AUTOMATIC TRAIN OPERATION (ATO) ACBM3 TYPE

- **Subsystem for Automatic Train Operation under the engine-driver supervision**
- **Operates within the LZA system (ATC)**
- **Speed control, automatic target braking, running time control with energy optimisation**
- **Braking curve generated by vehicle in the real time**
- **Vehicle equipment control (doors, outside lights, information system)**
- **User changeable onboard data (Route Map, Time tables, Vehicle parameters)**
- **High reliability**

General Description
The ACBM3 (ATO) automation subsystem together with SOP-2P (ATP) subsystem forms the LZA system of the ATC (Automatic Train Control) class.

The main objective of the ACBM3 subsystem is automation of engine driver´s interventions which significantly improves the operation quality (in time and distance). The result is the smooth operation, minimum deviations from the timetable, minimum traction energy consumption, precise stopping in designated locations and full automation of door control and other vehicle systems.

The ACBM3 solution supports the prospective full automation of the metro operation under a dispatcher´s supervision in the future.

Basic Technical Description
The ACBM3 subsystem does not have own stationary parts but uses stationary parts of SOP-2P system. Transmission data channel track – vehicle transfers data for SOP-2P and also for ACBM3.

From the Route Map the system receives the required input data quite independently on a position of the transmission elements at the railyard. From a railway point of view the initial interventions of the ACBM3 subsystem has a continuous pattern though the transmission of some information has intermittent pattern.

If necessary the driver can enter the train control anytime. He can set a lower speed limit or directly set the more intensive braking by relevant control lever without switching off the ACBM3 subsystem.

The subsystem also provides (in cooperation with dispatcher´s system) many of dispatcher´s functions, i.e. functions remotely controlled by a dispatcher even without cooperation of a driver. For instance, passage of the train through a station, stopping the train in a designated location (even in a tunnel), blocking the departure from a station, correction of a time table or introduction of a completely new time table.

In cooperation with dispatcher´s system (but without a direct participation of a dispatcher) the ACBM3

ACBM3 mobile part

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subsystem provides also an unmanned turn of the train. At the terminal station a train set moves to track for train direction change and returns back again to the departure platform by itself without the presence of a driver.

Subsystem Basic Properties are as follows:

- vehicle operation control by unified output signal – "proportional traction"
- operation hierarchic structure: travel time control/target braking control – speed control – interface to vehicle
- application of the verified control principle of close feedbacks
- generation of a relevant guiding curve by a direct calculation in ACBM3 mobile part (on-board)
- identification of a train instant position on track through information points (physical or virtual) included in stationary part of ATP
- use of special private on-board data – route maps and time table
- simple private stationary part – only for communication interface to the local (used) system of dispatcher´s control of Metro operation.

To make the maintenance work easy the system provides:

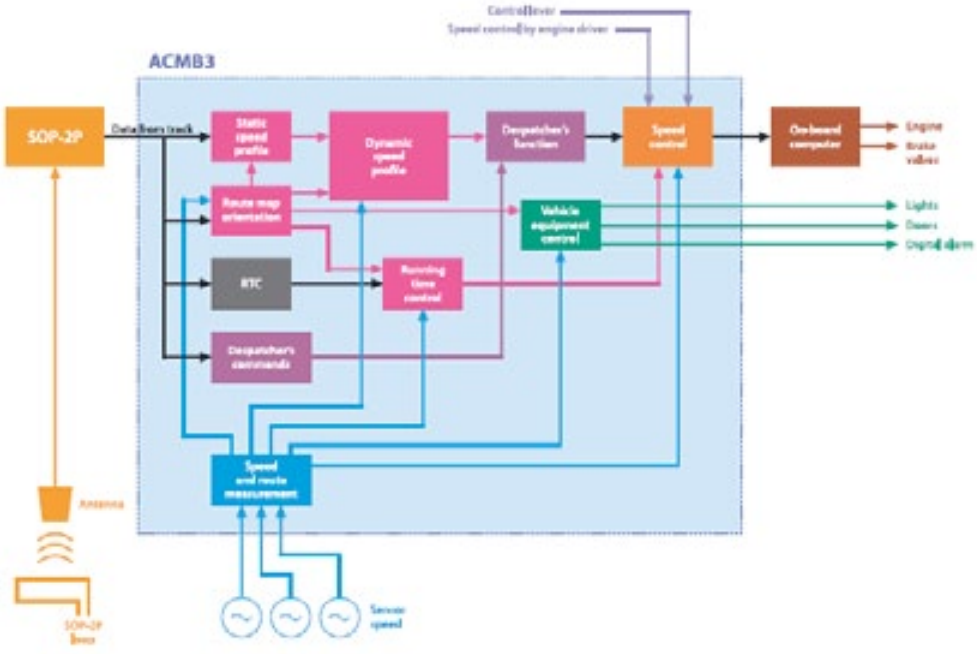
- detection of ACBM3 states, distinctly definable as faulty
- storing of faulty states in memory
- retrospective record of last 100 seconds of operation and record of operating values (of up to one hour)

For presentations, training of drivers or non-standard situations the system provides:

- auto-simulation of ACBM3 operation (of stationary vehicle)
- support of external simulation systems (including simulation of driver´s view from the cab to the track).

Basic Technical Parameters

Precision of speed control	± 0,5 km/h
Speed limits set by a driver	20 to 80 km/h (after 10 km/h)
Precision of stopping at station	typically up to ± 0,15 m
Operational deceleration on horizontal track	0,9 m/s^2
Precision in keeping the time table	–0/+5 sec.
Range of arrival time correction	± 10 min, with 5 sec. step
Step of wheel diameter setting	1 mm, individually for each axel
Memory capacity of route data	approx. 1000 km of route/1 MB
Number of routes stored in the route map	up to 8
Number of stations on each route	50 (can be expanded)



Block diagram