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Implementation of LX protection in ERTMS L2 baseline 3

Finding a balance between blocking road traffic and train traffic

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Danish ERTMS deployment

2100 km of mixed operation railway, 3 existing national borders and one future border

Renewal of all signalling assets

> Traffic management and new Traffic Control Centres

> Train control and Train radio

> Interlocking, Point machines, train detection, Level crossing protection, Passenger warning and staff crossing systems

> Updated fibre backbone and renewed active network

Functional requirements – two different trackside solutions

> Thales

> Alstom

Approx. 400 level crossings with LX protection systems on the national network

Strækninger
Stationer markeret med '( )' indikerer, at udrustning af signaler på denne station ikke er omfattet af pågældende strækning.

- Frederikshavn–(Lindholm) 2018
  (Roskilde) - (Køge) 2019
  (Struer)-Thisted 2020
  (Langå)-Struer-(Holstebro) 2021

- Køge–(Næstved) 2021
  Mogenstrup–Rødby 2021

- (Vejle)-Holstebro-Herning-(Skanderborg) 2022
  (Vigerslev)- (Ringsted) 2022

- (Esbjerg)-(Holstebro)-Skjern-(Herning) 2023
  Storstrømsbro 2023

- (Roskilde)-Kalundborg 2024
  (Aarhus)-Aalborg Lufthavn 2024
  (Lunderskov)-Esbjerg 2024
  (Bramming)-Tønder 2024

- (København)-(Peberholm) 2025
  (Fredericia)-Aarhus 2026
  (Odense)-Svendborg 2024–2026

- Fredercia-(Middelfart)-Padborg 2027
  (Tinglev)-Sønderborg 2027
  Korsør-Middelfart 2027

- (Helgoland)-Helsingør 2028
  Femern-forbindelsen 2028
  (Roskilde)-(Korsør) 2028
  (Ringsted)-(Mogenstrup) 2028

- (København/Vigerslev)-Roskilde 2029

- København-Helgoland 2030

On main lines and some secondary lines the LX protection systems are covered by national ATP protection

> LX protection systems normal max line speed 120 km/h

> With special provisions up to 140 km/h

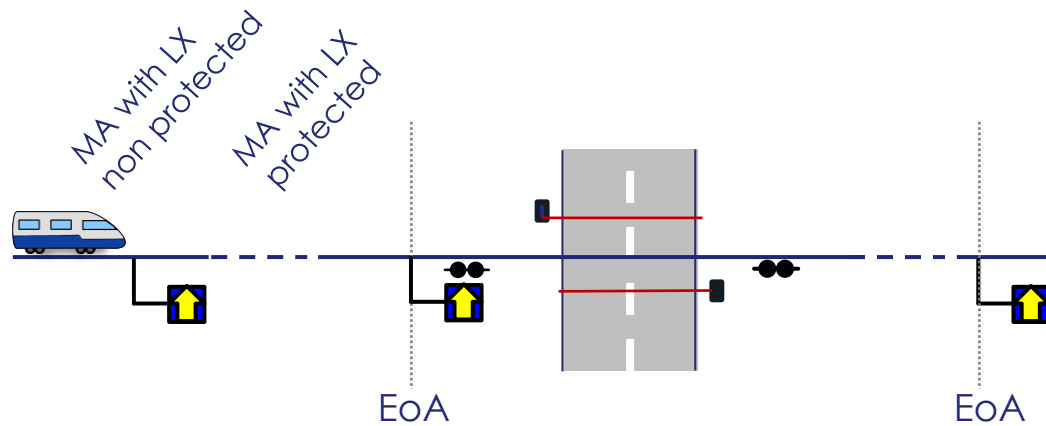**Functional and performance requirements for LX optimisation (activation and deactivation)**

> Optimisation towards route setting to avoid braking and showing LX icon on DMI

> Attempts at using speed dependent(MRSP) activation based in trains MA-request. The choice of activation is done by BDK at the TMS level.

> E.g. some LX are equipped with road clearance sensors which could stay occupied and delay the LX protection

> Speed over non protected LX will be restricted to 10 km/h to allow to approach, with a strict stopping requirement the train would not be able to approach the LX effectively

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> Connect LX to interlocking
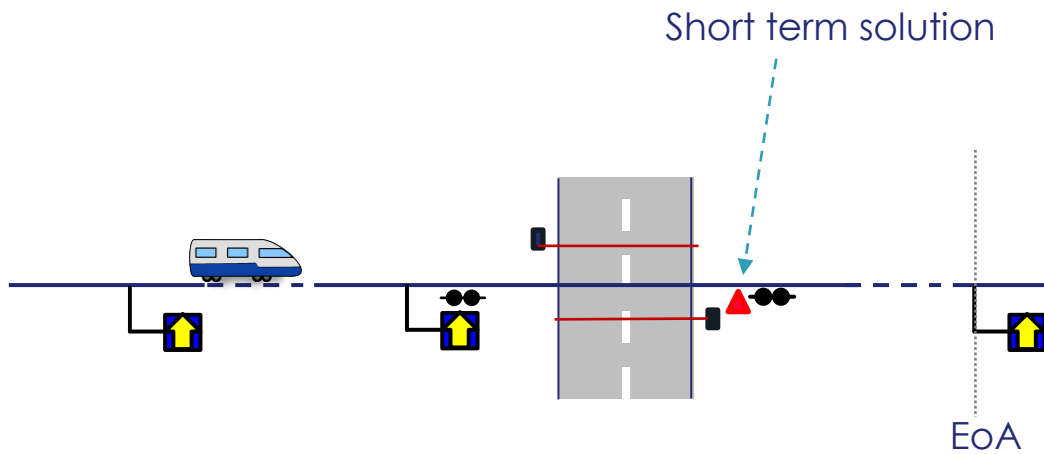
> Rely on MA request for temporary EoA

temp. EoA   EoA
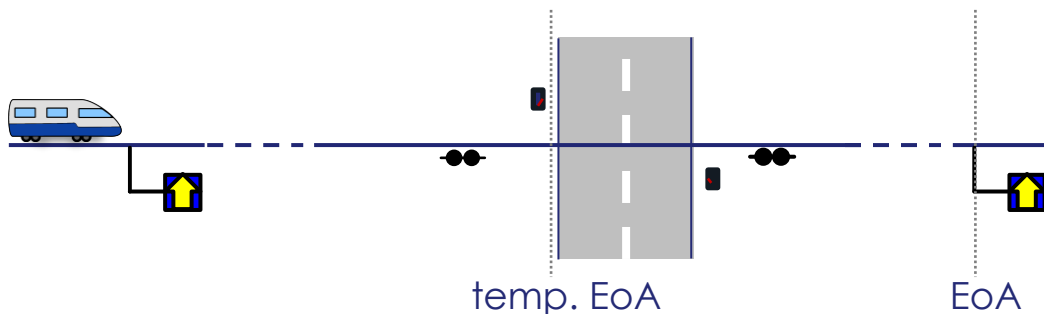
Withdrawn due to the fact that it was not 100% crystal clear
that an MA Request is sent for the temp. EoA in SV2.0

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> Place Marker Board in approach of LX

MA with LX non protected

MA with LX protected

EoA   EoA

> Additionally optimise closing trigger via information in the system

- Specific delay after route setting based on topology, time table, LX type, …
- Rules depending on traffic pattern, train type, max train speed, distance between LXs… configurable in our TMS

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Solution Evolution v2.0

> What happened next

Short term solution

EoA

> Clearance of LX led to non protected state of LX since system detected that this was done by the train → no reaction

> With next MA extension, MA with current LX state was sent to train and was considered instantly as new temp. EoA → tripped

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General LX blocking time performance:

> Open line 60-70 secs

> Stations 90-120 sec

> Finetuning of triggers by operator in TMS to ensure that typical traffic works well

Future developments:

> Possible upgrade to SV2.1 – small improvement due to the introduction of the perturbation point. MA-request more well-defined in SV2.1

> Introduction of ATO, use of the journey profile estimation for activation of LX

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Questions or still non protected level crossings?