ATO and ETCS can work together

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Aim of this presentation

- ATO as system helps train driver to control the train
- ATO cooperates with ATP systems
- ETCS is nowadays standard for ATP
- Cooperation of ATO with ATP ETCS is logical step
- Than ATO+ETCS has been developed and is operated
- Customers are asking for this functionality which is part of GRTMS initiative of UNIFE
AŽD PRAHA COMPANY PROFILE

- Leading CEE supplier of control, command, signalling and telecommunication equipment for transportation
- More than 55 years tradition on railway market
- Czech capital and stability of the renowned company
- Core business areas
  - railway transportation
  - road transportation
  - telecommunications
  - Metro
- 1700 employees, turnover 200 MEUR
- Member of UNIFE and UNISIG
- Company provides full life cycle of product in CCS & telecom (R&D, design, Production, Installation, Servicing)
ETCS + ATO 1st project location

GSM-R implemented

ETCS L2 pilot application
2008-2011
SRS 2.3.0d
3 stations, double track, 22 km

ETCS L2 under preparation

ETCS L2 under contract 2012

ETCS L2 + GSM-R design under preparation

More information about ERTMS projects at www.ertms.net
AŽD in ETCS L2 pilot project

- **ETCS On-board part**
  - On-board delivered by Ansaldo STS
  - AŽD Delivered of STM (LS) for CZ, SK
  - ETCS integration and implementation
  - Integration of ETCS to ATO - Control systems for vehicle operation up to full supervision

- **ETCS Track-side part**
  - Modification of all interlocking and line block systems
  - Collecting and feeding data for RBC
  - Development and installation of IRI (Interlocking interface to RBC)
  - RBC and ETCS Balises delivered by Ansaldo STS
**Automatic Train Operation - AVV**

- **AVV** = Automatické Vedení Vlaku (Czech language)
- Automation system (SIL 0)
- AVV is designed for railway network and metro application

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**typical DMI of AVV for railway application**
Automatic Train Operation - AVV

- **AVV controls:**
  - traction engines
  - brakes (traction, dynamic, pneumatic)

- **On-track orientation:**
  - Balises MIB
  - ETCS balises
  - GPS device

- **Target braking with accuracy**
  - ±0.5m for railway and ±10 cm for metro

- **Control train running to reach next station just in time with minimum consumption of traction energy**
  - just-in-time arrival accuracy
    - ±5 sec for railway and ±2 sec for metro
  - energy savings 10-30%
  - CO₂ reduction (for diesel trains)
<table>
<thead>
<tr>
<th>TIME LINE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1960 - 1969</strong></td>
<td>ČSD research of train driving automation saving of energy for traction better utilization of track and rolling stock parameters First tests of Automatic Target Braking (ATB) were done</td>
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<tr>
<td><strong>1970 - 1979</strong></td>
<td>Automatic Speed Control Regulators developed (precision ±1km/h). regulators are capable to control the pneumatic train brake about 750 vehicles of all traction equipped</td>
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<tr>
<td><strong>1980 - 1989</strong></td>
<td>ATB suitable for commercial operation First mass implementation of ATB was in Prague Metro and on railway Pilot installations of Energy Saving Device in commercial operation</td>
</tr>
<tr>
<td><strong>1990 - 1999</strong></td>
<td>Introduction of ATO computer including all parts of system. The track solved by Route Map Class 470 EMUs additionally equipped with digital ASC, ATB and ESD were set in regular operation, so <strong>first complete ATO started its life</strong> Integration with ATP, additional track info received over in-fill radio</td>
</tr>
<tr>
<td><strong>2000 - 2011</strong></td>
<td>Implementation for various types of vehicles Prague underground Metro line A fully equipped Metro - Driverless operation implemented in terminus stations <strong>Integration of ETCS</strong>, replacement of proprietary balises MIB to ETCS balise and / or GPS localisation</td>
</tr>
</tbody>
</table>
MIB on-track orientation
- All 75 EMUs class 471
- All 20 Locos class 380

ETCS-balise on-track orientation
- EMU 471.042
- Loco 362.166

GPS signal on-track orientation
- All 37 DMU class 842
- All 19 Locos class 750.7
AVV+ETCS integration reasons

- Modern EMU fleet fully equipped with AVV
- AVV+LS (CZ, SK ATP) already integrated
- ETCS is a logical next step as advanced integration
- AVV uses for control of train running
  - National ATP line – ATP data and AVV balises MIB
  - No ATP line – only AVV balises MIB
  - **ETCS line - the ETCS data from EVC**
AVV+ETCS safety

- The AVV itself is SIL 0

- AVV - EVC link is therefore SIL 0

- The safety of train running is ensured by ETCS or national ATP/STM system
AVV+ETCS interface

- Developed by AŽD Praha & Ansaldo STS
- Direct communication EVC – AVV with periodic transmission of the data
- AVV provides message “ATO_STATUS” and EVC “TRAIN_DATA”

- Simple integration AVV-BTM (no EVC)
  - solution for vehicles without full ETCS equipment
Integration of AVV with ETCS

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**EVC → AVV**

- Last Relevant Balise Group (LRBG) information for on-track orientation
- Static Speed Profile (SSP), converting to Dynamic Speed Profile (DSP) and its realisation

**EVC ← AVV**

- TIU functions for service braking
- *TIU functions for Change of traction power system (DC/AC)*
### Driver activities ETCS w/o AVV

<table>
<thead>
<tr>
<th>Train driver activity</th>
<th>ETCS without AVV</th>
<th>ETCS with AVV</th>
</tr>
</thead>
<tbody>
<tr>
<td>order to depart</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>control of moving off</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>reaching and running $V_{max}$</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>braking to speed restriction</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>reaching and running $V_{restr}$</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>order to increasing of speed</td>
<td></td>
<td>x SC</td>
</tr>
<tr>
<td>control of moving off</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>coasting before stop (with respect to arriving &quot;just in time&quot;)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>station entry in restricted speed</td>
<td>x SC</td>
<td>x SC</td>
</tr>
<tr>
<td>braking to the platform</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>stopping at the platform</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

AVV has no influence to any ETCS function

**ETCS +AVV does decrease the working load of driver**
Experiences and future development

Lessons we learned:

- AVV can be operated with ETCS
- Easy integration due to no complicated EVC-AVV interaction
- ETCS braking curves are not optimised for energy consumption

Possible further steps:

- AVV functions modification for IC trains
- Proved replacement of MIB to ETCS balise
- Equipping of regional trains (no ETCS on-board) with AVV+BTM
ATO Leader in central Europe

www.azd.cz

www.ertms.net

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