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AUTOMATION OF THE RAIL – REMOVING THE HUMAN FACTOR?

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Introduction

SAREPTA project (2017 – 2021)

- Focuses on systems that are autonomous, remotely controlled and/or periodically not manned
- Road, sea, aviation and rail

Purpose

To describe current **rail** accidents as a basis for questioning whether future digitalisation will improve safety

Outline

- Current rail accidents
- Autonomy and levels of automation
- Safety potential of future automation
- Do automation remove the human factor?

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Current rail accidents

Automated metros

No significant accidents reported

Main line railways

- *Fatal train accidents* (five or more killed) have declined in Europe since 1980
- *Types of accidents*: Persons killed/injured in Europe (Eurostat 2017)

1. Rolling stock in motion
2. Level-crossings

   … followed by …
3. Collisions
4. Derailments

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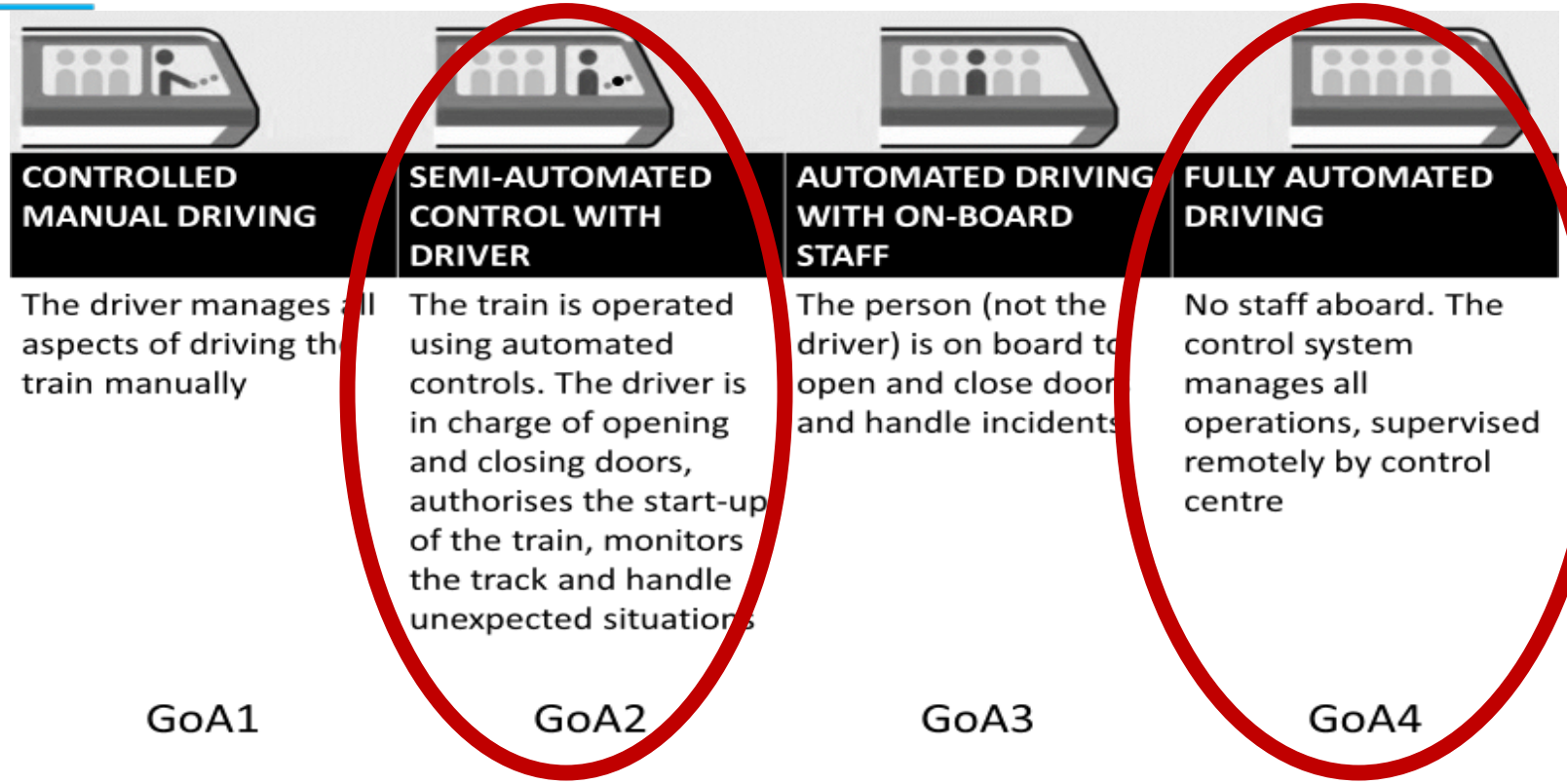
Autonomy and Grades of automation



ERMTS
(European Railway Traffic Management System)
Common signalling system to be introduced in all EU countries by 2030

Autonomous metros
(Unattended Train Operation – UTO)

- *May automation prevent future rail accidents?*
- *How can new technology contribute?*

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Fully automated metro

- Closed off networks (e.g. run underground)
- No points where train cross with others
- Station area strongly marked
- Platform screen doors

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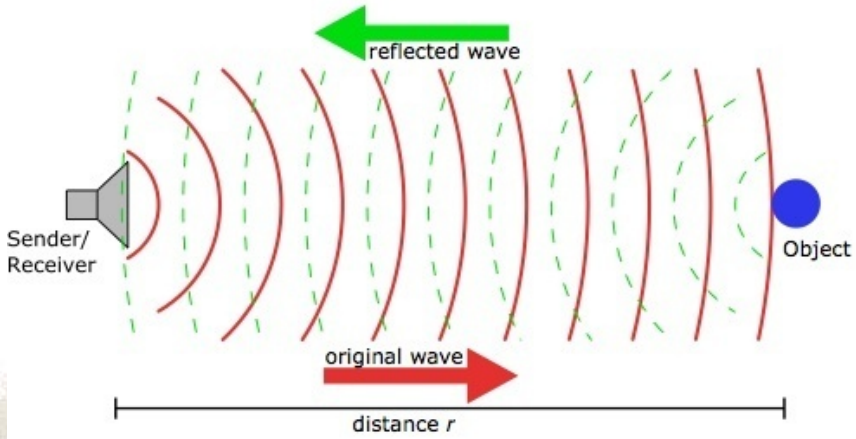
Rolling stock in motion

- People along the track, at platforms, working at the track, fall from vehicle

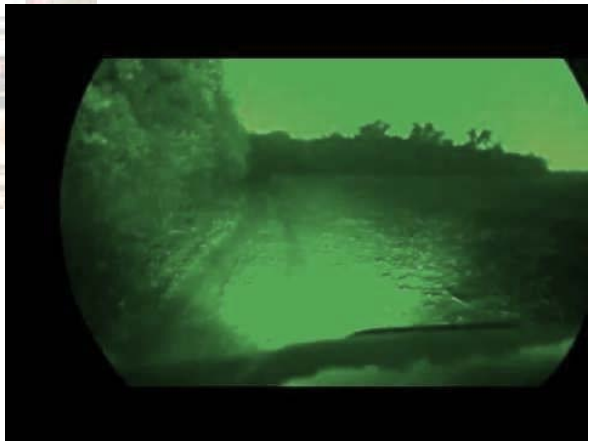
- Animals along the track (reindeer, horses, moose etc)

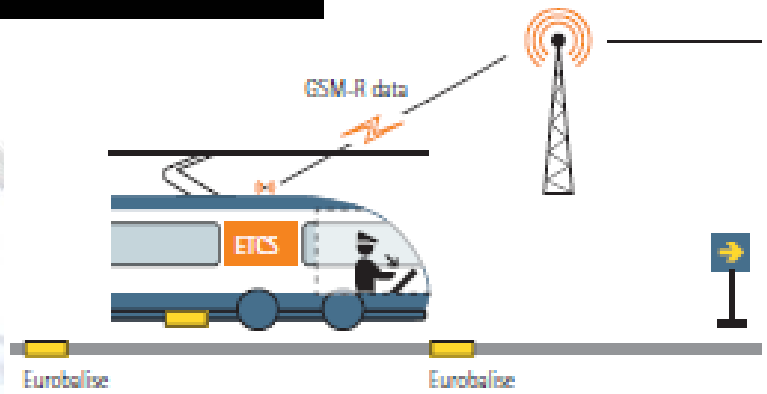
Technology development



People

- Obstacle detection
- Regenerative braking
- Monitoring systems
- Satellite based positioning systems

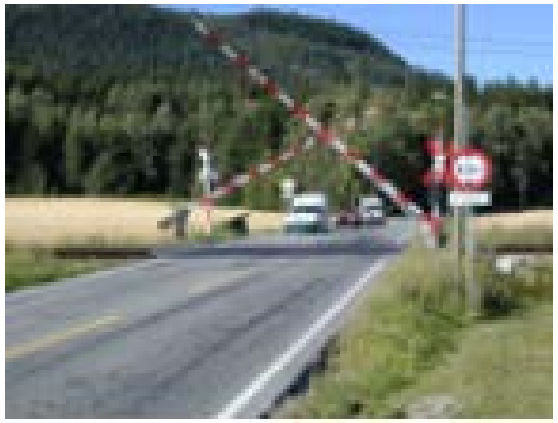




Animals

- Acoustic signals (fearing animals)

Level crossings



- Signalling/ dispatching error

Often **road user** errors or violations:

- Obeying warnings
- Situational awareness

Photos: BaneNor

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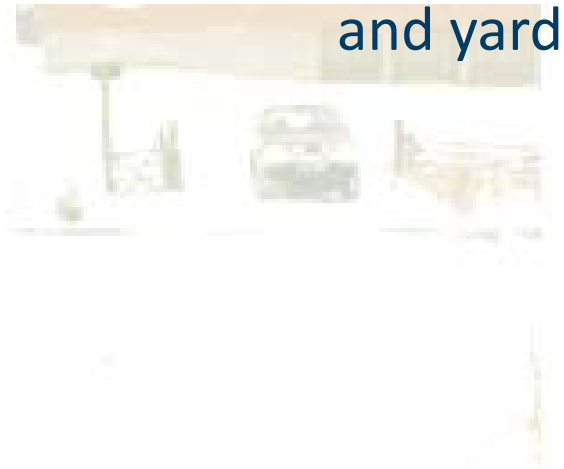
Technology development



- Obstacle detection in cars and trains
- Alarms
- Regenerative braking
- Real time management of signals and yard

Photos: BaneNor

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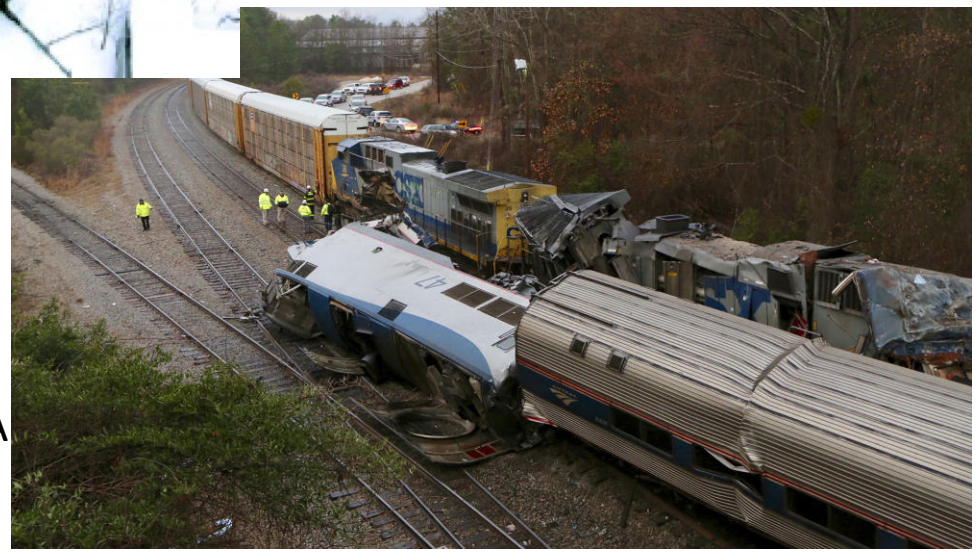
Collisions

Åsta, Norway 2000

- Most often signal passed at danger



Sør-Carolina, USA
February, 2018

- Wrong track
- Signal error

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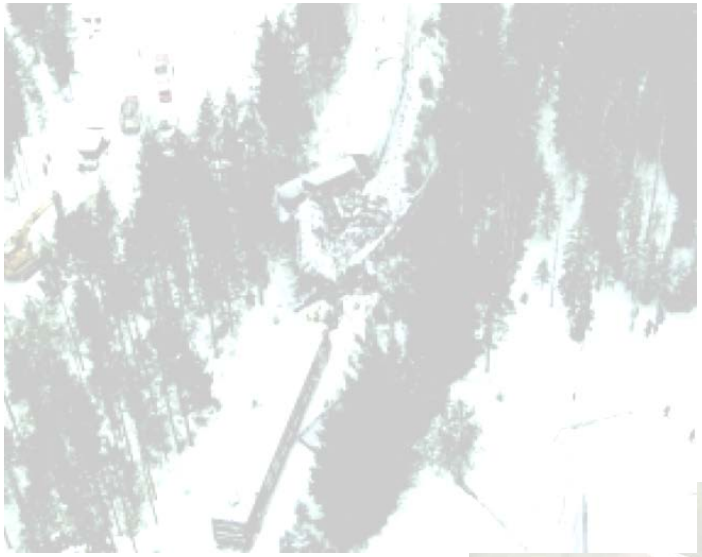
Technology development



- Obstacle detection
- Traction transformers
- Regenerative braking
  (be aware of passenger safety and comfort)
- Monitoring systems
- Satellite based positioning systems

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Derailment

Spain 2013

High-speed train at 180km/h in a curve

Human error?

- Driver should manually have switched off, but was speaking on the phone
- ERMTS-1, but the ETCS (European Train Control System) was switched off

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Technology development

EMTS level 1 should have:

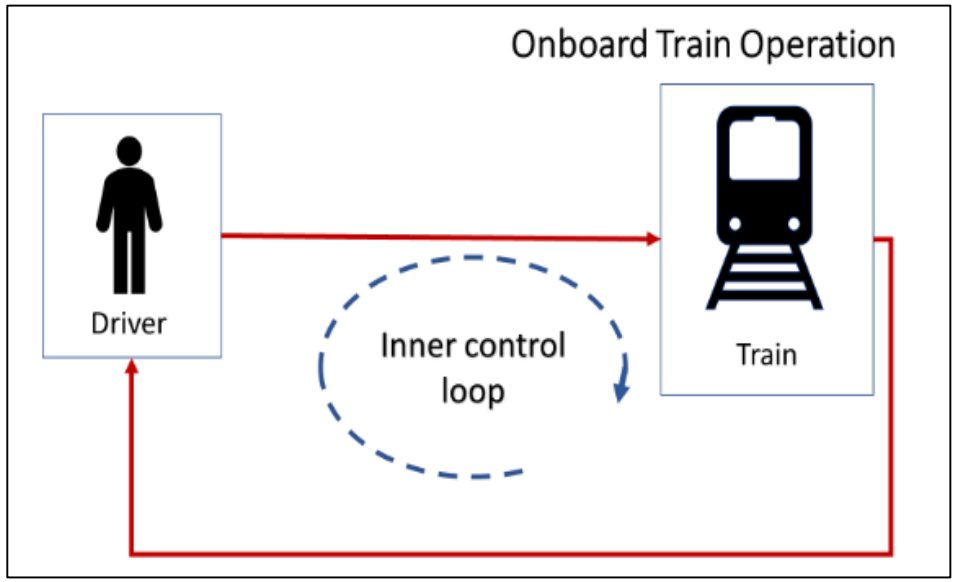
a) Text message at the dashboard

b) Yellow flashing text

c) After 5 sec.: braking continuously

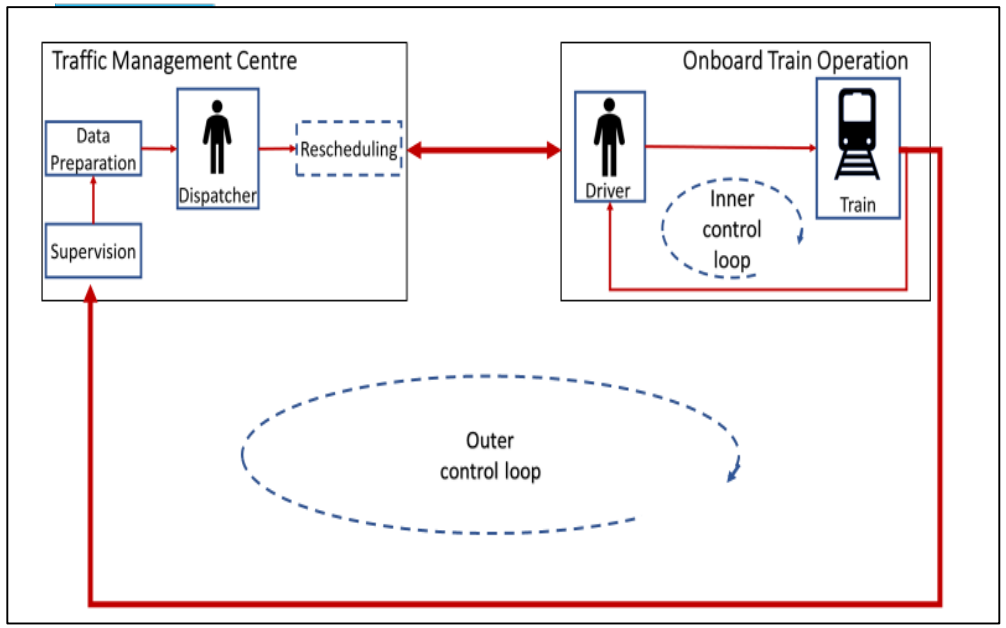
Automation – Removing "human failure"?

Less human dependability?



Grades of automation	Responsibility	
		
GoA-1 Manual operation	**Drivers**	Guide assist
GoA-2 Semi-automated control with driver	Monitors all time	Manage movements within limits
GoA-3 Automated driving with on-board staf	Ready to take back control	Drives itself, may give back control
GoA-4 Fully automated driving	Not required	**All time**

Conclusion - Do automation remove the human factor?



Outer control loop

Context - open surroundings is a challenge, but technology may improve safety (many pilots)

Management Centre necessary

Risks: Technical failure, humans at the track, telecommunication overload, maintenance detection etc

Too much emphasize on new technology?

- Unexpected events will occur (Black swans)
- Humans may prevent incidents becoming catastrophes
- R&D and pilots are necessary (e.g. resilience)

On-board personnel

- Recognize abnormal situations
- Prepared to take manual control (training)
- Evacuation procedure training

Management centre:

- Surveillance
- Remote control (in case of failures)
- Evacuation management
- Service to the public

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Thank you!

Questions?

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