Bombardier Transportation (Switzerland) Ltd

WELCOME

hpc-forum-ch

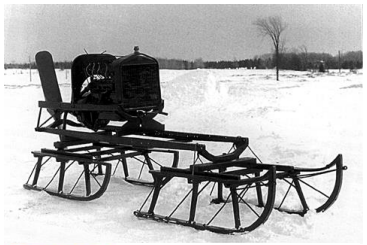
Stéphane Wettstein
Chief Country Representative

Zurich May 18th, 2017

BOMBARDIER
the evolution of mobility

BOMBARDIER OVERVIEW

Ready for the future – 75 years high engagement for mobility

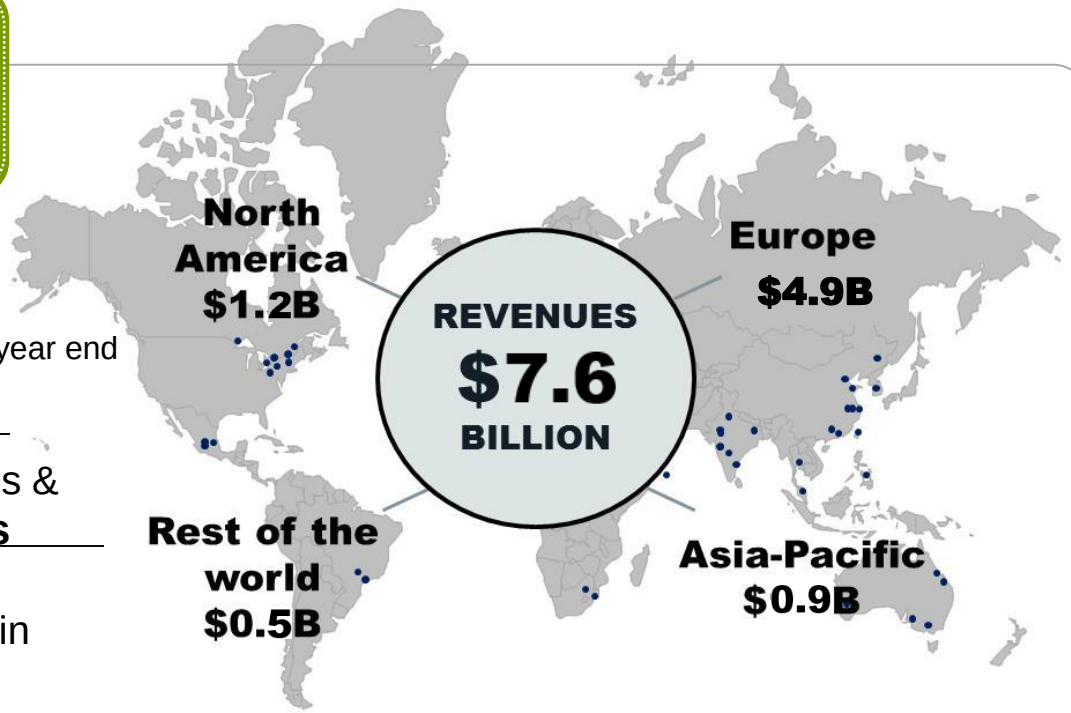


Alain Bellemare President & CEO Bombardier Inc.

BOMBARDIER
the evolution of mobility

BOMBARDIER TRANSPORTATION
BT continuously breaking new ground in sustainable mobility

Efficient rail products and services across a global footprint



37.150 employees worldwide (39.400 year end 2015)

Production and engineering sites & service centers in **28 countries**

Operational headquarters in **Berlin, Germany**

Note: All amounts in US dollars. Information as at Dec. 31, 2016. Totals may not add up due to rounding.

BOMBARDIER TRANSPORTATION
The broadest portfolio in the rail industry

Rail Vehicles

- Light rail vehicles
- Metros
- Commuter trains
- Regional trains
- Intercity trains
- High speed trains
- Locomotives

Transportation Systems

- Driverless Systems: Monorails, Metros, People Movers
- Light rail systems
- Metro Systems
- Intercity Systems
- E-mobility Solutions
- Operations and Maintenance

Services

- Fleet Management
- Asset Life Management
- Material Solutions
- Component re-engineering and overhaul

Rail Control Solutions

- Integrated control systems
- Automatic train protection and operation
- Interlocking systems
- Wayside equipment
- Services

Propulsion & Controls

- Traction converters
- Auxiliary converters
- Traction drives
- Control and communication

Bogies

- Portfolio to match entire range of rail vehicles
- Full scope of service over the lifetime of a bogie

BMBARDIER TRANSPORATION
Thank you very much for your attention – enjoy your visit

BT Switzerland – Industrial Partner of Public Transport

BOMBARDIER
the evolution of mobility

ORBITA

Remote diagnostics SBB-ICN

HPC Forum 18.05.2017

Hanspeter Krieger

Maintenance Project Engineer

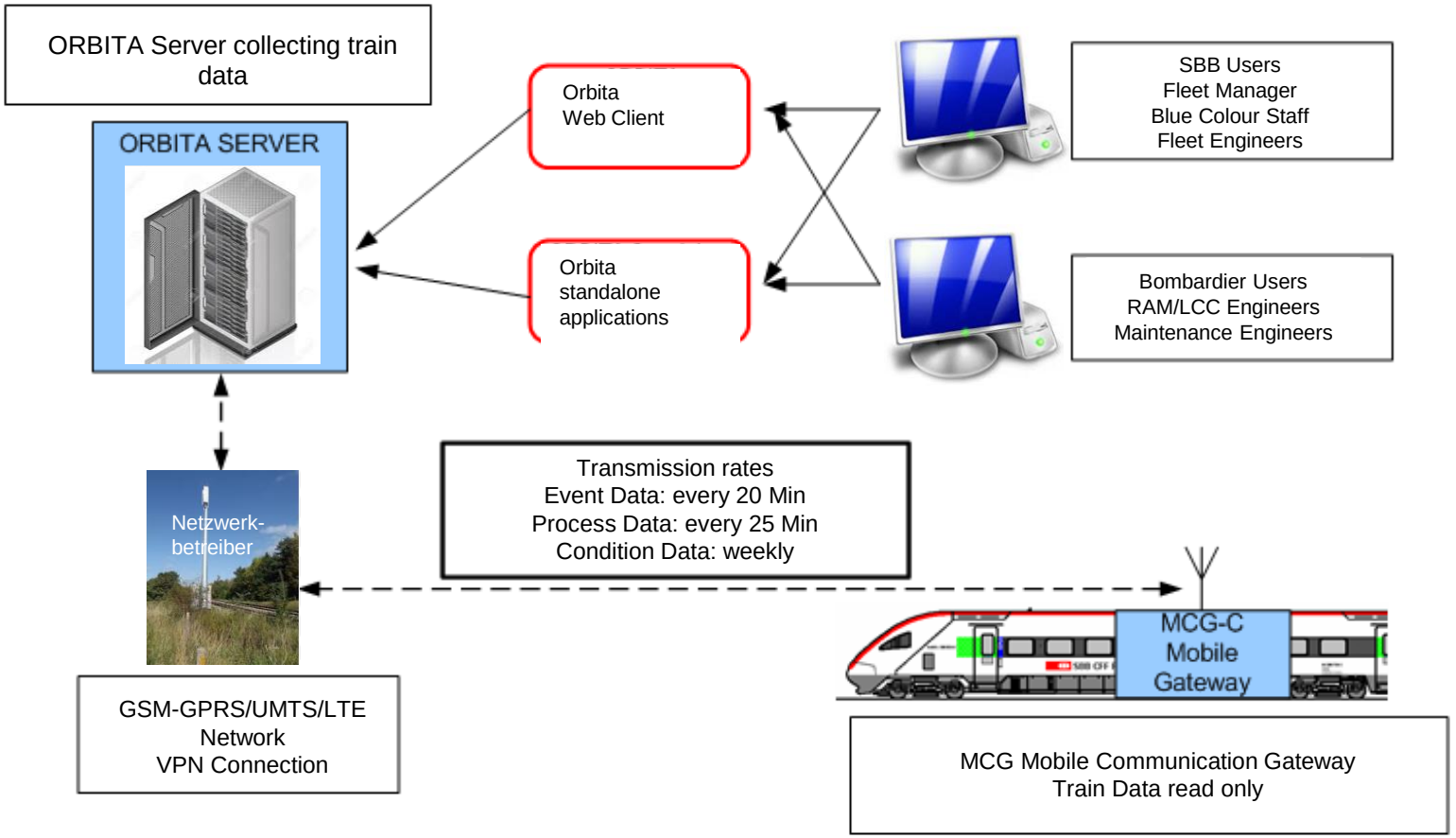
5.5.2017

BOMBARDIER
the evolution of mobility

ICN-Fleet SBB

ICN:	Intercity Tilting Train
Fleet size:	44 trains (7 coaches)
Delivery:	1999-2005 Bombardier (ADtranz) Schweiz
Controll and diagnostic system:	MITRAC
Traction Converter:	GTO (based on „Lok 2000“ family)

ICN *ORBITA* – Data Flow

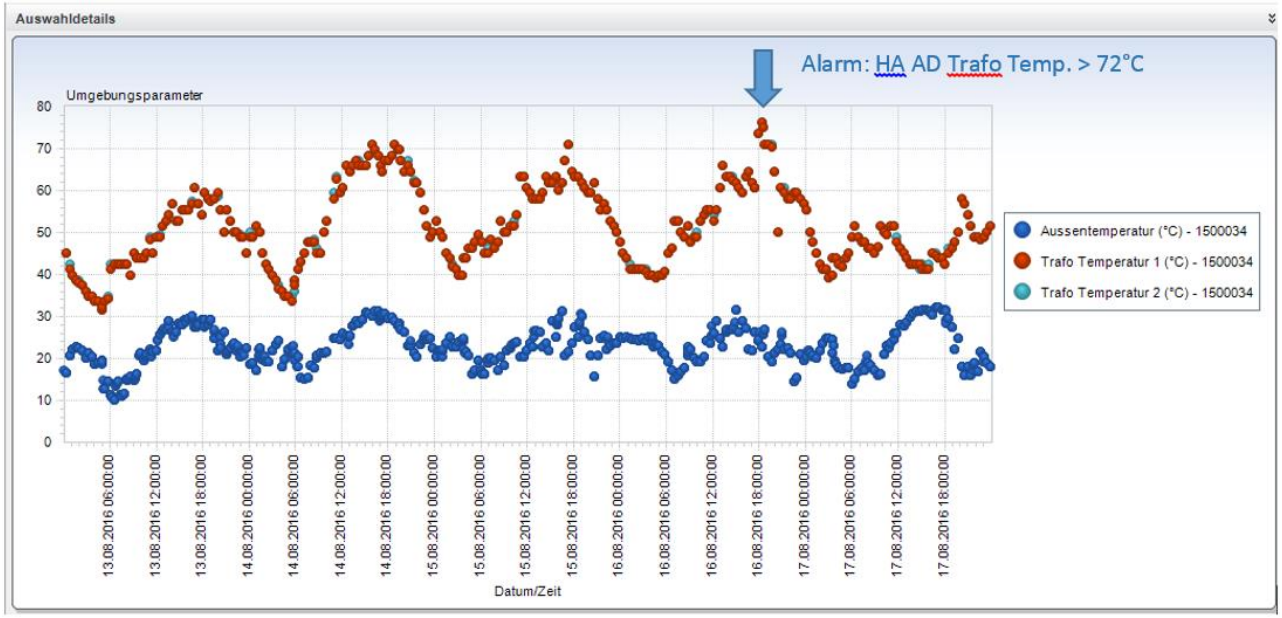


Project Targets Orbita SBB ICN
Conclusion of contract 2008

- Integration into SBB organisation for daily services and maintenance 2009 
- Step by step improvement of availabitlity (39 → 40 → 41 trains in sevice) 2010 
- Improvement availability of critical systemes (particularly tilting system) 2011 
- Reduction of delays caused by the ICN fleet 2011 

CBM: Transformer Over Temperature Triggers Cooler Cleaning

Alert: HA AD Trafo Temp. > 72°C



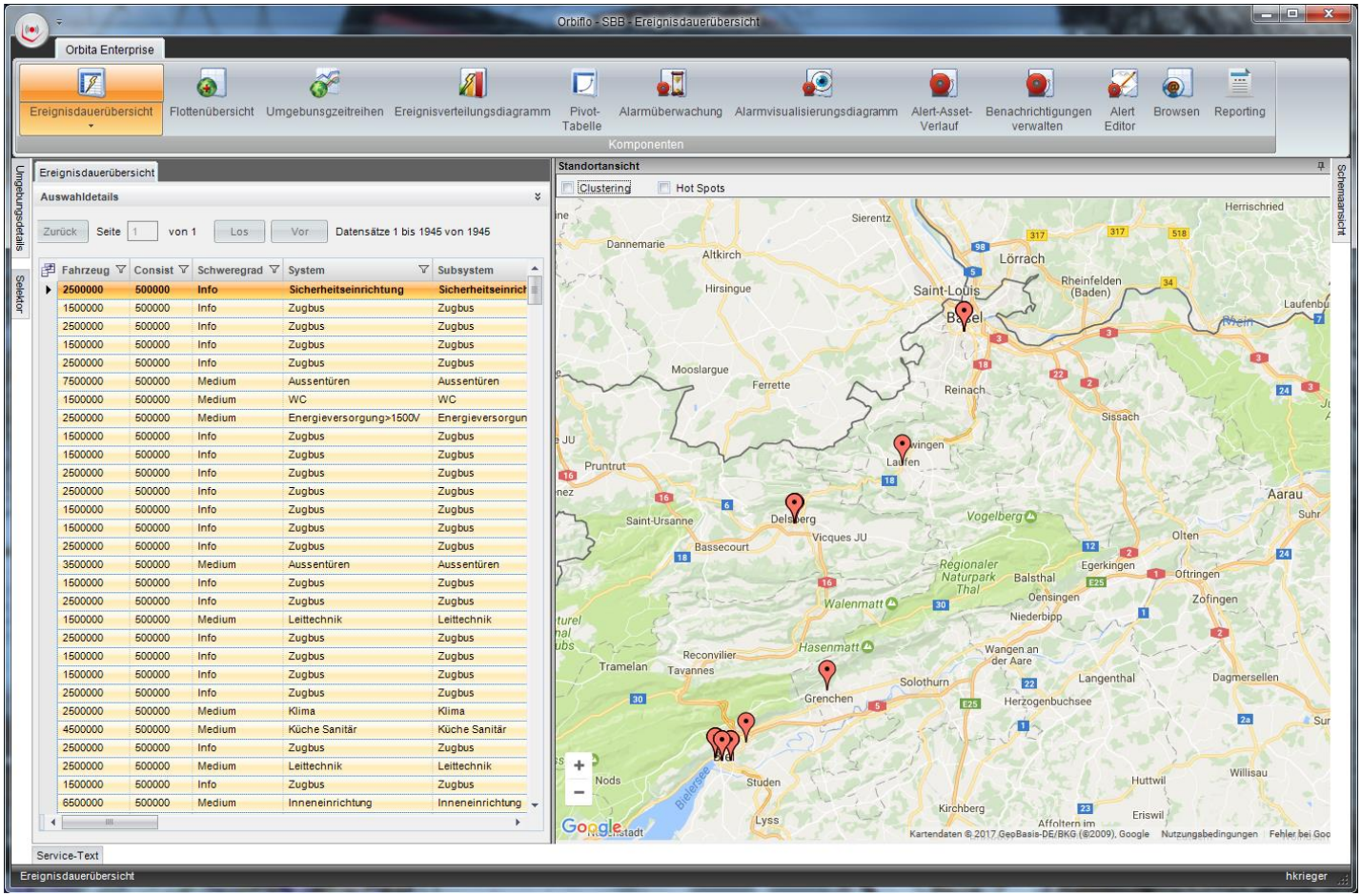
Alert:
«HA AD Trafo Temp. > 72°C» is triggering when cooler temperature reaches 72°C
> before any traction reduction accurse.

Cleaning of cooler can take place without disturbance of daily service

BOMBARDIER
the evolution of mobility

Q&A

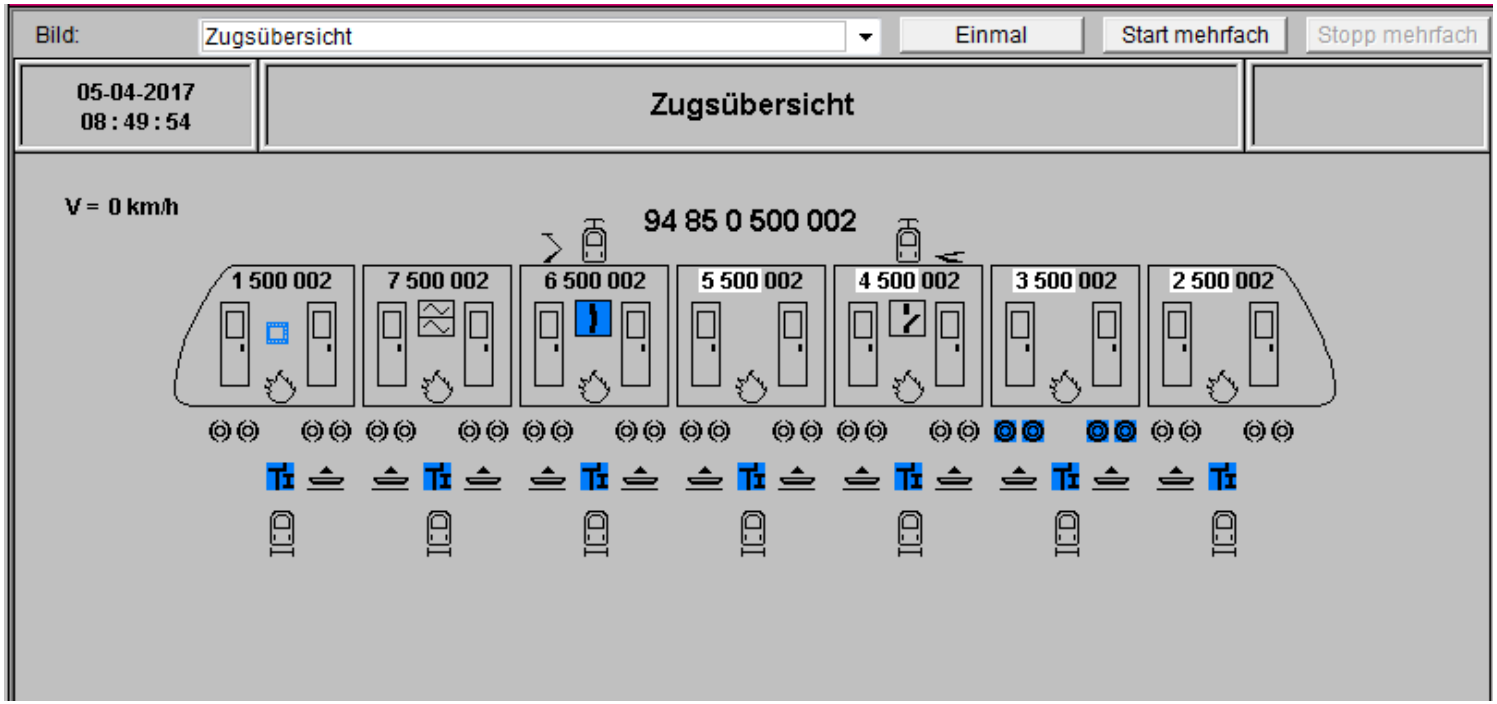
Live Screen – Position Over View



BOMBARDIER
the evolution of mobility

Live Screen – Train Overview

Train Overview



BOMBARDIER
the evolution of mobility

ETR1000 - V300ZEFIRO

CBM - Condition Based Maintenance

Stefano Ritter,
Product Introduction & Test manager
18.05.2017

BOMBARDIER
the evolution of mobility

Agenda

1. Project Overview & Scope Split with HRI
2. CBM: What does it really means?
3. CBM & BUS Architecture on ETR1000
4. Diagnostic Events & Alerts
5. Prognostic and CBM Functions

PROJECT OVERVIEW

ETR1000 - Fastest ecological mass transportation system in Europe

- Customer: TRENITALIA – GRUPPO FERROVIE DELLO STATO ITALIANE Manufacturer: BOMBARDIER the evolution of mobility / AnsaldoBreda
- **High capacity** and state of the art solutions for **energy efficiency**
- **NTP** date: **30.09.2010**, 1,54 billion €. Total **50 trains**. **Delivery** of the last train: **May 2017**.
- 10 years **Full Maintenance** contract, option for 5+5+5 years
- Designed average **annual distance: 500.000 km**
- **Daily use:** at least **18 hours in commercial service,** auxiliary services in function for 24 hours a day.
- bi-directional, **single deck** trainset, **8 cars**, two bogies per carbody
- in fixed formation with distributed power
- 16 out of 32 axles driven with induction motors
- multiple traction operation with 2 train units
- Train length: **202 m**
- Capacity: **469 + 2** seats in 4 classes / levels
- Max power: **9.8 MW** in AC
- Commercial speed:
  350 km/h @25kVac - **300 km/h** @3kVdc,
- Mileage: **51% in AC, 49% in DC**, May 2017
- Max speed in test: **393 km/h**

SCOPE SPLIT WITH HRI

BT share 42.3%, AB share 57.7%

BT part

- Overall design responsibility / technical lead, homologation, type tests
- TCMS, onboard and wayside diagnostic system
- Bogies
- Propulsion and auxiliaries
- Brakes
- Circuit diagrams
- End car (car body, installation, cab)

AB part (today HRI) Hitachi Rail Italy

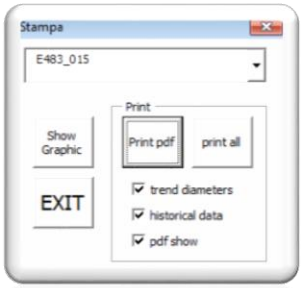
- Intermediate cars (car body, installation)
- Interiors
- Crash
- HVAC
- PIS
- Industrial design
- Doors

CBM: WHAT DOES IT REALLY MEANS?

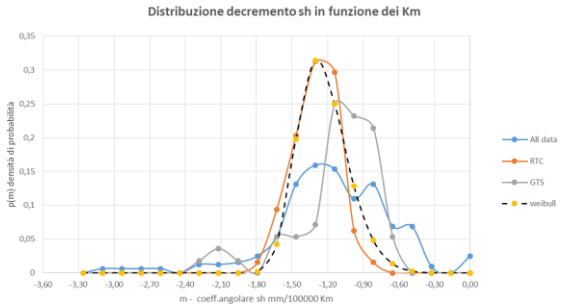
Changing from fixed maintenance intervals to Condition Based Maintenance

DO WHAT IS NECESSARY
WHEN IT IS NECESSARY...!!!!!!

MEASURE & SAMPLE



ANALYZE & DEFINE STD CURVE



RE-DEFINE ACTIVITY / PERIODICITY

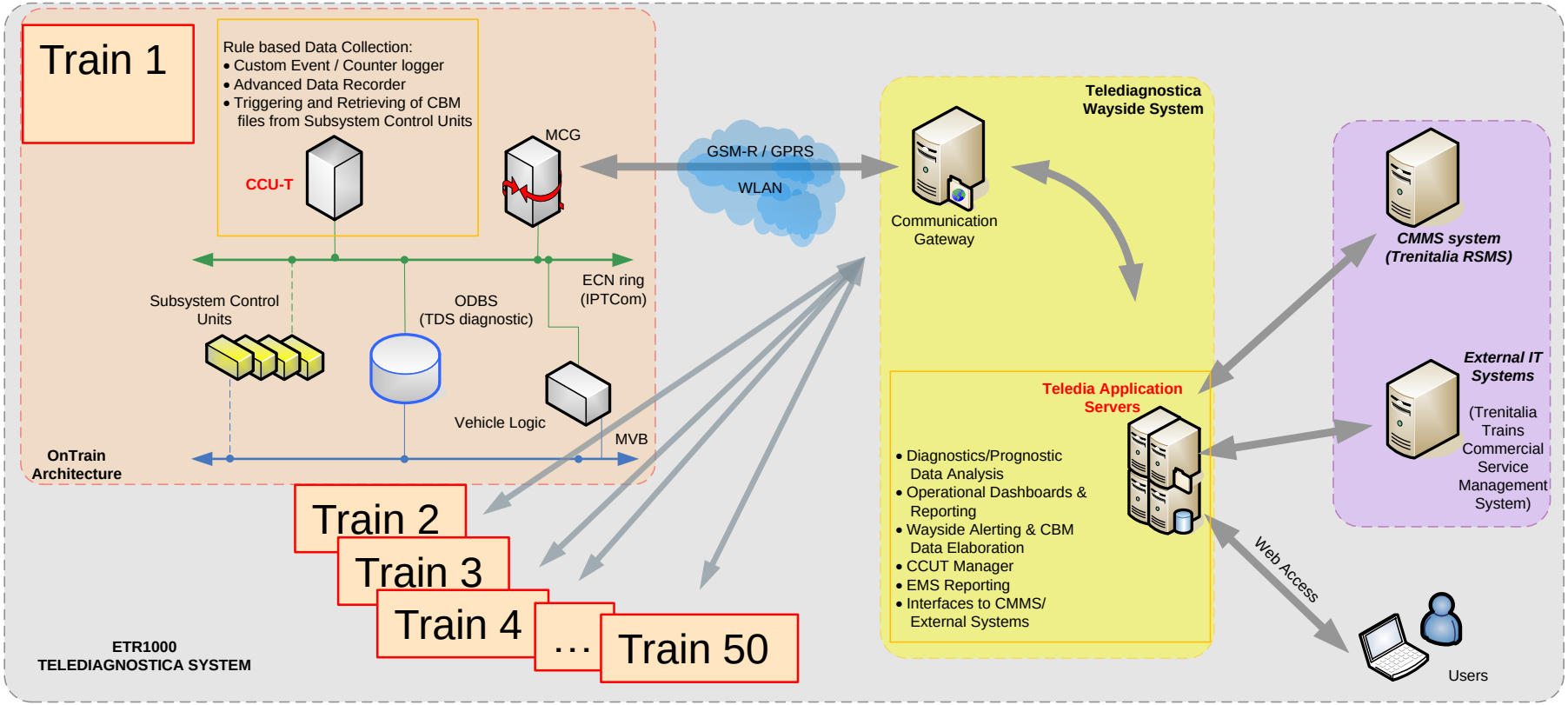
Piano di manutenzione E483 I

Riferimento al Doc. n. 3EGK 0000 22 N 0401	Attività	Operazioni basate sui km [Migliaia di km]					Operazioni basate sul tempo [anni]					Classificazione SNC	Scadenza particolare
		I1	I2	I3	R1	R2	T1	T2	T3	T4	T5		
Edizione 04 Data 05/14		30	150	300	1.200	2.400	0,5	1	4	8	16		
	~~Revisionare le pompe del fluido refrigerante~~									~~X~~	X	R	
	Controllare la sonda di misura della pressione e della temperatura								X	X	X	R	
	Pulire il blocco del convertitore								X	X	X	R	
	Pulire i moduli CM-M								X	X	X	R	
	Controllare le resistenze di carico, di smorzamento e del filtro (effettuare la misurazione della resistenza su tutte e 5 le resistenze)									X	X	R	
	Cambiare le valvole di arresto del circuito di raffreddamento									X	X	R	
	Cambiare i tubi flessibili EPDM									X	X	R	
	Misurare la capacità dei condensatori CM-M									~~X~~	X	R	
	Misurare la capacità di tutti i singoli condensatori compresi i CM-M C									~~X~~	X	R	
	Reinserire i moduli CM-M								~~X~~	~~X~~	X	R	
5.6	**Convertitori dei servizi ausiliari**												
	Mettere a terra il convertitore dei servizi ausiliari						X	X	X	X	X	S	

BOMBARDIER
the evolution of mobility

CBM ARCHITECTURE ON ETR1000

Telediagnostica system - On Train – Wayside – Servers – Users & External IT



Telediagnostica Trenitalia system:

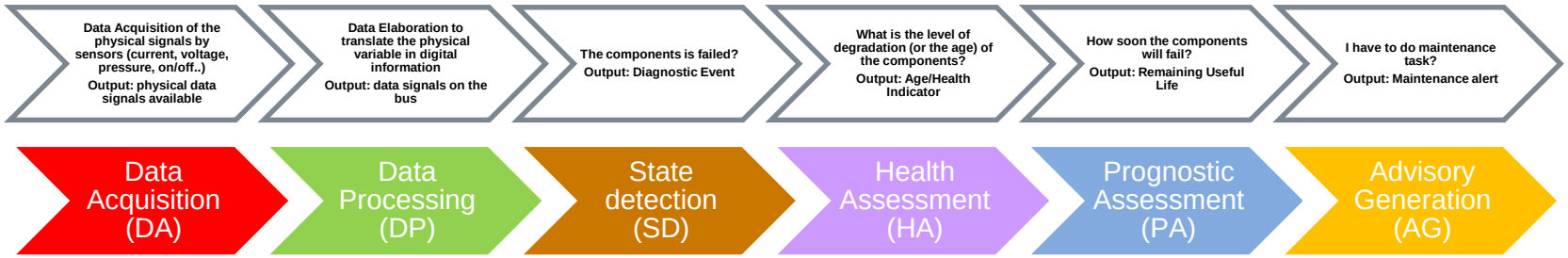
- Manages the ETR1000 fleet
- Is fully dedicated to monitor the performance and the failure of the vehicles
- Triggers automatically corrective and preventive works in the Trenitalia maintenance system.

BOMBARDIER
the evolution of mobility

PROGNOSTIC AND CBM FUNCTIONS

Prognostic Health Monitoring & CBM – Activity ongoing

- CBM functions & diagnostic alerts are **contractual deliverables to Trenitalia**
- Several **sensors** to evaluate the **age/health** of the critical systems
- Prognostic Health Monitoring (PHM), based on following steps



- Systems with prognostic and CBM:
  - Bogie
  - Propulsion
  - HVAC
  - Pantographs
  - Passenger doors
  - Brake system

For each system a list of Prognostic/CBM functions has been defined.
Each function is split in the above PHM steps
(DA, DP, SD or HA, PA, AG)

- Key point of success to implement Diagnostic Alerts & CBM:
  - A dedicated Engineering team and Customer Service team on field, working together since 2015

Q&A

MITRAC Powerlab

HW & SW Testing for High Power Traction Systems

Guided Tour

Markus Joerg

Head of Propulsion Product Engine
High Power Propulsion

18.5.2017

BOMBARDIER
the evolution of mobility

MITRAC Power Laboratory

HW & SW Testing for High Power Traction Systems

Facts and Figures

- In operation since 2009
- 1’380 m^2 lab floor and prototype assembly area
- 320 m^2 machine room area: motors, transformers, cooling
- 400 m outdoor test tracks

6 Test Cells

- Type, combined and system tests
- Product investigation Test
- Converter Reliability Test
- IGBT load cycling test over extended time
- Semiconductor characterization
- Cooling system test bench

Supported Voltage Systems

- 0 - 4.2 kV DC
- 15 kV AC 16.7 Hz
- 25 kV AC 50 Hz
- 8 MVA installed accessible power
- External Diesel aggregates for DE Loco propulsion systems

BOMBARDIER
the evolution of mobility

BOMBARDIER

the evolution of mobility