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Deutschland

Jöhstadt | June 14th, 2022

Next generation CCS: APS – Advanced Protection System for route and train protection

Word cloud

RCA

Reference CCS Architecture

Train integrity

(Virtual) fixed block

Block-centric

RCA

Train protection

Route protection

Hybrid Level 3

ETCS

ERJU

Train-centric

RBC

Interlocking

Moving block

CCS development

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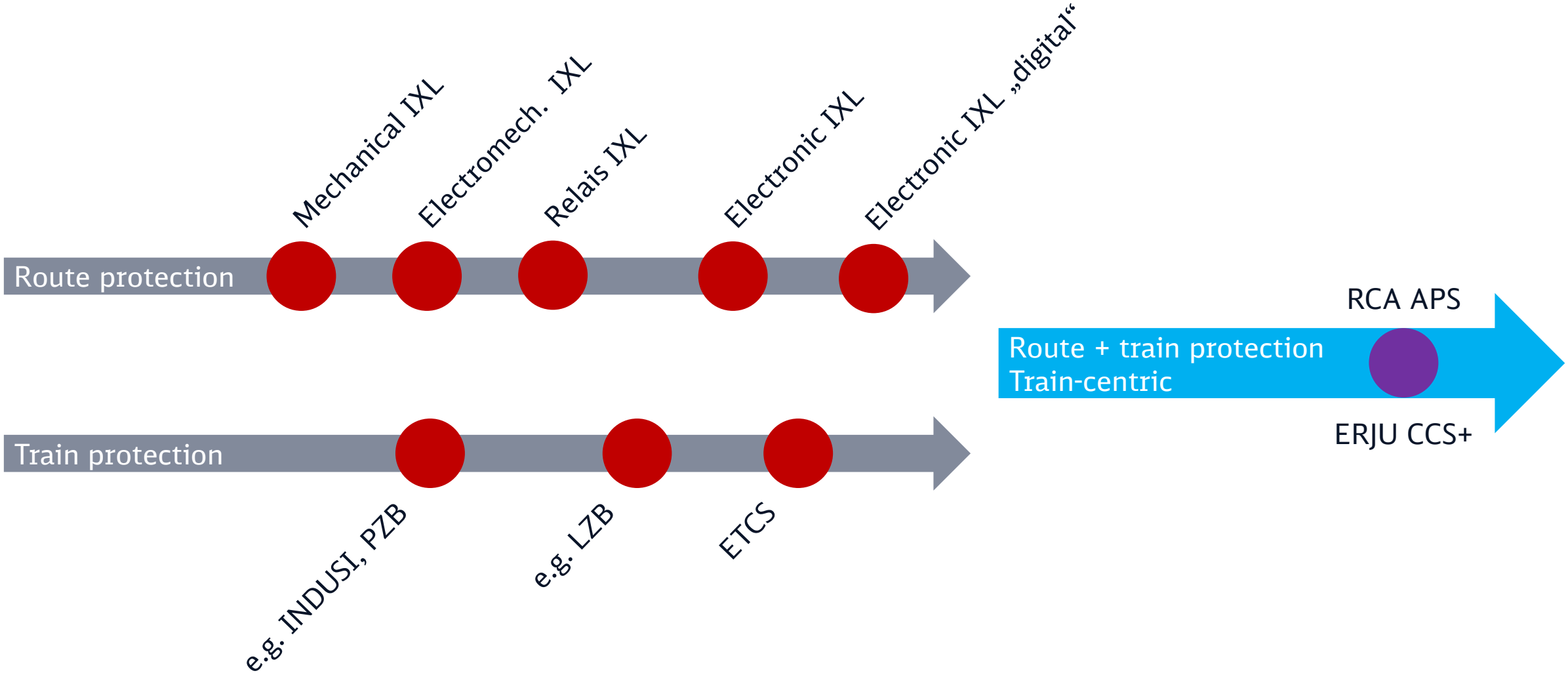

→ Architecture

RCA Candidate Architecture – Layered approach

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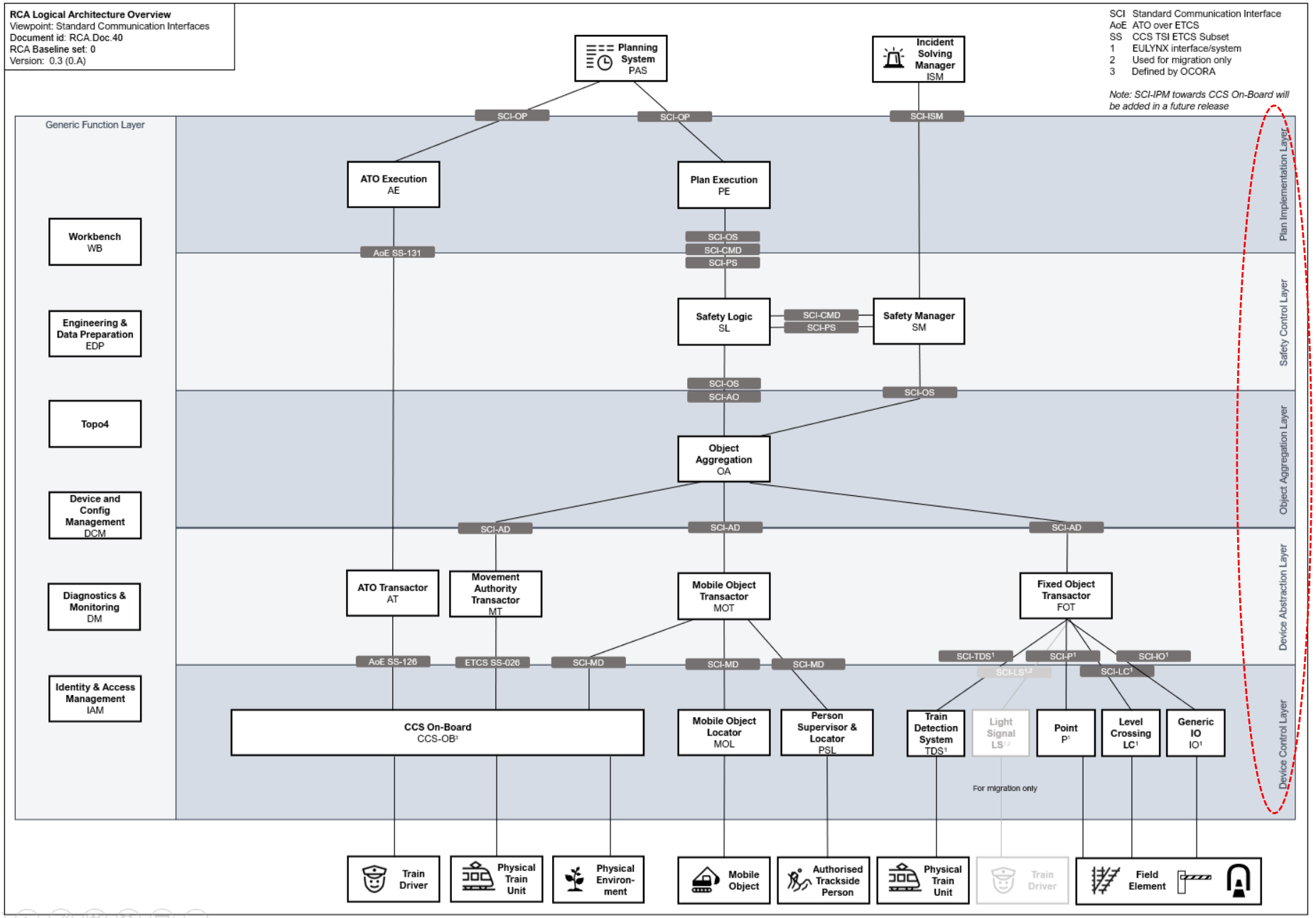

Layers

- Plan Implementation
- Safety Control
- Object Aggregation
- Object Abstraction
- Device Control

Benefits

- Clear responsibilities
- Clear interfaces
- Interchangeability
- Competition, market entry, costs
- Separated life cycles

Challenge

- Integration

RCA Candidate Architecture – The APS stickman (informal)

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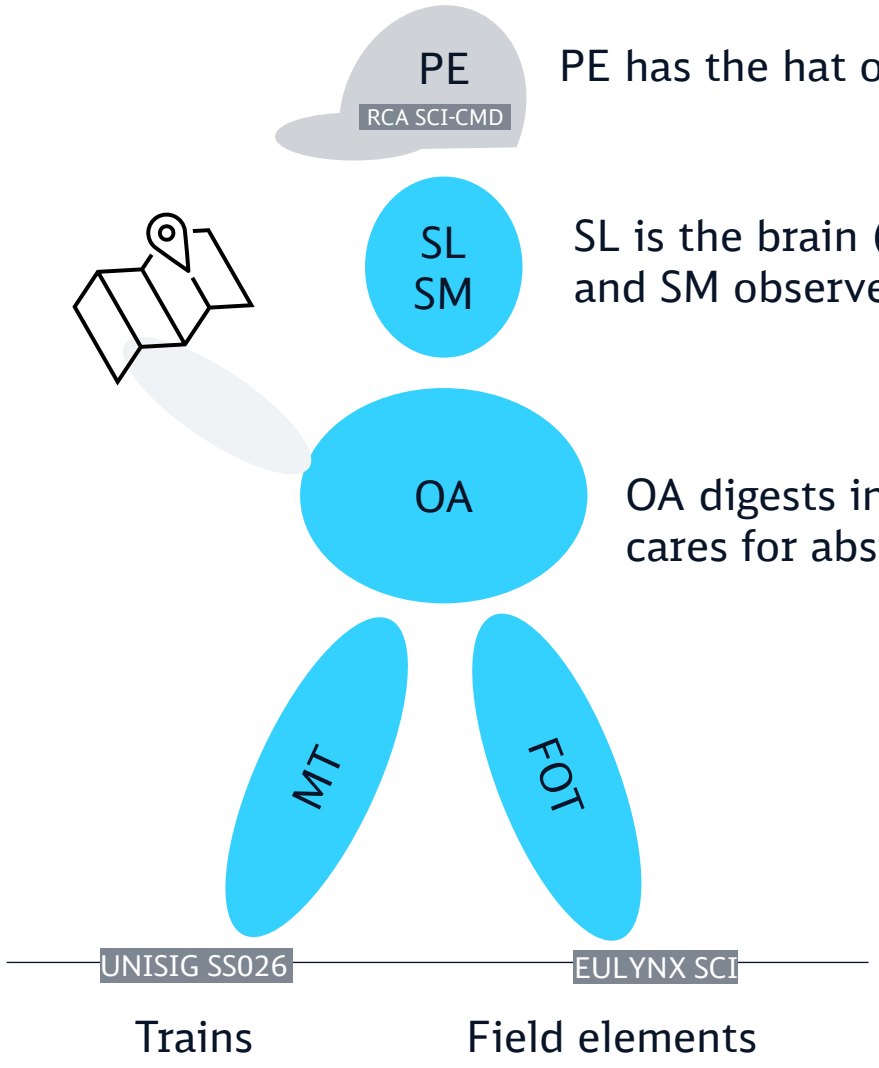

PE has the hat on – knows what to do

SL is the brain (controls: accepts/rejects) and SM observes safety

OA digests information – up & down; cares for abstraction

Two legs on the ground of solid (standardised) interfaces

Not shown: the „third leg“ to the non-trackbound movable objects

(trackworkers, maintenance vehicles)

Where is the interlocking, where is the RBC?

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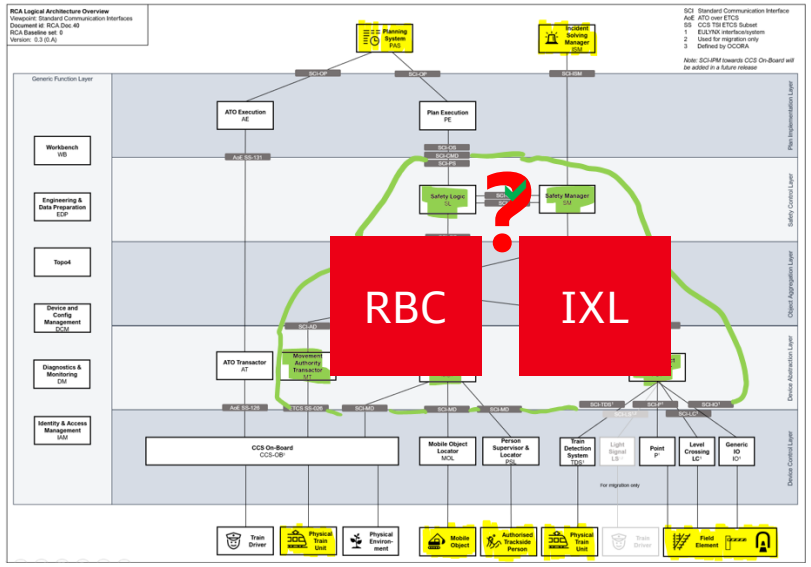
At a first glance: APS = RBC + IXL?



block- or occupation-centric

No, APS is

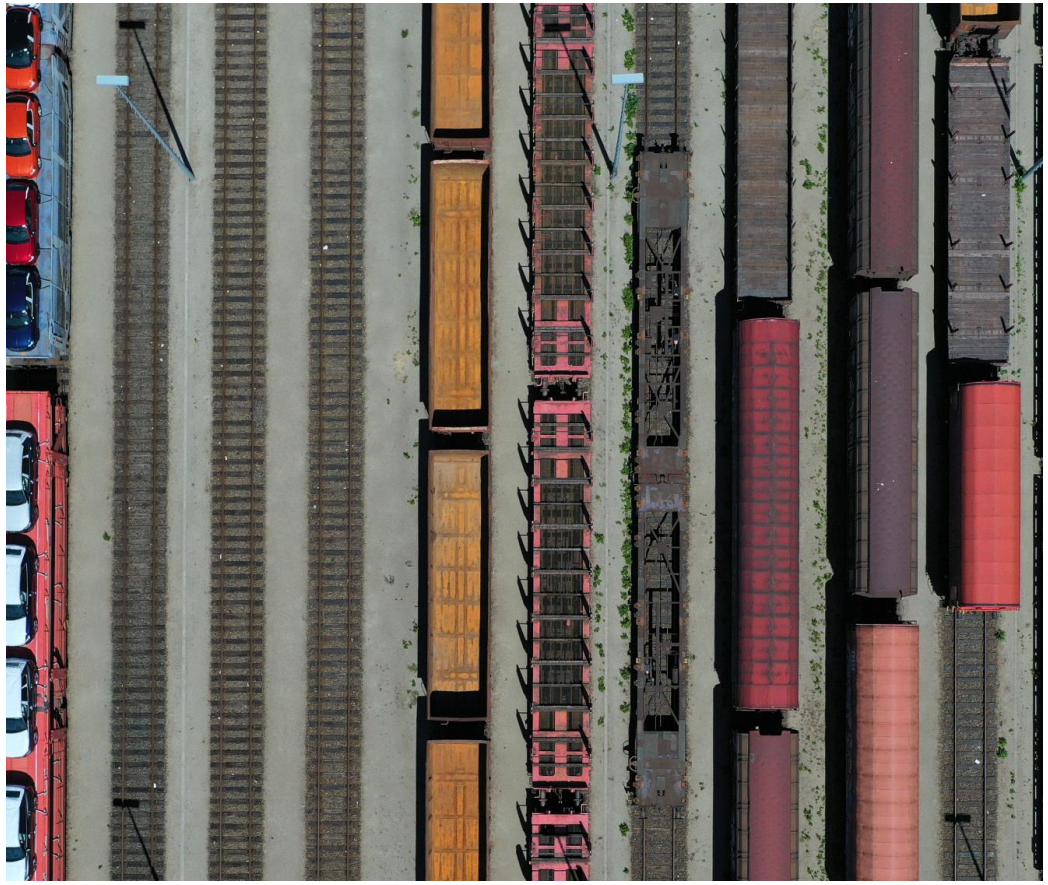
Trackside train protection (today task of RBC)

plus route protection (today task of IXL)

plus focus on *movable objects* ✔

- trains (trackbound movable objects)
- other road/rail vehicles and track workers

train-centric ✔



→ Block-centric vs Train-centric approach

Block-centric view: Only auxiliary class of objects in focus

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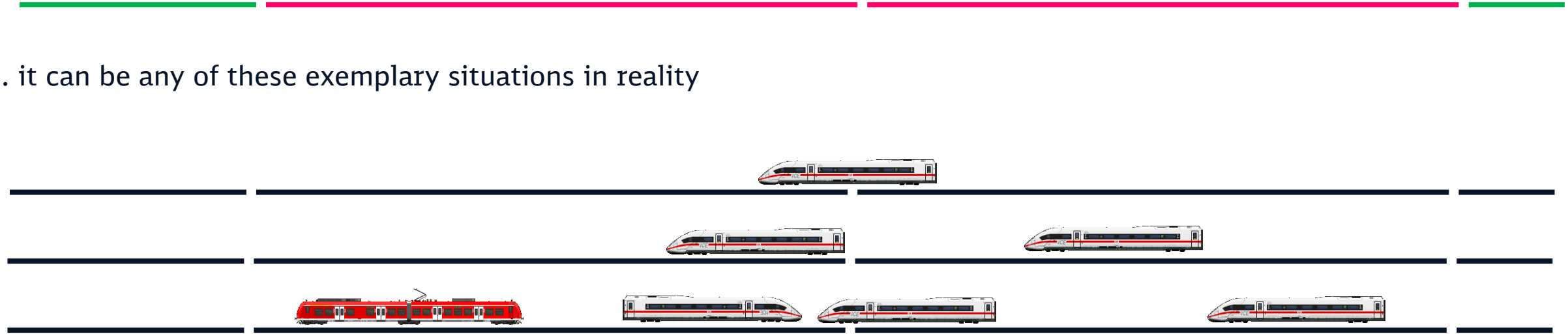
When the interlocking sees this (example: 4 axle counter sections on a straight track)…



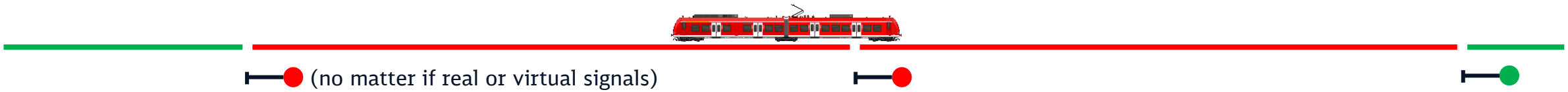
… it can be any of these exemplary situations in reality

which means the interlocking view is not oriented to the business object (train) but to **auxiliary objects** (blocks/occupations) which suppresses essential information

Block-centric view: Supplement by train information (RBC)

With the RBC which knows the business object, both views can be combined

but still the basic functional separation *route protection* and *train protection* is in place, consider this example



where, when the interlocking can‘t report a qualified signal stop to the RBC, the RBC cannot *directly* conclude whether the signal was closed triggered by the passing train itself (regular situation) or a preceding train (hazard).

➔ The block-centric view is supplemented by train information but basic (interlocking) principles still hold and require complicated technical solutions.

From block-centric view to train-centric view: Real business object

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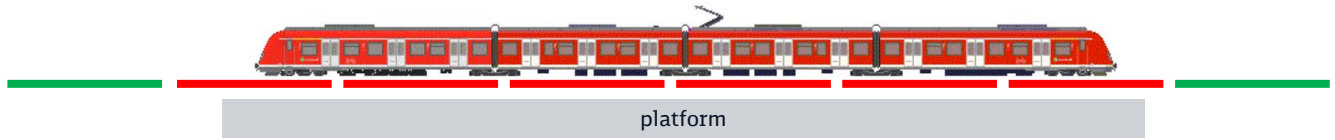
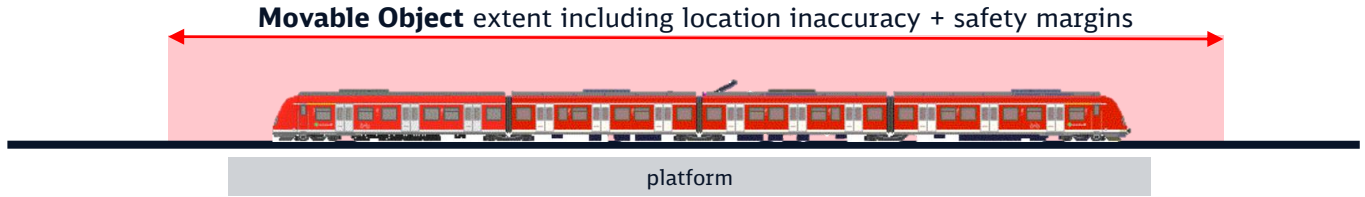
Due to capacity improvement needs, in block-centric approach blocks can be (real or virtually) sub-divided so that a train occupies more than one block section



and if this happens in the terminal station and the train has to turn, the interlocking gets a sequence error (expected release order not fulfilled). → Again the mitigation means complicated technical solutions

In **train-centric** view, all this is already built-in.



→ None of the two examples will cause a change in APS

Train-centric view: Flexible movement permissions

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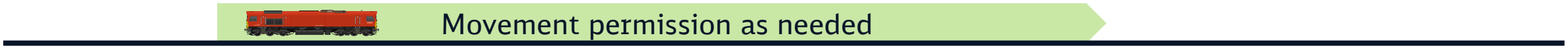
While block sections determined the extent of a movement permission

this is in train-centric approach no more the limiting factor



→ This paves the way to optimum **capacity** usage (no adaptation of block sections needed)

ONE BASE. Train-centric can serve all operational principles

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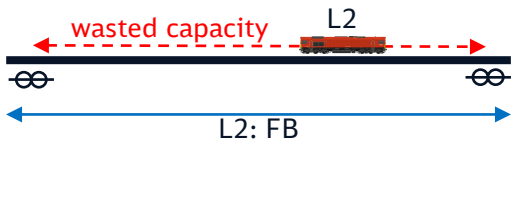
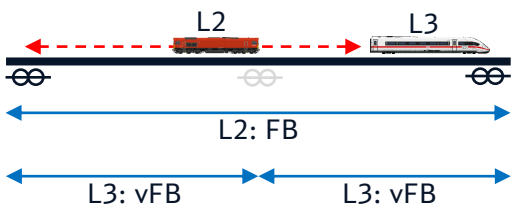
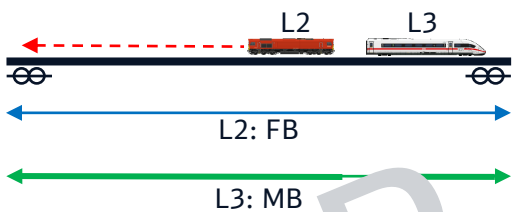
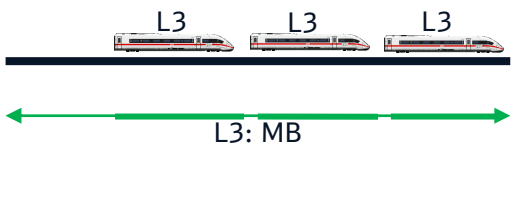
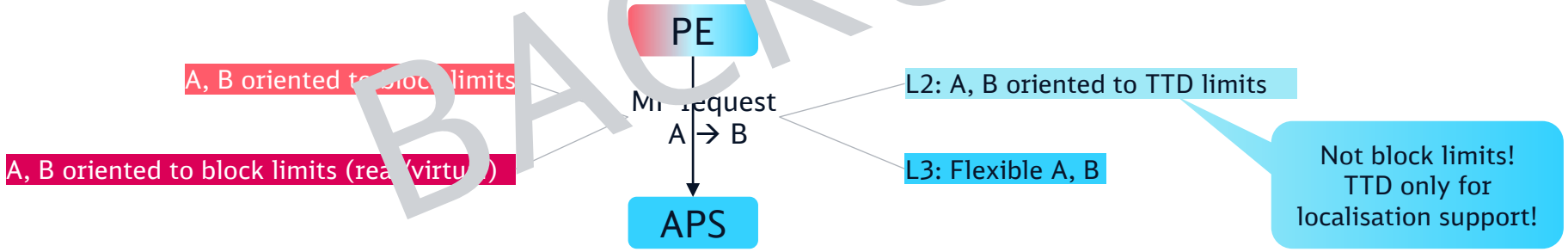
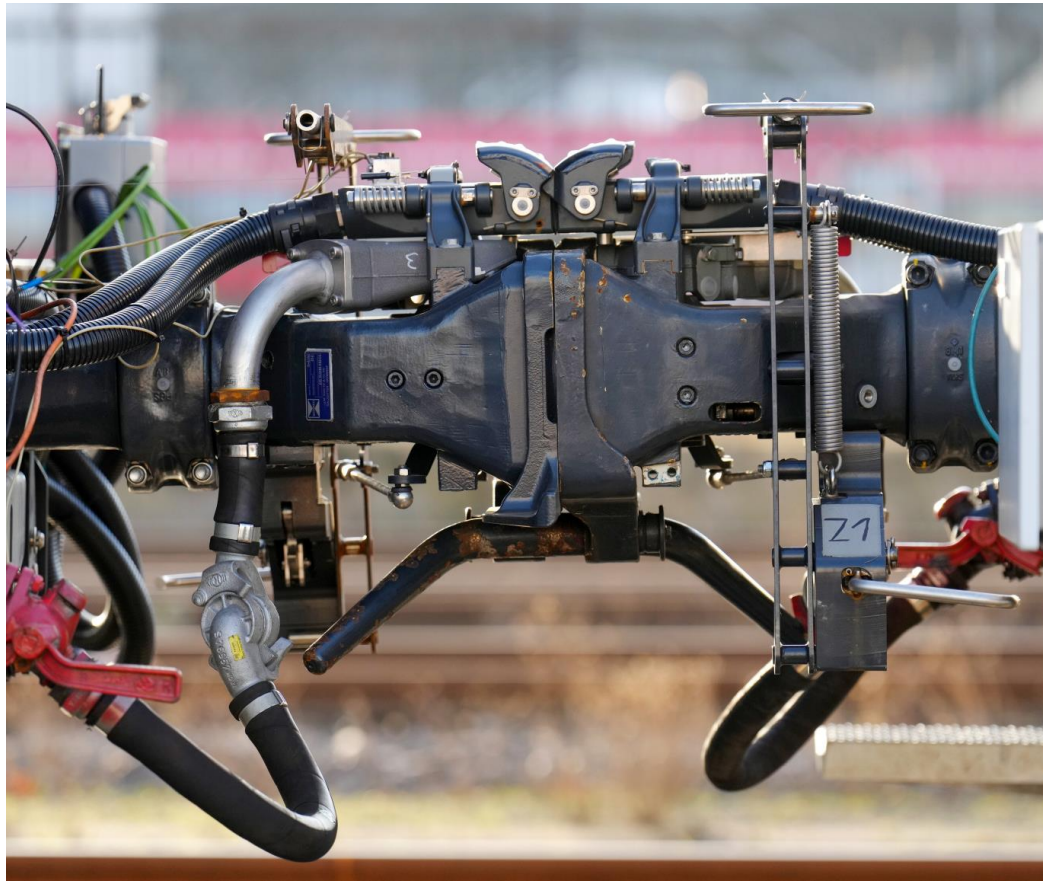
Operational Principle	Fixed block	Hybrid virtual fixed block (EUG HL3)	Hybrid fixed/moving block	Full moving block
				
Typically provided by	Classic CCS	Enhanced CCS	New APS	
Same APS, depends **only** on PE-chosen A, B				
A→B Flexibility	Fixed	Fixed	L2: A flexible, B fixed L3: flexible	Flexible
Use cases	(Abandon old CCS)	Migration (TIMS equipment of fleet)		Capacity
	E.g. ProRail: TMS only supports FB			



→ Train integrity

Still trackside train-detection equipment (TTD)?

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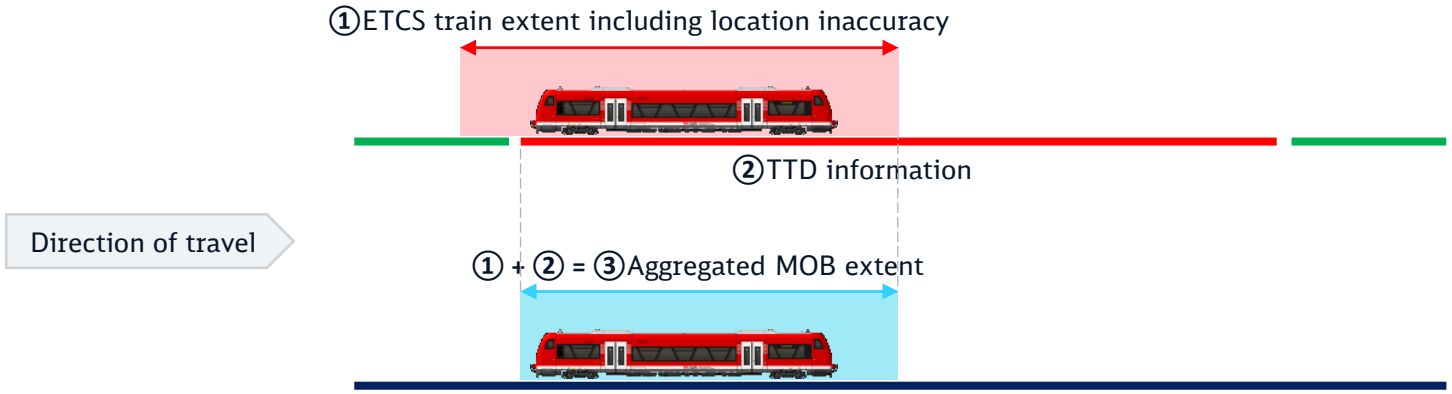
- From the beginning, APS will support TTD
- This is needed anyway for migration scenarios

- But: the role of TTD will change: from the central **signalling** asset to a pure **location** asset
- This will be used for **object aggregation**

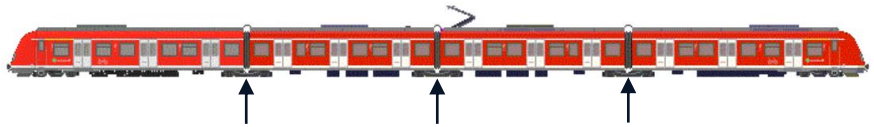


➔ Different source of localisation information is aggregated

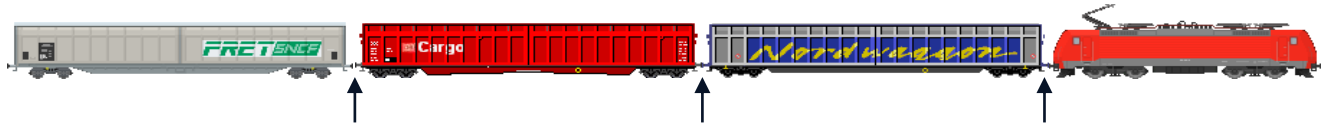
Train integrity

- As *trackside* train detection (TTD) proves vacancy, its decreased use (or even abolishment) requires substituation
- *Onboard* train detection (OTD) takes this role by a Train Integrity Monitoring (TIM) device
  - proving the completeness (integrity) of the train
  - delivering the safe train length

- (E)MUs: Basing on existing train bus interfaces between semi-permanent parts (arrows)



- Freight trains (and single wagon trains): Expected from DAC (digital automatic coupler) (arrows)



➔ TIM is mandatory prerequisit for OTD to abandon with TTD (but see next slide)

Mule = Donkey + Horse

→ Hybrid operation

Hybrid/mixed operation (migration)

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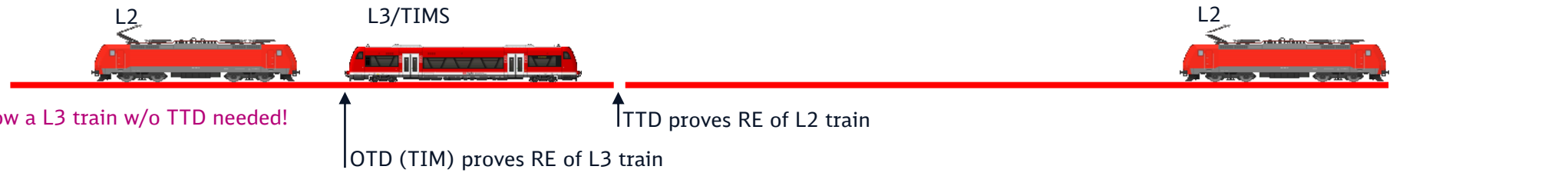
- Train front end (FE) is reported by ETCS train position report in both ETCS L2 and L3
- In ETCS L3, the train rear end (RE) can be deduced from integrity + train length
- For a train to follow safely and closely it is important to clear the RE of the preceding train

- No TTD

- (Full) TTD



➔APS supports mixed L2/L3 operation from the beginning

(This will be needed to cope with different TIM equipment grades during migration, expected to be a long period.)

„Hybrid“: Isn‘t there Hybrid Level 3 of EUG?

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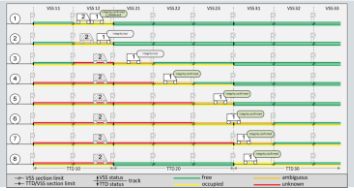
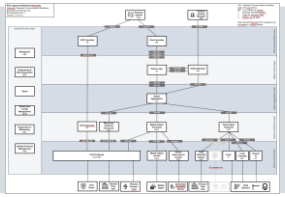
	EUG HL3 	APS 
Migration L2 → L3	✔	✔
Foundation	Block-centric	Train-centric
Prerequisits	ETCS	ETCS, Eulynx
Disruptiveness	Evolutionary	New technology
Generic safety logic	-	✔
Supported types of operation	Fixed block (L2) Hybrid virtual fixed block (L2/L3)	Fixed block (L2) Hybrid virtual fixed block (L2/L3) Hybrid fixed/moving block (L2/L3) Moving block (L3)

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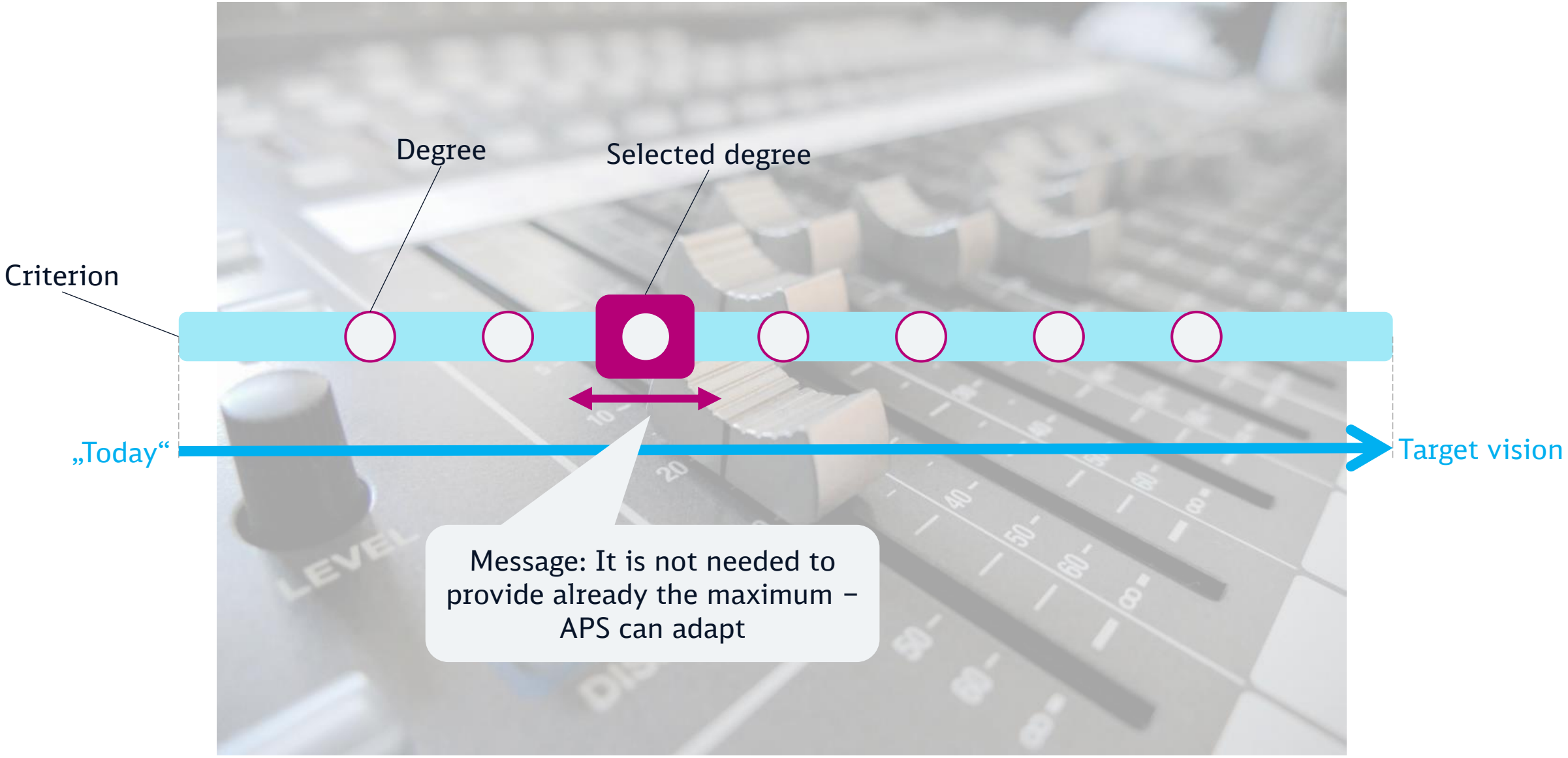
→ A step too big?

Built-in migration!

Migration - The sliders (1)



Migration - The sliders (2)

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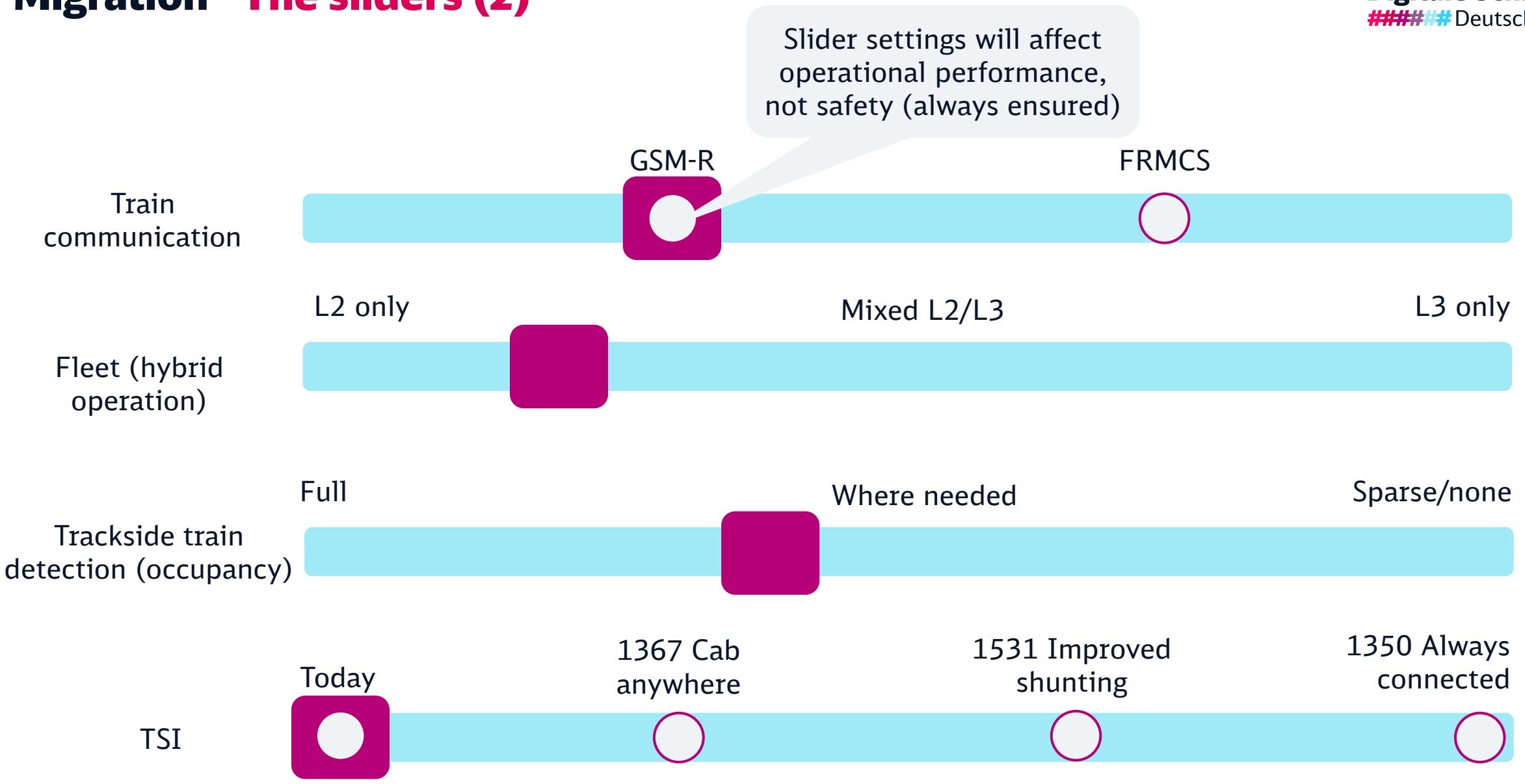

Migration - The sliders (3)

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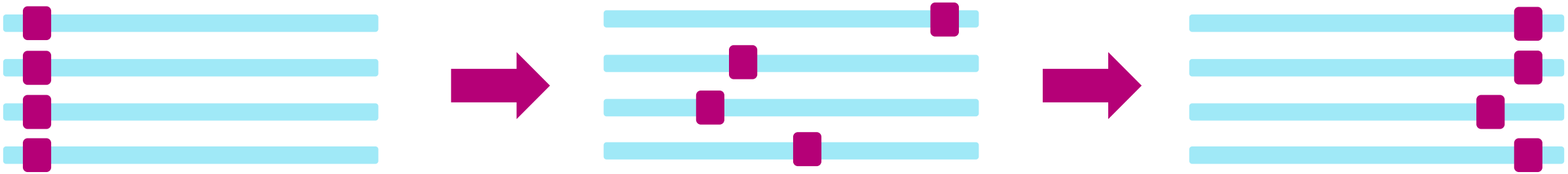
Examples. APS will serve them all – environment-driven

Already suited to replace today‘s CCS = already value!

According to needs, line, and feature availability

Target vision



Sliders are influenced by external factors (e.g. infrastructure or fleet) and APS can *dynamically* adapt – **no APS sw adaptation** needed!

Message: **Don‘t fear** the target vision‘s **ambitions** (e.g. *always connected*) – APS will cope with every step within and until.

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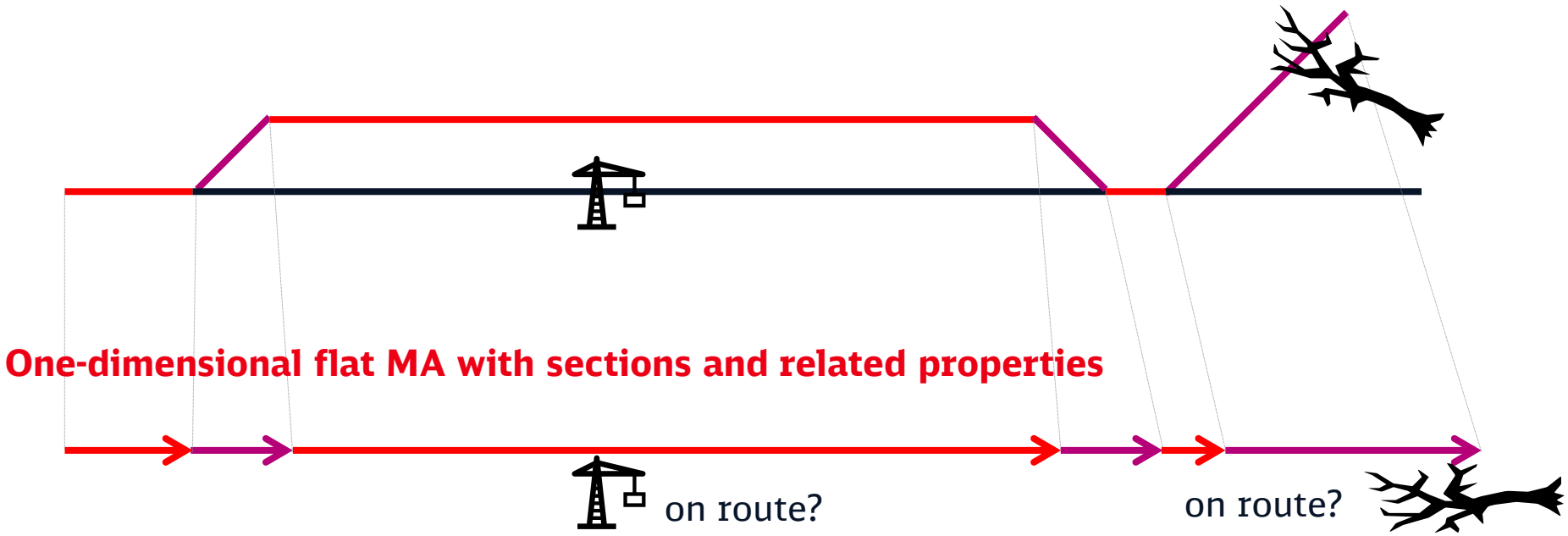
Vielen Dank für die Aufmerksamkeit.

→ Backup

2D Movement Permission vs. 1D Movement Authority (1)



2D Movement Permission vs. 1D Movement Authority (2)

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