ERTMS and ETCS Performance Optimisation

Workshop 6B of CCRCC 2019

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ETCS L2 and its periphery: Where are the bottlenecks?

Theses to be discussed:

- Interlocking
  → *Thameslink: Block size is very important, optimized by simulation, very complex; Degraded operation is challenging (big capacity loss); Depends on network; L2 high density block rather expensive; Level 3 is attractive because of costs (much less axle counters); ATO gains sustained and repeatable performance*
  → *Paris – Lyon: much shorter block length with ETCS; permissive blocks are hindering capacity, substitute them by regular blocks*
- How to measure capacity?
  → *don't limit thought to number of trains; operational concept (mix of train categories, stopping patterns, ...) is important*
  → *headways? (too simple for nodes)*
  → *how to optimise overall networks?*
  → *desired timetable is important!*

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ETCS L2 and its periphery: Where are the bottlenecks?

Theses to be discussed:

- Axle-counters
  → *with ETCS Level 2 and high density of blocks, number of axle counters increases vastly*
  → *fall back options to deal with single failures are needed*

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ETCS L2 and its periphery: Where are the bottlenecks?

Theses to be discussed:

- Line-side Signals / Fall back options
  → *Class B systems result in additional constraints to block size optimization*
  → *high availability requirements when abandoning Class B systems as fall back*
  → *shunting still requires shunting signals – get rid of shunting?*
  → *is differentiation between shunting and train movements still required? fully supervised shunting movements? e. g., pushed movements aren't covered by ETCS supervision (Italy, Switzerland: want to get rid of shunting signals)*
  → *Danmark will remove difference between open lines and stations ("one big station")*

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ETCS L2 and its periphery: Where are the bottlenecks?

Theses to be discussed:

- Radio
  → *no significant discussion*

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What can we do with Level 1?

Strong Theses to be discussed:

- FS
  → *Level 1 as substitution for Level 2 in case of issues with radio?*
  → *Austrian experience: no capacity gain even with optimized infill loops, operation in case of technical issues difficult; now L2 is preferred*
  → *Spain: L1 is suitable for some lines (may be cheaper), but not for high capacity*
  → *Luxembourg: L1 with IP-based interlocking ("more clever movement authorities"); new signal aspects, new operational procedures; L2 out of scope*

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What can we do with Level 1?

Strong Theses to be discussed:

- LS
  → *completely dependent on national legacy system, safety targets*
  → *some problems with specification remaining, e.g. CR 870*
  → *no increase in capacity, but in safety*

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Capacity gains due to Level 3?

Strong Theses to be discussed:

- Small blocks, virtual blocks, moving blocks, blocks at all?
  → *do moving blocks increase capacity compared to small virtual blocks?*
  → *TMS logic does not support moving block yet?*
  → *moving block will increase solution space of future TMS (more flexible operation)*
  → *technical fall back? procedures during degraded operation?*
  → *Eulynx-like interlocking architecture will allow for "cheaper" (much less cables) and "simple" virtual block parametrisation*

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Capacity gains due to Level 3?

Strong Theses to be discussed:

- Train integrity
  → *topic postponed*

- Performance impact from radio, odometry?
  → *to get most out of it, radio must be faster (e2e), to save axle-counters on an open line, it´s o. k.*
  → *to get most out of it, we need fast and accurate safe rear end localisation*

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Game changers or possible optimisation measures?

Strong Theses to be discussed:

- breaking curves
  → *a lot of discussion to performed:*
  → *steepness, series of curves, Gamma-optimisation, Lambda-model, …*
  → *hardly any know-how, few experiences, but: it´s a **GAME Changer**!*
  → *trackside does not know about trains' breaking performance → assumptions on safe side → harming capacity*

- virtual balises
  → *may reduce operational costs*
  → *improve odometry by GNSS instead of additional physical balises*

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Game changers or possible optimisation measures?

Strong Theses to be discussed:

- CCS convergence
  → *maybe e2e performance gains?* → *EuLYNX*

- ATO
  → *get rid of breaking announcements!*
  → *a lot more impact on performance besides ETCS*
  → *reduction in running time supplements in the timetable due to reproducible train runs*

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Other?

Strong Theses to be discussed:

- Let´s be faster in migration!
  → *the worst of all is mixed traffic with legacy systems*
  → *keep everything (rules, signals, overlap, …) and put ETCS upon that, is worst case*
  → *there is still a lot to do for this besides technology (operational rules, specification, safety assessment, availability measures, approvals, onboard migration, …)*
  (not discussed)

- Dwelling times
  → *optimize station layout, optimize rolling stock design for fast (de)boarding*

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Other?

Strong Theses to be discussed:

- Migration: Vehicle & Infrastructure dependencies
  → more balises or more accurate vehicle odometry? Wo optimizes whole system in diverse European railway market? Infrastructure and vehicles depend on each other
  → benefits on infrastructure side; costs on infrastructure and vehicle side – balance between IM benefits and RU migration costs?