360.revista de alta velocidad

número 5 - junio - 2018. Pág 159 - 163

The application of the upcoming standard on ATO over ETCS

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Abstract:

Interoperable ATO over ETCS is close to become a new standard, seen as key for the future automation of main line Railway operations in Europe.

Valuable experience and feedback is expected from an early implementation project on the Mexico City – Toluca suburban line.

Issues that could affect the deployment of systems according to the standard are identified, together with proposals to mitigate the impact.

Keywords: ATO, ETCS, Standard, Automation, Shift2Rail

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1. The application of the upcoming standard on ATO over ETCS

1.1 ATO

Automatic Train Operation is widely seen as the next big boost for the productivity and performance of main line railways. Automation has been used by metros for almost half a century, and today the technology is well proven in this environment. Urban transit operators around the world have been reaping important benefits, yet the number of main line applications remains limited.

It is relatively straightforward to provide automation within a closed system, where the trains are all essentially the same, with similar performance characteristics and a handful of standard stopping patterns. But this is clearly not the case where fast and slow passenger and freight trains must share the same tracks, sometimes run by different operators. Some form of interoperable technology is needed, which as yet is not available off the shelf.

When discussing ATO, it is important to distinguish between the four grades of automation (Table I), which require diminishing levels of human involvement up to GoA 4 which is fully unattended.

TABLE I. GRADES OF AUTOMATION

Grade of Automation	Train Operation	Setting train in motion	Stopping Train	Closing Doors	Operation in the event of disruption
GoA1	ATP with Driver	Driver	Driver	Driver	Driver
GoA2	ATO with Driver	Automatic	Automatic	Driver	Driver
GoA3	Driverless	Automatic	Automatic	Train Attendant	Train Attendant
GoA4	Unattended	Automatic	Automatic	Automatic	Automatic

Being developed by the ERTMS Users Group, Unisig and ERA, the proposed architecture for an interoperable ATO over ETCS is initially envisaged for GoA 2, retaining a driver in the cab.

2. ATO over ETCS

In the main line arena, ETCS offers a standardised ATP function as part of the architecture of the European Rail Traffic Management System. This was originally created to achieve signalling interoperability across Europe, but it is being applied more and more outside Europe, thanks in part to the availability of most elements off the shelf from multiple suppliers.

It seems logical for any main line automation project to incorporate ETCS to provide the ATP functions. But ERTMS is also about interoperability, and it will be essential to ensure seamless operations across boundaries if the European rail network is to become more competitive against other transport modes.

To ensure the maximum benefit from automation, similar system approach and interoperability

requirements should extend to the ATO. Any compliant train should be able to run safely with the target level of automation as long as it is running over a compliant infrastructure. That means complementing ETCS with interoperable ATO, while minimising the impact on the existing ETCS specifications.

This approach at the level of the wider railway system goes far beyond the traditional projectoriented approach, in order to ensure a smooth migration towards automation.

2.3 From concept to deployment

The AoE concept has been developed by a team drawn from the ERTMS User's Group and the UNISIG suppliers' association as part of a TEN-T project running from 2012 to 2014. This produced a system requirement specification and a number of interface specifications, which were presented to the European Agency for Railways at the end of 2014.

Additional technical work in 2015 included discussions with representatives of the wider European rail sector about integrating AoE into the agency's longer-term strategy for the development of new functions linked to ERTMS.

These discussions took off with the launch of the Shift2Rail technical work in September 2016. The project plan of the IP2 workstream of Shift2Rail includes the consolidation of the specifications, development of prototypes and demonstrations at different levels of integration.

In parallel, UNISIG and the ERTMS Users Group have started the work with the European Agency for Railways for adapting the ETCS specifications to allow integration with the ATO function, in such a way that the impact on the ETCS should be minimised, facilitating a smooth migration of the systems to include the Automation functions. The aim is to have the first GoA2 Shift2Rail demos running by 2018-19.

As part of the IP2 workstream, Shift2Rail will also address higher levels of automation up to GoA 3 and 4. Early implementation projects are also envisaged to provide feedback under real conditions and take the specifications to a higher level of maturity.

2.4 Early implementation: México-Toluca suburban line

While the final specifications are still under discussion, CAF Signalling has had the opportunity to pioneer a commercial application of AoE on the Mexico City – Toluca commuter line now under construction.

ATO system for this line includes both onboard and trackside equipment.

The project began in 2015, allowing the train control system to be designed from the outset using the AoE draft specifications. Grade of automation required is GoA2. Driving between stations will be automatic, but the drivers will be required to close the doors at each stop; they will also be able to operate the trains manually during periods of disruption.

The line will be fitted with ETCS Level 2 following SRS Version 2.3.0d. Although AoE specifications are mainly being made in the context of ETCS Baseline 3, this early implementation is demonstrating that the interoperable concept will also work with Baseline 2. The critical interface specifications follow the draft AoE standards, notably Subset 126 for the interface between ATO onboard and trackside and Subset 130 for that between the ETCS and ATO onboard equipment.

2.5 Early conclusions

Although the Mexico City – Toluca line is not yet operational, the project development work so far confirms that interoperable AoE offers many advantages. Most significantly, it has

confirmed that a standard and interoperable approach to GoA2 is feasible, combining ETCS as the ATP function to ensure safety with an ATO overlay based on the draft specifications. This configuration ensures a high level of functional independency between ATO and ETCS. The automation functionality and performance is not limited by ETCS, except for the safety constraints imposed by the ATP. No modifications have been needed to the RBC, and the concept can be implemented using ETCS trackside equipment to either Baseline 2 or 3.

AoE is a powerful concept built on interoperability and standardisation. While it can be applied to a standalone project such as Mexico City – Toluca, the concept itself is oriented to a wider railway network. Having a configuration that allows an ATO-equipped train to run automatically over any equipped section of the network should simplify the deployment and migration process, reducing the level of investment needed and delivering huge benefits to railway operators and passengers.

2.6 AoE: Benefits and Challenges

ATO benefits are widely demonstrated in all the studies performed about the system. Automatic Operation will provide important improvements in operation, cost and user experience, such as:

- Capacity Increase, reducing headways through optimizing driving.
- Higher punctuality by using the line data, schedule data and TMS information from the trackside in order to drive efficiently to achieve the foreseen timing.
- Higher comfort
- Energy efficiency by using the line data and real-time information in order to drive at an optimized speed profile, providing relevant energy savings.
- Decrease of maintenance cost by reducing track and train wear due to the optimized driving.
- To achieve these improvements and take advantage of these benefits, railways sector must face some challenges:
- Migration from an ATP system to an ATP+ATO system will affects to both On-Board and trackside system. This fact demands some degree of coordination between Infrastructure Managers and Train Operators.
- Communications should evolve to allow a higher capacity.
- Even if ATO can be standardized, trains where the system will be implemented were completely different, so integration of On-Board equipment should be study carefully and independently for each case. Depending on the automation grade, ATO system will interact with the train (traction, brakes, etc.) more or less.
- Drivers' function will change. Depending on the automation grade, the tasks to be performed by the driver will change more or less. This change will have human and social impact in drivers. They should to learnt and adapt to their new functions.
- The only chance to take advantage of the important benefits offered by the automation is to achieve a high degree of commitment within the full railway sector. Nowadays the initiatives to develop AoE are supported by the different actors within the sector, but results must be important to keep with it.
- Some actions have been performed in order to ease the achievement of this challenges but other ones should be analysed and developed to meet the goals. Some of them are identified as follows:

  Flexible implementation: Specifications and requirements should be defined in order to

allow the implementation of ATO system affecting as less as possible the ETCS performance and the underlying signalling system in case of existing ones.

- Clear migration facilities and plans. This is needed to define realistic planning and deployment of such a complex system. Equipment to be provided by the suppliers must also facilitate step-by-step migration strategies.
- Conformance Testing: Standardization of testing seems to be one of the most important topic to be defined in order to meet the real interoperability of ATO system.
- Railway Sector Commitment is needed mostly to facilitate the co-ordination of planning and deployment affecting the trains, the trackside signalling, and the trackside-train communications.

3. References

Villalba, M. (2016) Pioneering ATO over ETCS Level 2, Railway Gazette International.