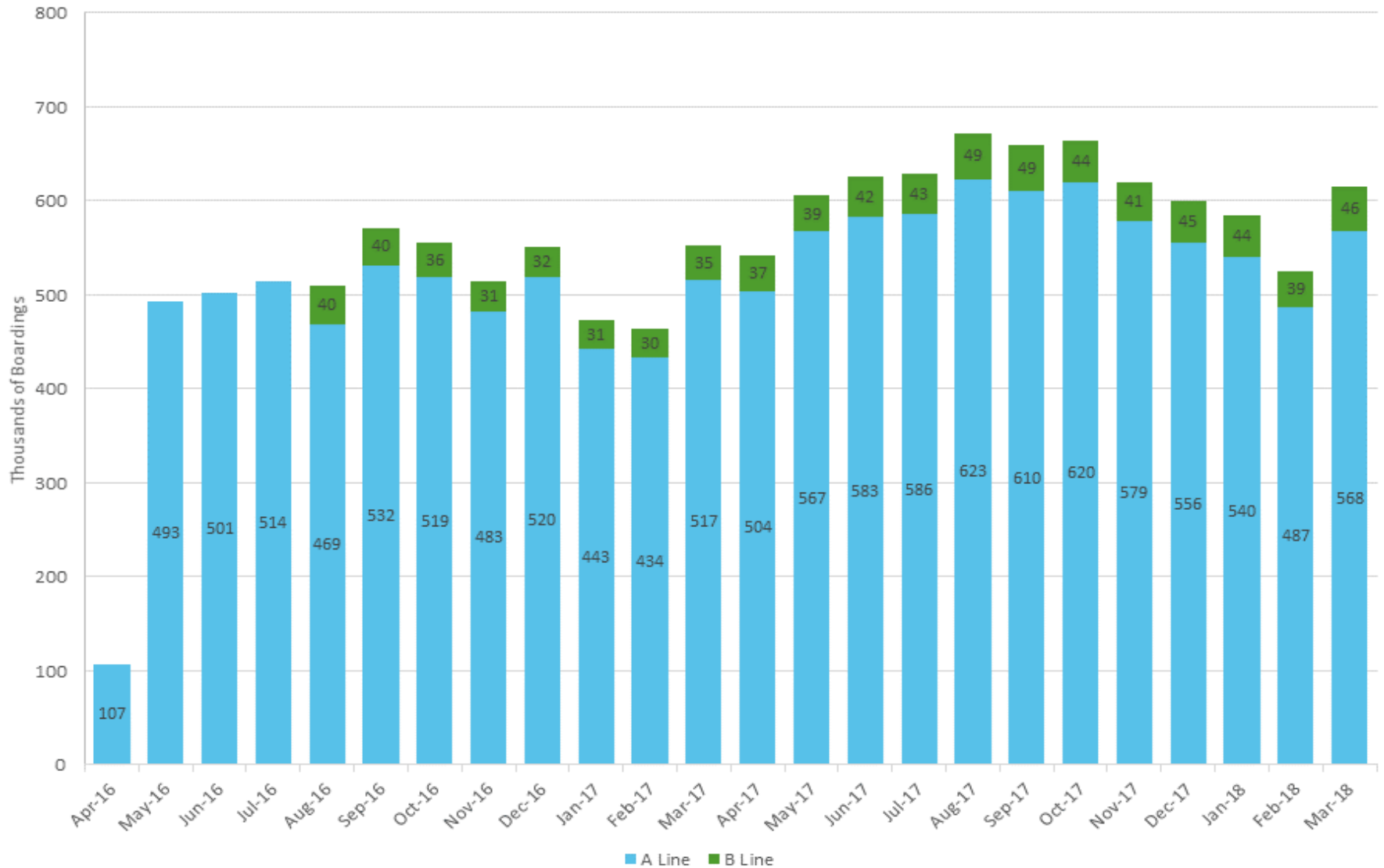


On-Time Performance (Yearly)



Ridership

RTD Monthly Commuter Rail Ridership



Ridership

% Increase Over Previous Year		
Month	<u>A Line</u>	<u>B Line</u>
May-17	15.02%	
Jun-17	16.35%	
Jul-17	13.94%	
Aug-17	32.93%	21.31%
Sep-17	14.85%	23.40%
Oct-17	19.48%	22.82%
Nov-17	19.91%	29.18%
Dec-17	6.92%	41.08%
Jan-18	35.33%	41.32%
Feb-18	12.21%	30.86%
Mar-18	10.01%	31.25%

Constraints

- Competitive Procurement
- Lean Staffing
 - For O&M
 - For IT support (3 people user support, upgrades, troubleshooting for Admin and Ops. systems)
- Limited \$ for customization
- Vital to respond promptly to defects

Approach

- Off-the shelf systems
- Integration
- Little customization
 - Key interfaces only
 - In-house report writing
- Data automatically moves between systems
 - Data is not entered into multiple systems

Approach - Automatic Data Flow

Field Alert

→ OCC Incident

→ Maintenance

→ Reporting

Products

- Trapeze Enterprise Asset Management (EAM)
 - Asset & Maintenance Management
 - Preventive maintenance scheduling & work documentation
 - Defect tracking & repair documentation
 - Condition tracking & renewals management
 - 3rd Party Work project management
 - Inventory & Tool Management
 - Procurement & Warranty Management
 - Scheduled and Ad Hoc Reporting
 - PM Compliance reports
 - STO Point penalty reporting
 - Equipment failures & status

- Hyundai Rotem – Quester Tangent
 - Monitoring & Diagnostic System (MDS)

Products

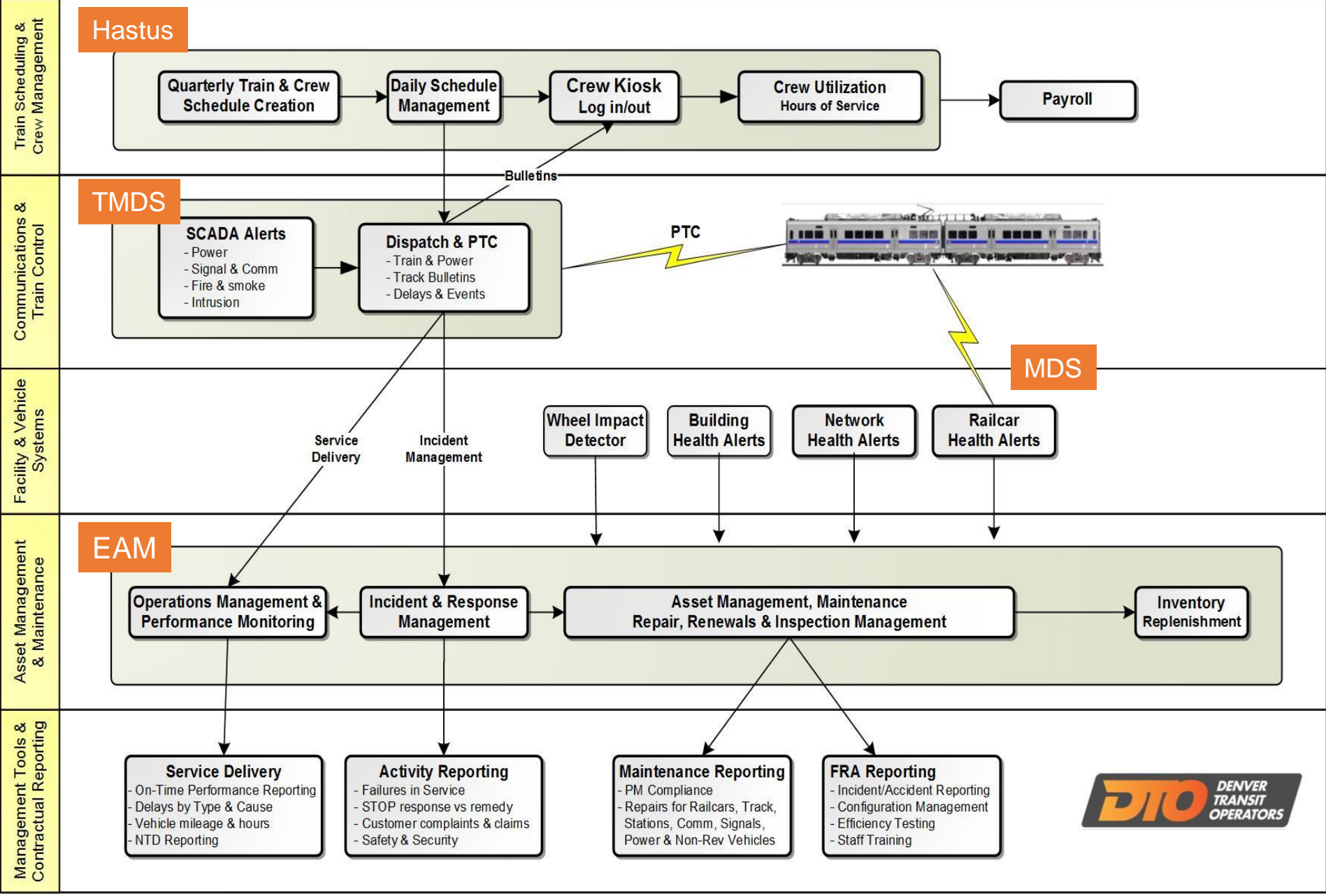
□ Hastus

- Train and Crew Scheduling
- Crew Management
 - Bidding work and vacations
 - Daily dispatch (feeds payroll)
- Hours of Service Tracking
- Feeds daily train & crew schedule to TMDS

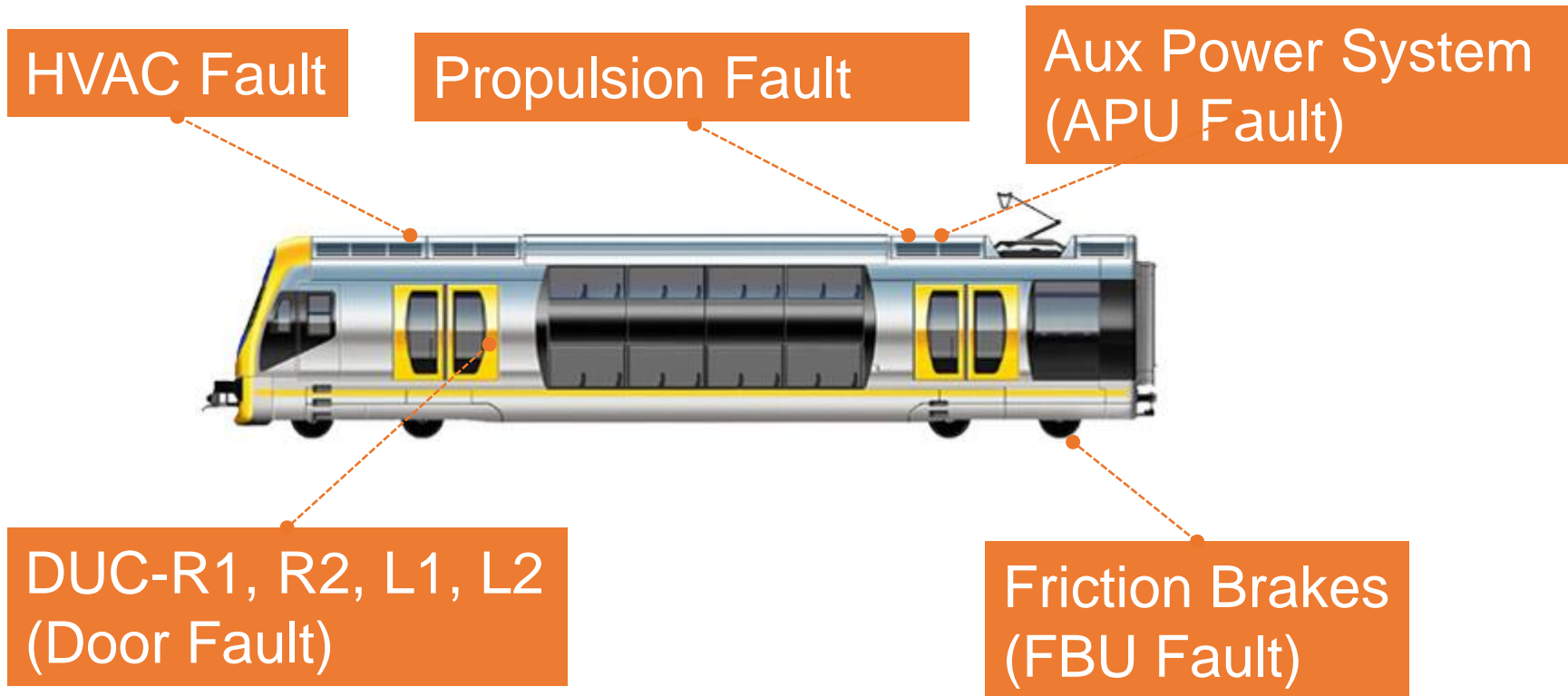
□ Wabtec TMDS/TPMS

- Dispatching & Performance Reporting
- Interface to Positive Train Control
- Traction Power Management
- SCADA & NMS – real time infrastructure alerts

Transit Operations & Planning Solution (TOPS)



Vehicle onboard systems: Sample of Real-Time Alerts



Integrating Alerts into EAM



Vehicle faults



Train Control & Infrastructure Alerts (SCADA)



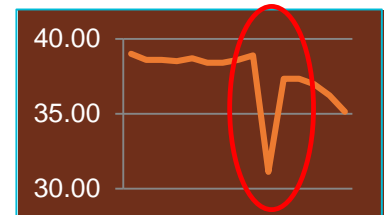
Integration server
Captures Alerts



Trapeze
EAM



Maintenance triggered
and team alerted



Analyze fault data

Service Requests/Defects



Search



Reload



Sort

Filter
MOST RECENT
Sort



New



Copy



Delete



Edit

Row #	Shop	Priority ID	Equipment ID	Symptom	Status	Date and time entered	Reporting
24	R	2	4064	COMM FAULT	PENDING	05/04/2018 12:12	MDS
25	R	S2	4064	HVAC FAULT	PENDING	05/04/2018 12:12	MDS
26	R	3	4063	CCTV FAULT	PENDING	05/04/2018 12:12	MDS

Date and time entered: 05/04/2018 12:12
 Entered by: MAXQ

Basic Info

Equipment ID: 4064
 2014 HR EMU EMU MB CAR

Shop: R RAILCAR MAINTENANCE SHOP
 Status: PENDING [View/edit/open work order](#)

Work order ID: 0 0

Symptom: HVAC FAULT HVAC FAULT

Task ID: R08-002 HVAC UNIT

Priority ID: S2
2 HOURS STO REMEDY TIME INTERNAL SHOP PR

Date and time required: 05/04/2018 14:12
 Meter 1: 37650

Estimated hours: 0.00
 Latest meter reading: 37650

Posted hours: 0.00

Comments

Description: FAULT TO DETECT OPEN DAMPER

Comments: REMOVE FRESH AIR FILTER AND VIA PTE OPERATE DAMPER TO CONFIRM OPERATION.

Train System Alert Message

Auto-generated Technician Message
 (how to respond to alert)

“Smart Infrastructure”

SCADA Alert types:

- ❑ Power Substation (22)
- ❑ Crossing House (12)
- ❑ Master Locations (12)
- ❑ Interlockings (140)
- ❑ Comm House (7)
- ❑ OCS (4)
- ❑ Elevator (2)
- ❑ Sump Pump (3)

NMS Alert types:

- ❑ CCTV Camera (1) & Recorder (5)
- ❑ Ruggedcom Radio (7)
- ❑ PA Amplifier (5)
- ❑ VMS signs
- ❑ UPS (4)
- ❑ Network & Switches (20)



Infrastructure: Sample of Real-Time SCADA Alerts

Infrastructure	System	Alarm Type
Communications House	Fire Alarm	Intrusion
		AC Power
		High/Low Temp, Fire, Smoke
Traction Power	Power	Disconnect Switch Open/Closed
		Disconnect Switch Local/Remote
		Equipment Trouble
		Intrusion
Interlocking	Interlocking	Main/Aux Active or Standby
		Link failure, Fault, Power Fail...

Infrastructure: Sample of Real-Time SCADA Alerts

Infrastructure	System	Alarm Type
Grade Crossings	Crossing Housing	Gate Down/Up
		Crossing Deenergized
		Fire or Smoke Alarm
		Intrusion
		AC or DC Power Out
		Crossing Out of Service
		Ground Fault
		Loop Health

Incident Flow

Field alert -> OCC -> Maintenance Process -> Reporting

1) Incident (TMDS)

Captures:

- Asset impacted
- Symptom
- Trains Delayed

Creates Service Request

2) Service Request (EAM)

Asset + Symptom:

Calculates Remedy Time
Emails responsible
Maintenance group

Creates work Order

3) Work Order (EAM)

Records work done
Stops Remedy Clock
Feeds daily reporting

Elevator Alert

1) Incident (TMDS)

SCADA Captures:

Asset:

Fox St Elevator #1

Symptom:

Fault

Check CCTV for occupancy and escalate accordingly

Creates Service Request

2) Service Request (EAM)

Asset + Symptom:

Calculates Remedy Time
= 2 hours from report

Emails responsible
Maintenance group

Creates work Order

3) Work Order (EAM)

Records work done

Stops Remedy Clock

Feeds daily reporting

Interlocking Alert

1) Incident

SCADA Captures:

Asset:

Bright Interlocking

Symptom:

Main Electrologix
Standby Active Indicator

Creates Service
Request

2) Service Request

Asset + Symptom:

Emails responsible
Maintenance group

Creates Work Order

3) Work Order

Records work done

Feeds daily reporting

Service Task Order Remedy Times

STO Remedy Times

Every combination of Asset and Symptom has been assigned a unique TASK ID and is programmed with a Remedy Time.

When a Service Request is created, the Remedy Time is added to the date & time reported to calculate the date & time due for completion of this work order.

Daily reporting includes all incidents, the asset involved, symptom reported, calculated date and time due and the completion date & time.

If the Completion time is later than the Remedy Time permits then penalties are automatically calculated and applied to the monthly invoice.

Station Asset Symptoms	Remedy Time
ADA ramps/railings - minor	12 hrs
ADA ramps/railings - major	48 hrs
Cleanliness/Litter	4 hrs
Dumpster full	8 hrs
Graffiti - Station	8 hrs
Lighting any platform lights out or flickering	24 hrs
Lighting 75% of platform lights out	Immediate
Obstruction to safe access to station	Immediate
Recycle bin 75% full	4 hrs
Rodent infestation	24 hrs
Schedules/Maps	24 hrs
Signage	24 hrs
Snow/Ice on platform, ramps, parking lot...	2 hrs
Snow/Ice preventing safe train access	Immediate
Trash o bin 75% full	4 hrs
Waiting area/shelter - minor	12 hrs
Waiting area/shelter - major	48 hrs

Achievements in Automation & Integration

- Smart infrastructure provides real-time fault detection
 - Automatically sends alerts to the OCC
- Highly automated data capture
 - Avoids errors
 - Minimizes administrative labor requirement
- Automatic notification to maintenance staff
 - Speeds response times
 - Facilitates corrective action before failure
 - Increases system up time
 - Maximizes performance
- Highly automated reporting process
 - Increases confidence in /utility of reports