

Challenge #1: Debug our train tracks!

<http://hackzurich.siemens.cool>



SIEMENS

Siemens – a Company of Skilled Engineers

Siemens

- ❖ One of the biggest software companies worldwide
- ❖ Founded 174 years ago
- ❖ ~ 300'000 employees
- ❖ € 57 billion revenue (2020)
- ❖ Diverse portfolio
 - ❖ Mobility
 - ❖ Smart infrastructure
 - ❖ Digital industry
 - ❖ Health care
 - ❖ Power generation (wind, renewables, gas)

Engineers

- ❖ Daniel Helfer
 - ❖ Software engineer R&D
 - ❖ Expert for train control systems
- ❖ Christoph Walser
 - ❖ Project manager R&D
 - ❖ Expert on train management dispatching systems



Agenda

1. Siemens and workshop hosts ✓
2. What is our challenge about?
3. Railway technology primer: what you need to know
4. Data provided for challenge
5. How to get the data
6. Q&A

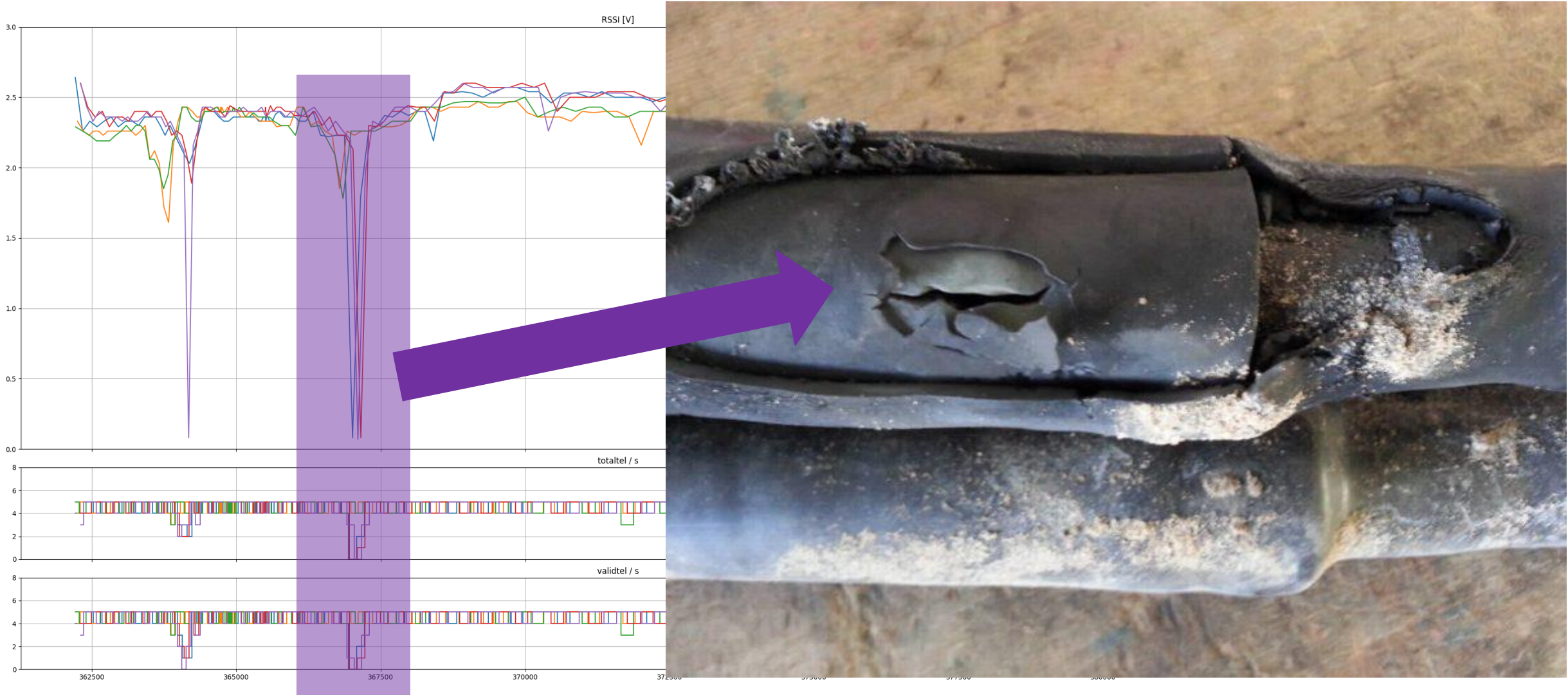


What is our challenge about?

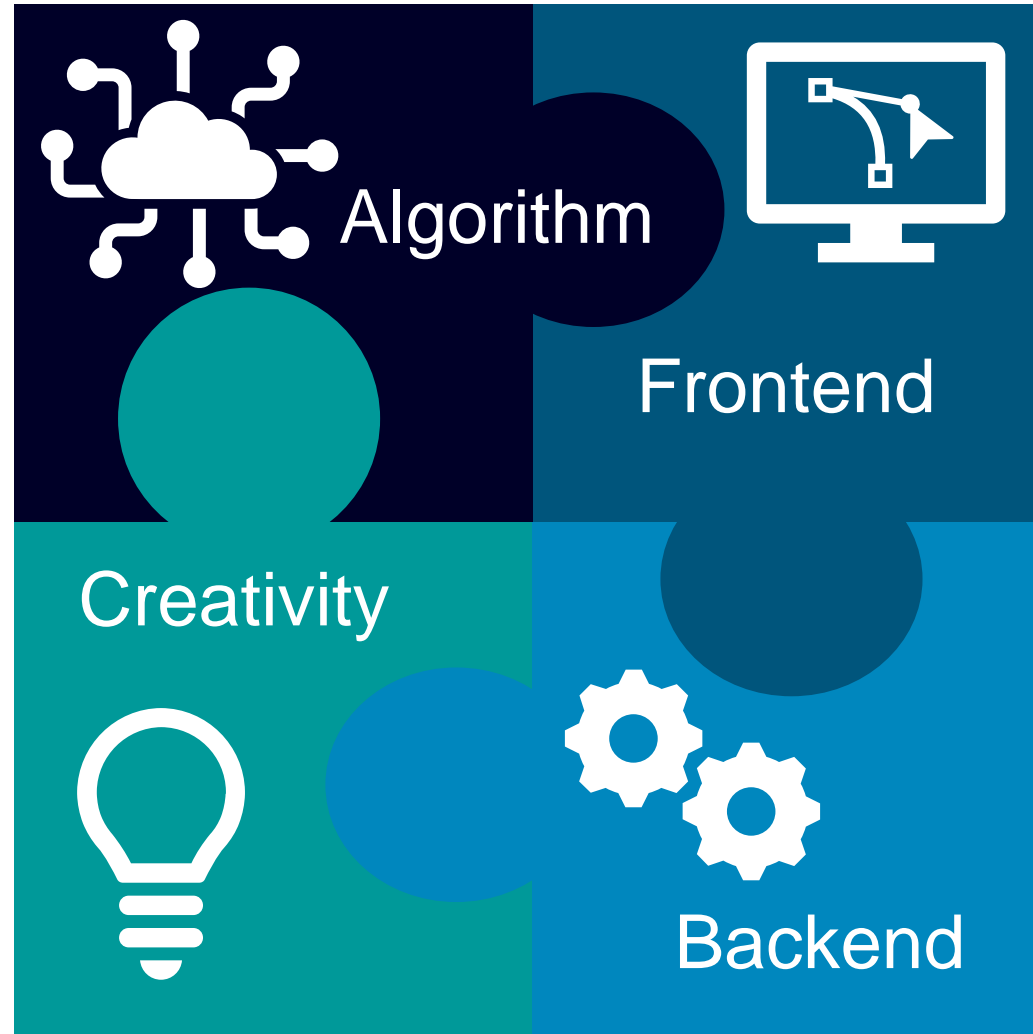
What is our challenge about?



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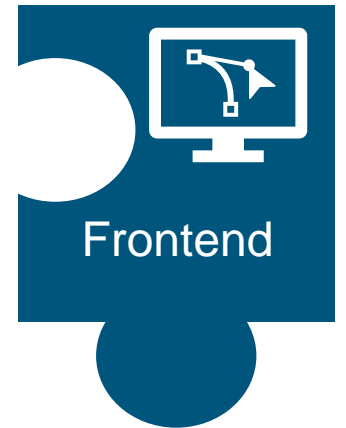
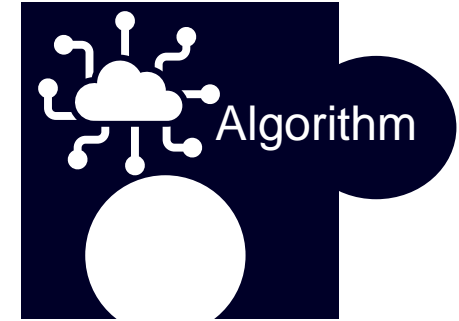


What is our challenge about?



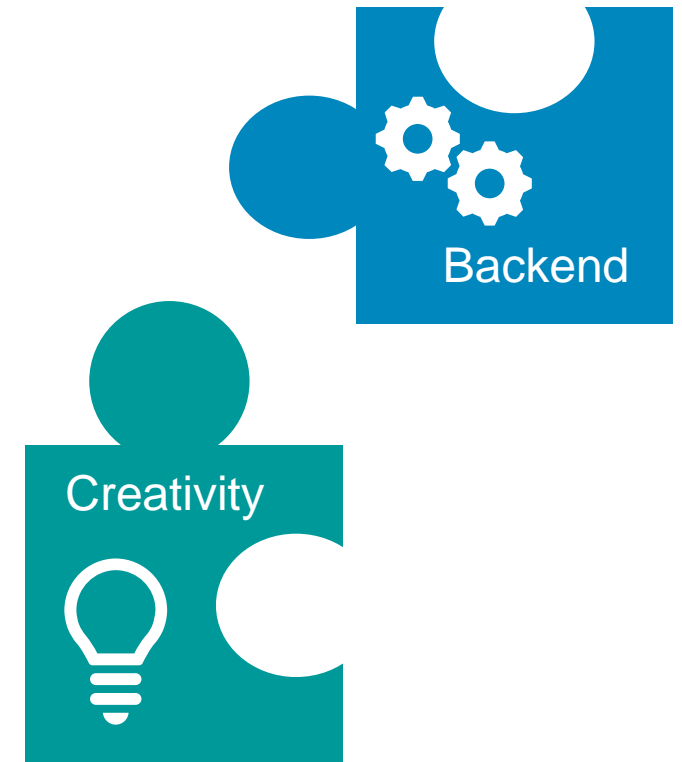
What is our challenge about?

- ❖ Develop an algorithm to detect, predict and categorize failures based on communication metadata provided by us.
 - ❖ Anomaly detection is possible with advanced statistics, artificial intelligence, and other principles
 - ❖ Predict the time of failure and the failure category
-
- ❖ Create a frontend that visualizes the data. Ideas for the frontend:
 - ❖ Show failures localized on some sort of a map
 - ❖ Have a slider to go back and forth in time
 - ❖ Show additional data on failure locations: pictures, Google Street View, Google/OSM maps, ...

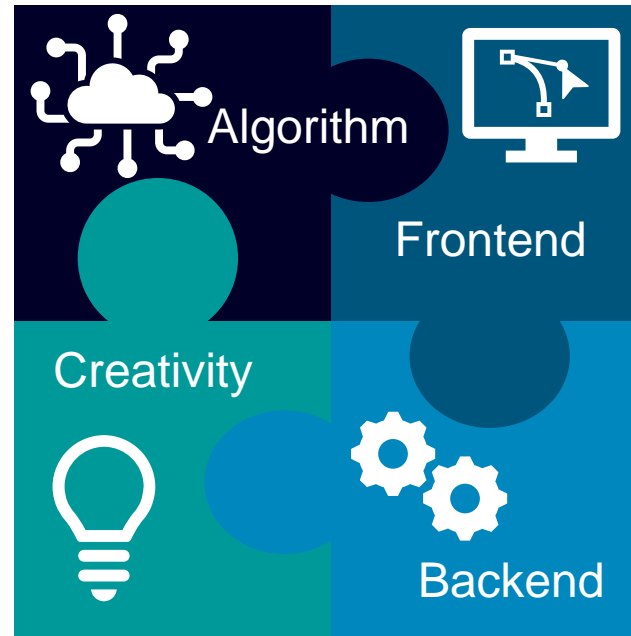


What is our challenge about?

- ❖ A backend to store raw and analyzed data would also be nice (but is not a must)...
- ❖ Discuss your ideas with us at our booth or on Slack – we are open for your creativity!



What is our challenge about?



Use the technology of your choice.
We like opensource software with permissive licenses 😊

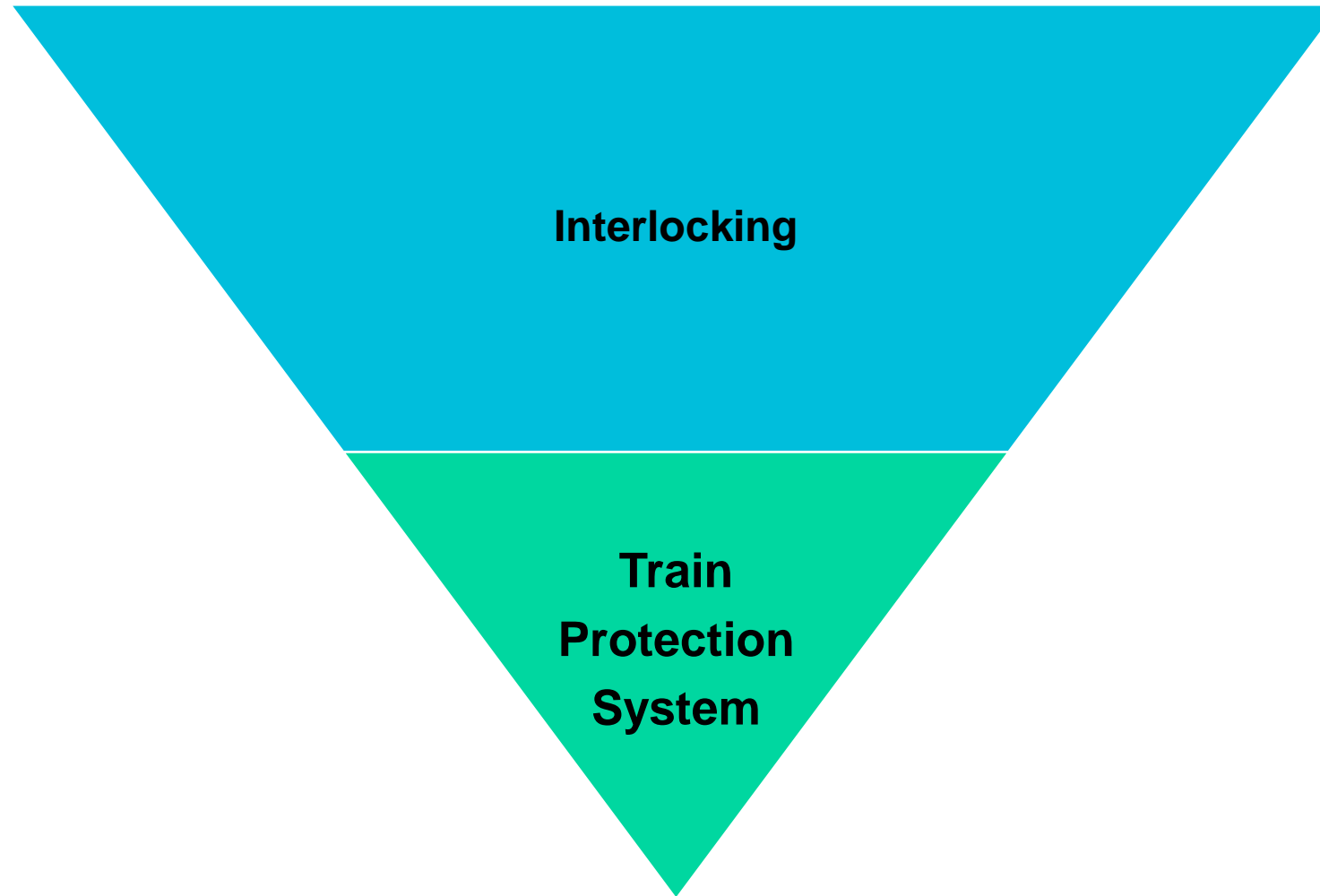


Railway technology primer: What you need to know

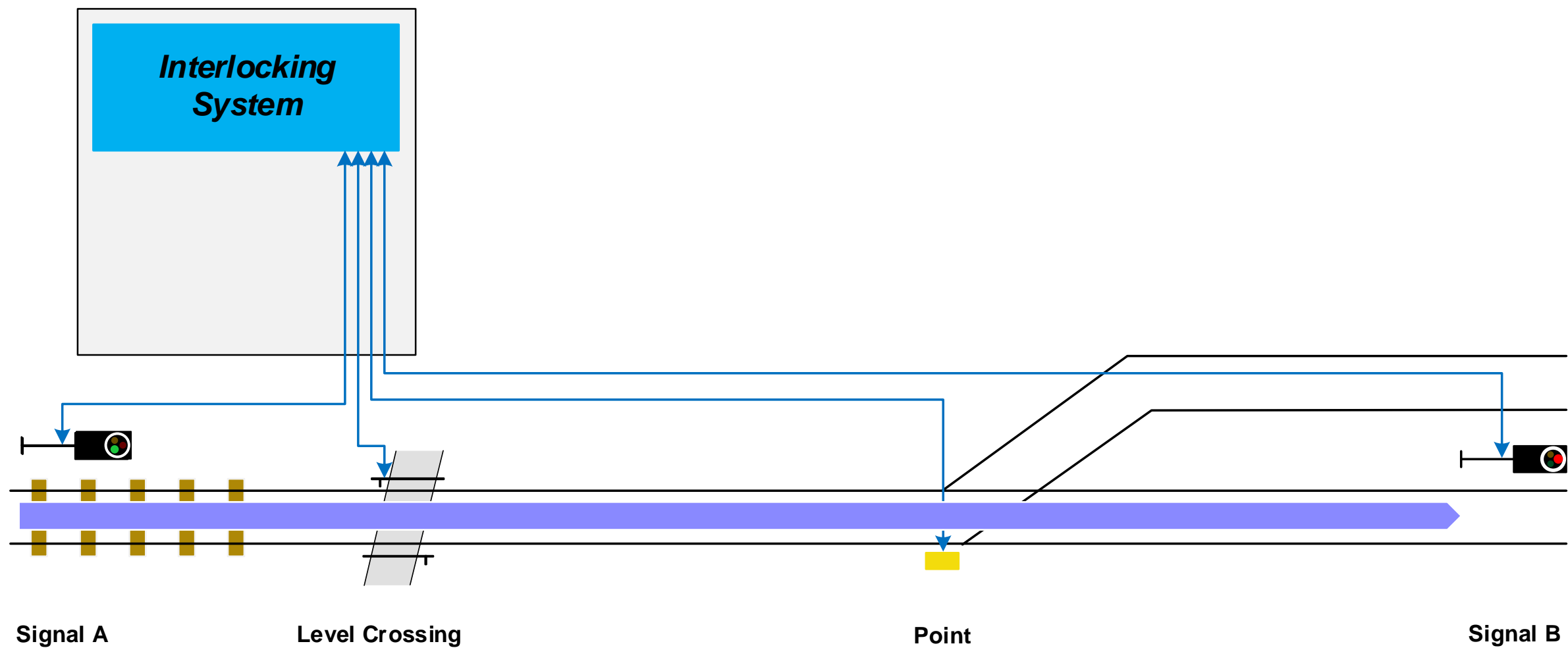
Have you ever asked yourself what is needed so that your train brings you safely to your destination?



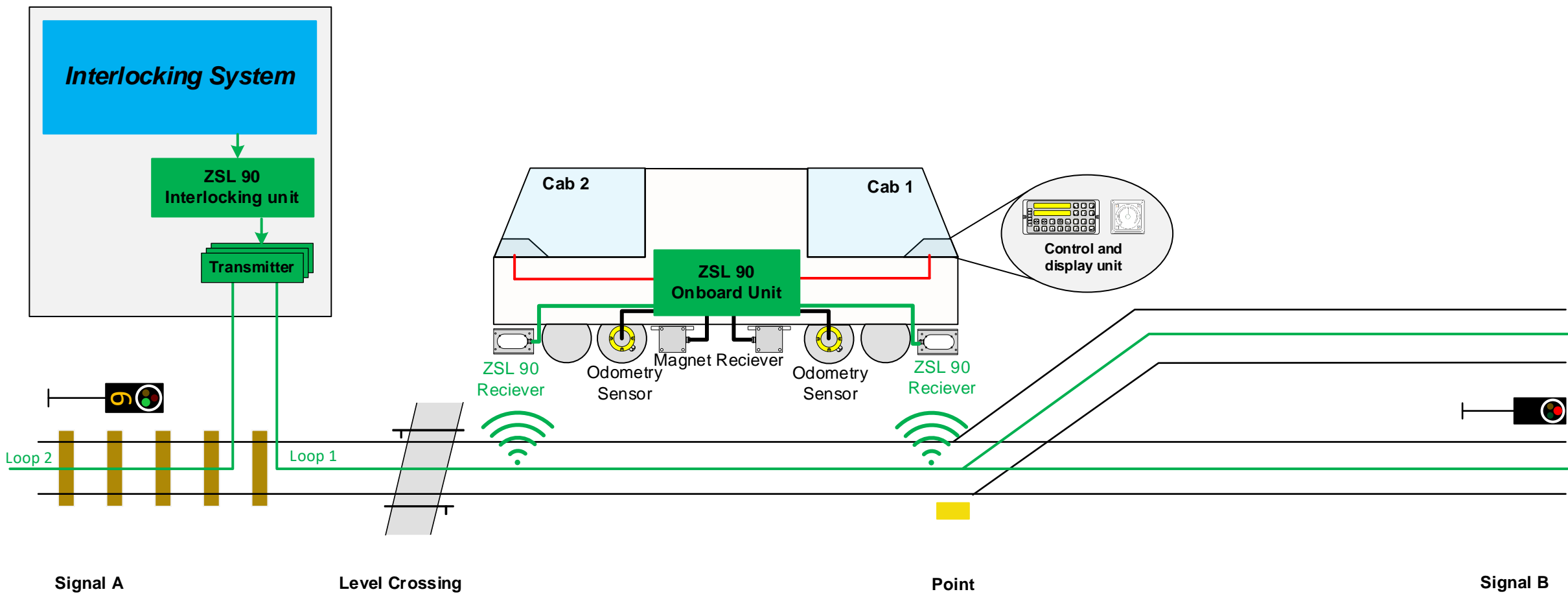
Making train rides safe



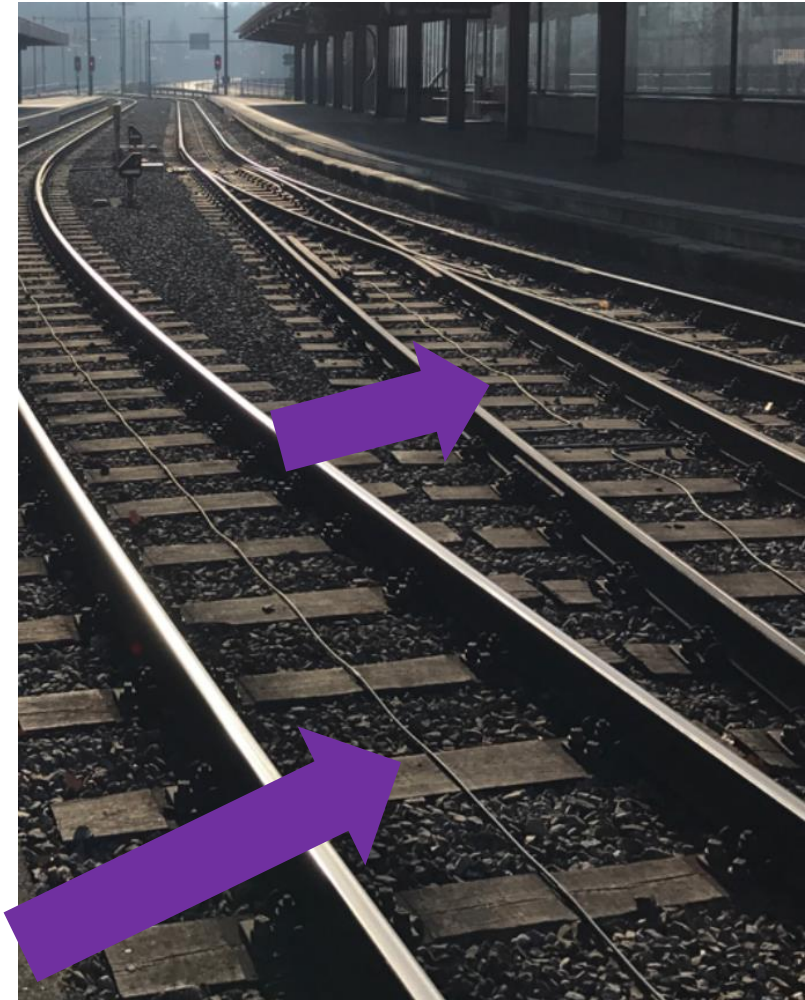
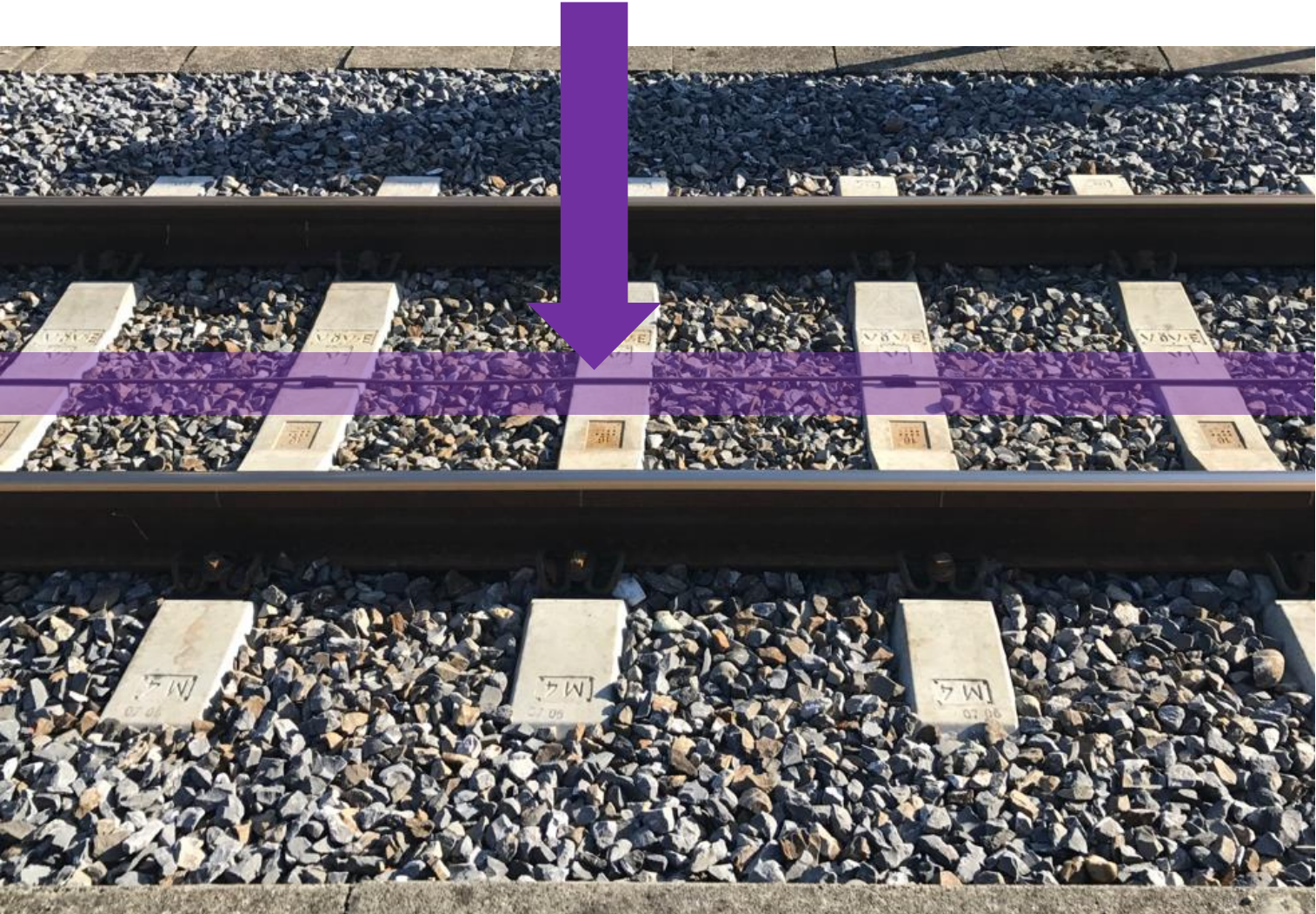
Interlocking system



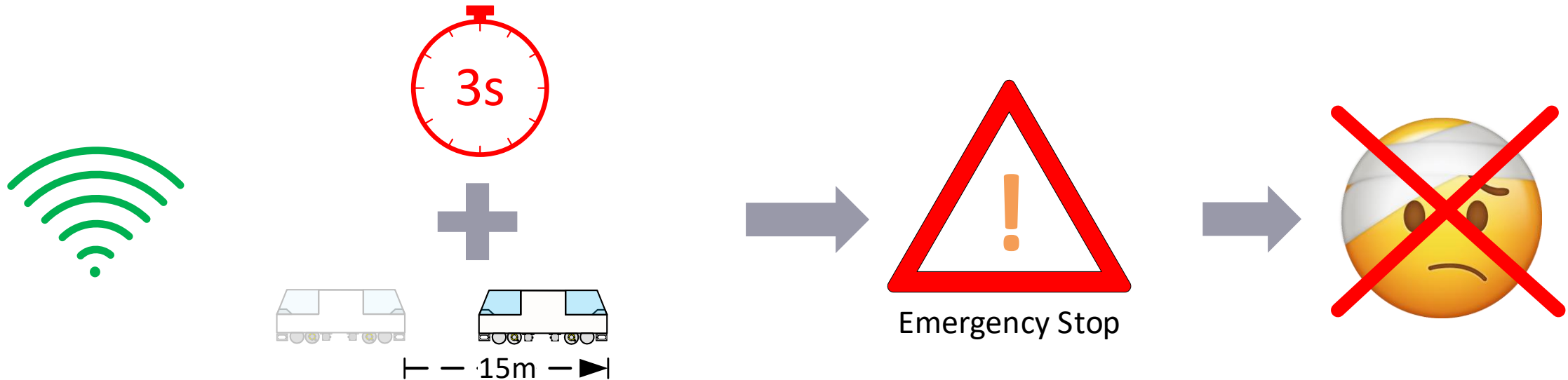
Train protection system 'ZSL 90'




Loop antenna



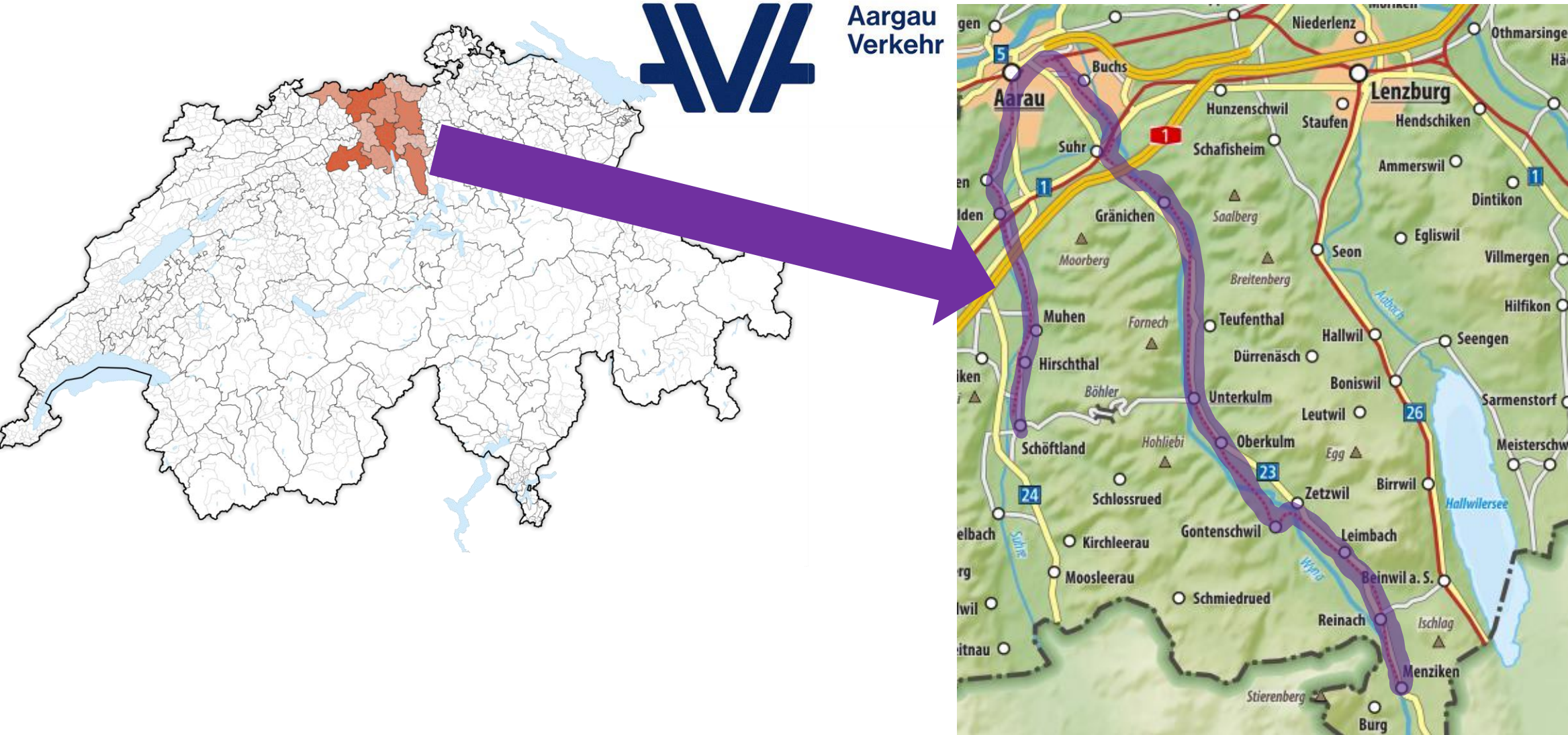
What happens if the loop transmission breaks?





Data provided for the challenge

Where do we have the data from?



Source: Tschubby, CC BY-SA 3.0, via Wikimedia Commons

Data sets provided

rsssi.csv

- RSSI readings, telegram statistics, and train positions
- Column DateTime as Key

velocity.csv

- Velocity/speed of train
- Column DateTime as Key

disruptions.csv

- Occurred disruptions
- Column DateTime as Key

events.csv

- Occurred events
- Column DateTime as Key

Mapping_Events_
Disruptions.csv

- Mapping table for all possible events/disruptions
- Translations German/English

How to use the provided data: Received signal data

rsSi.csv

- **Ax_RSSI**



- Received signal strength indicator (RSSI)
- Recorded signal strength by the receiver on the train
- The recorded RSSI signal lies within the range [0.0 V ... 3.0 V]

Value Range [V]	Rating
[2.0 – 2.9]	Excellent
[1.6 – 2.0]	Good
[1.2 – 1.6]	Fair
[0.9 – 1.2]	Weak

- **Ax_TotalTel**

- Total number of telegrams received since system start

- **Ax_ValidTel**

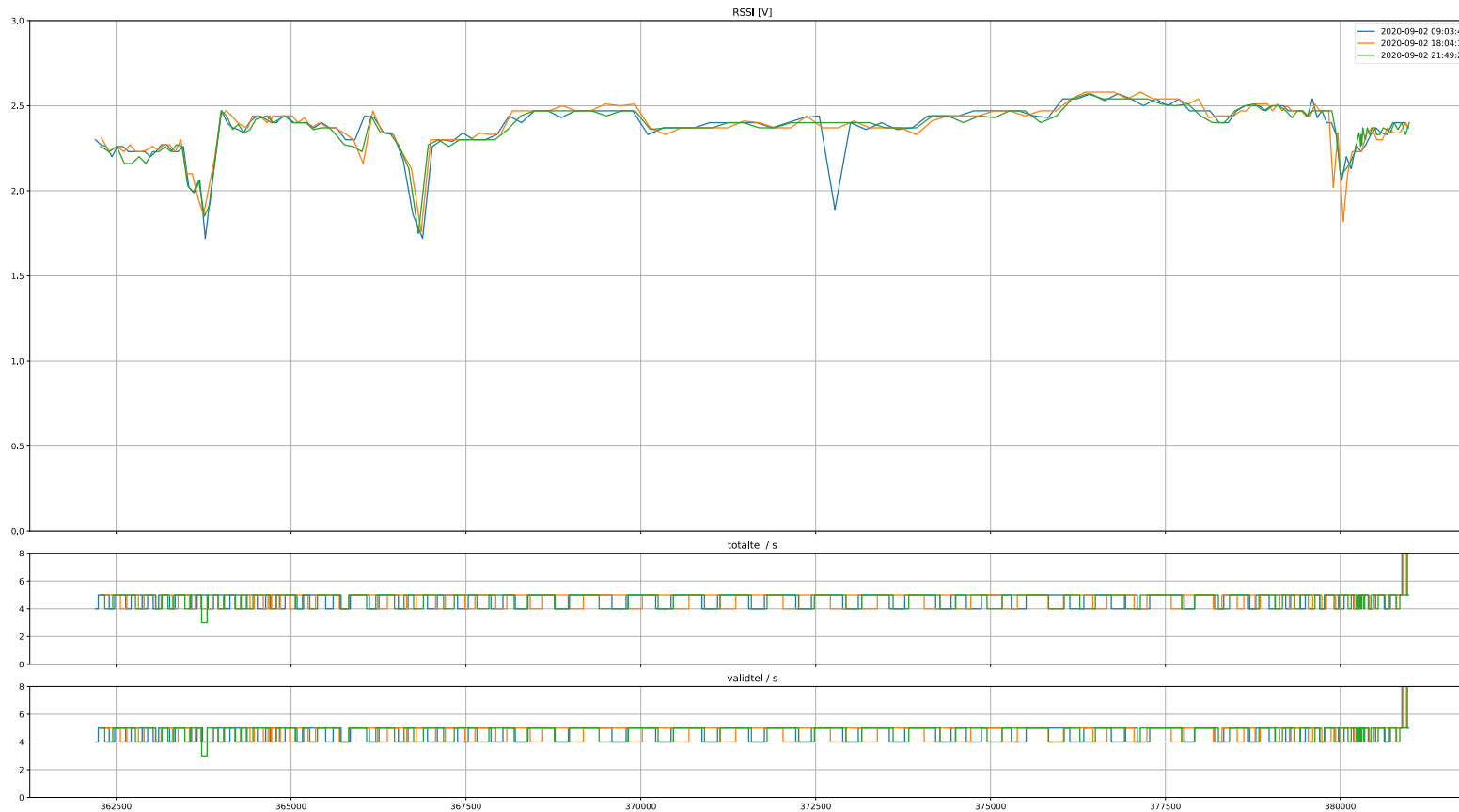
- Number of telegrams with valid CRC received since system start

As data is tracked once per second, the delta between two sample points can be used as a second quality indicator at the sample point.

Ax_, x=1,2 stands for receiver (antenna) number

Deep dive into signal data

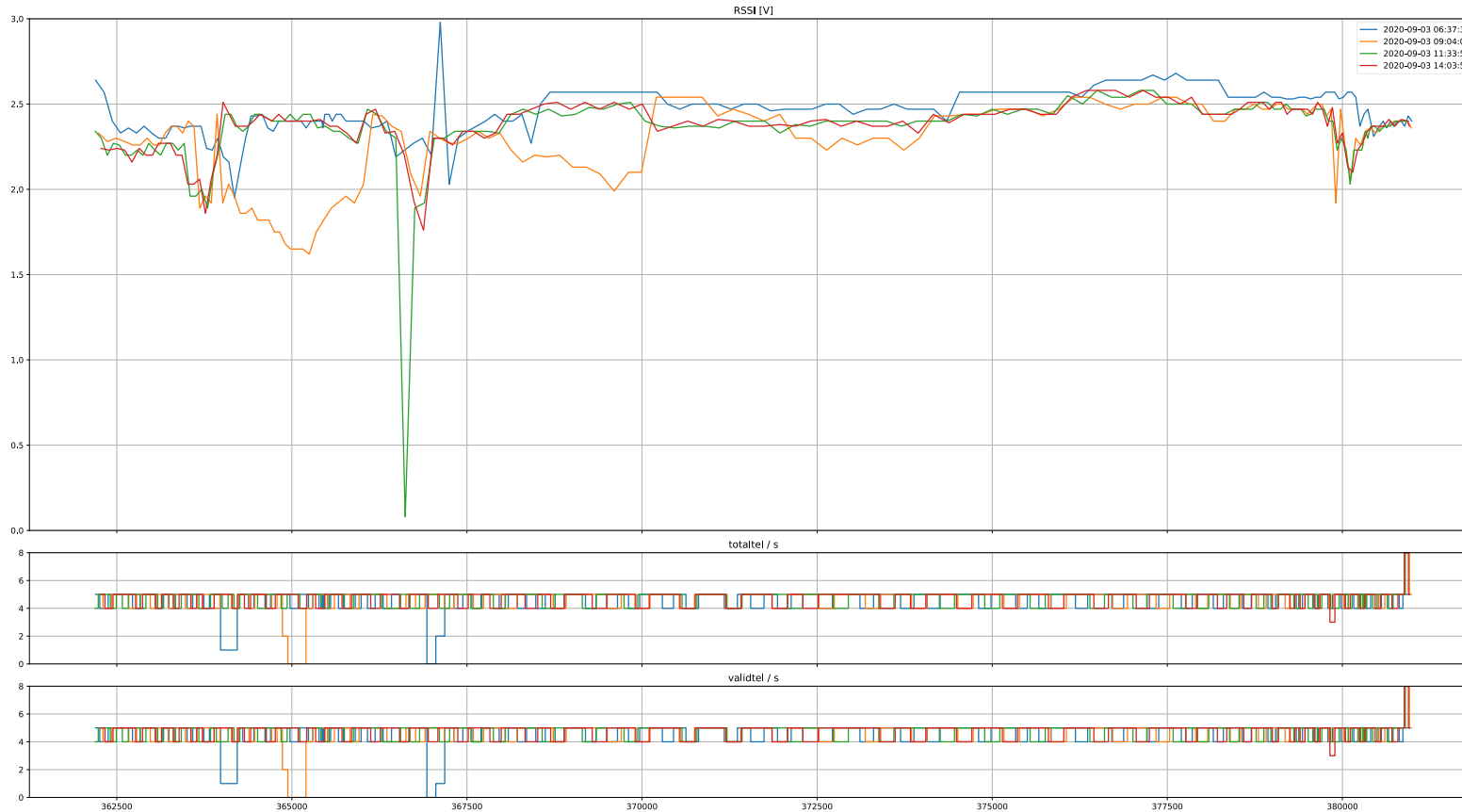
rss.csv



- RSSI, TotalTel and ValidTel plotted against the position on x-axis
- Every track path has a characteristic repeating RSSI profile
- The number of telegrams per second typically varies between 4 and 6 telegrams

Deep dive into signal data: Degradation of loop cable

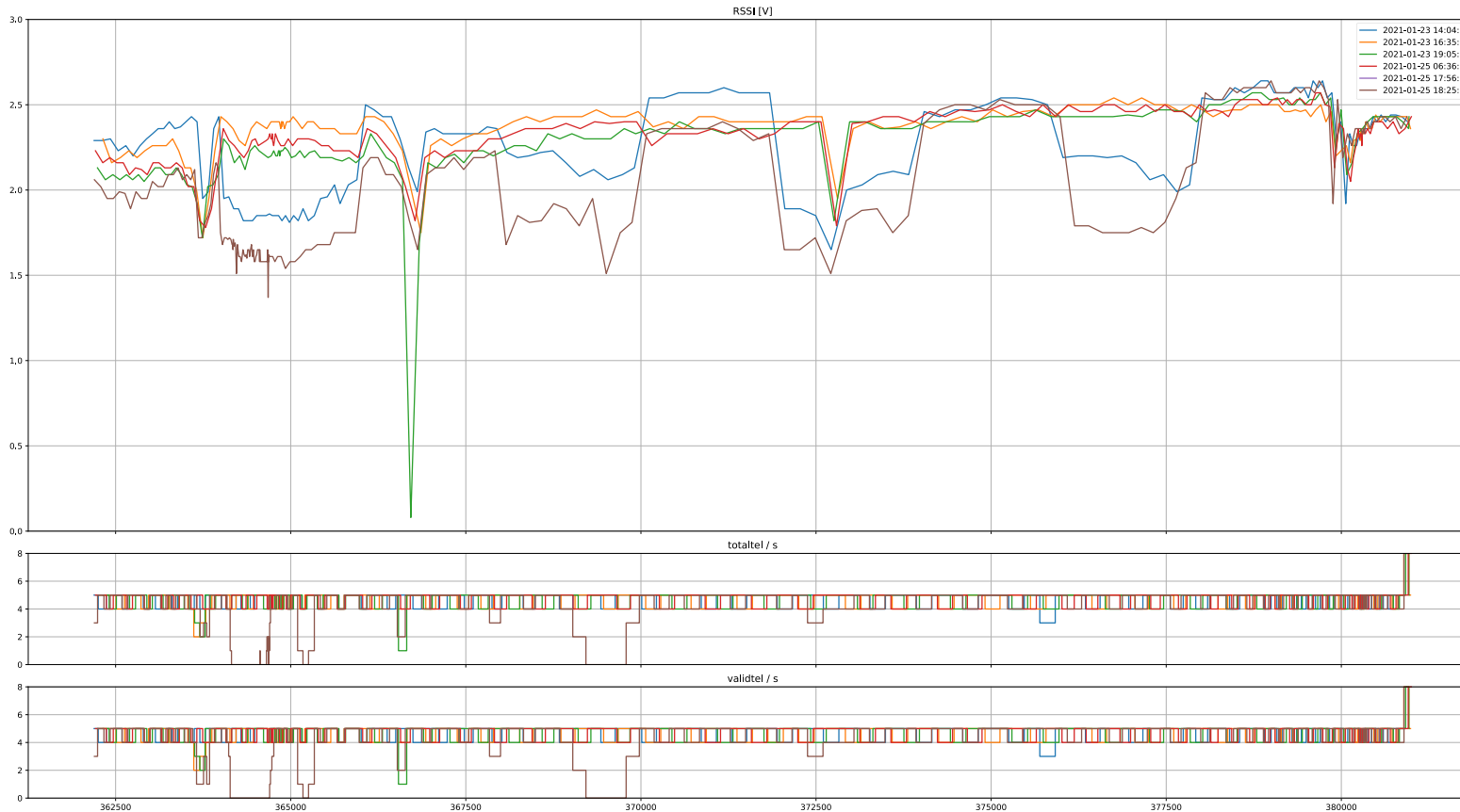
rssI.csv



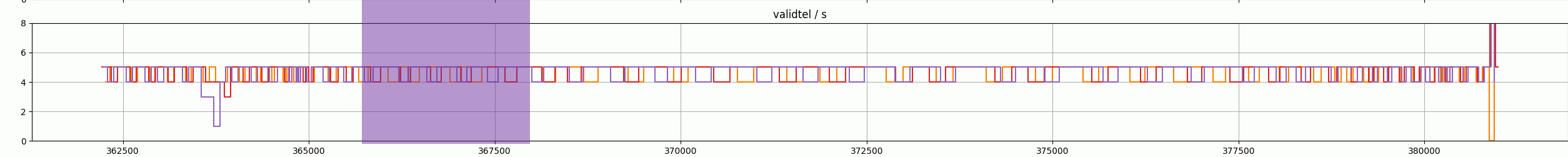
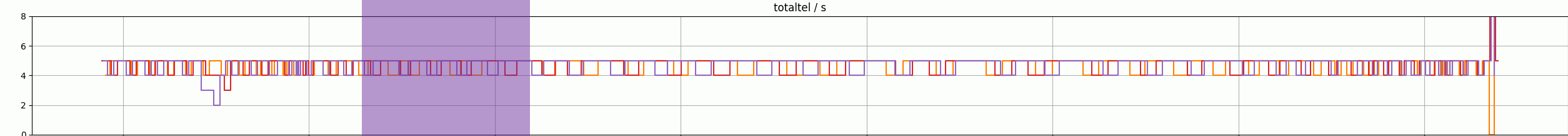
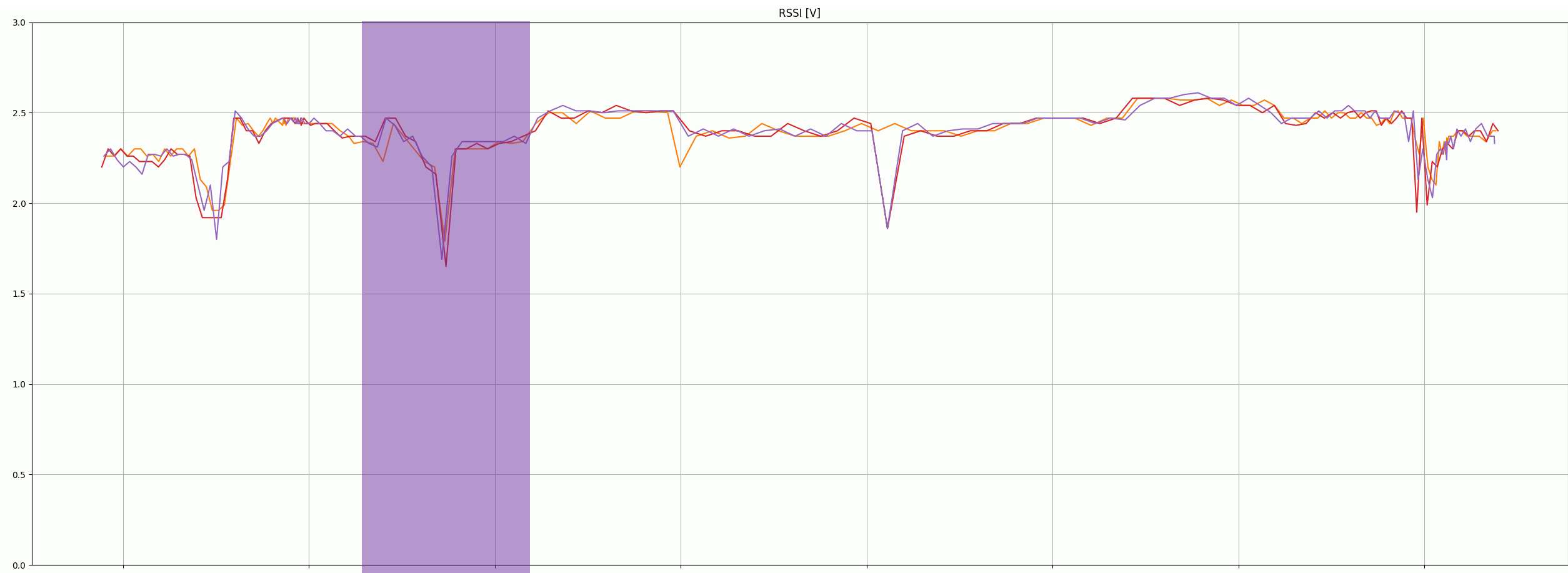
- Deviations of that profile may indicate defect or starting degradation of the loop cable
- If profile deviations and telegram dropout occur at the same time, this indicates a problem at this location
- With the high peak of the blue line to 3.0V and low peak of the green line to ~0V, the receiver indicates signal problems

Deep dive into signal data: Degradation of loop cable

rss.csv

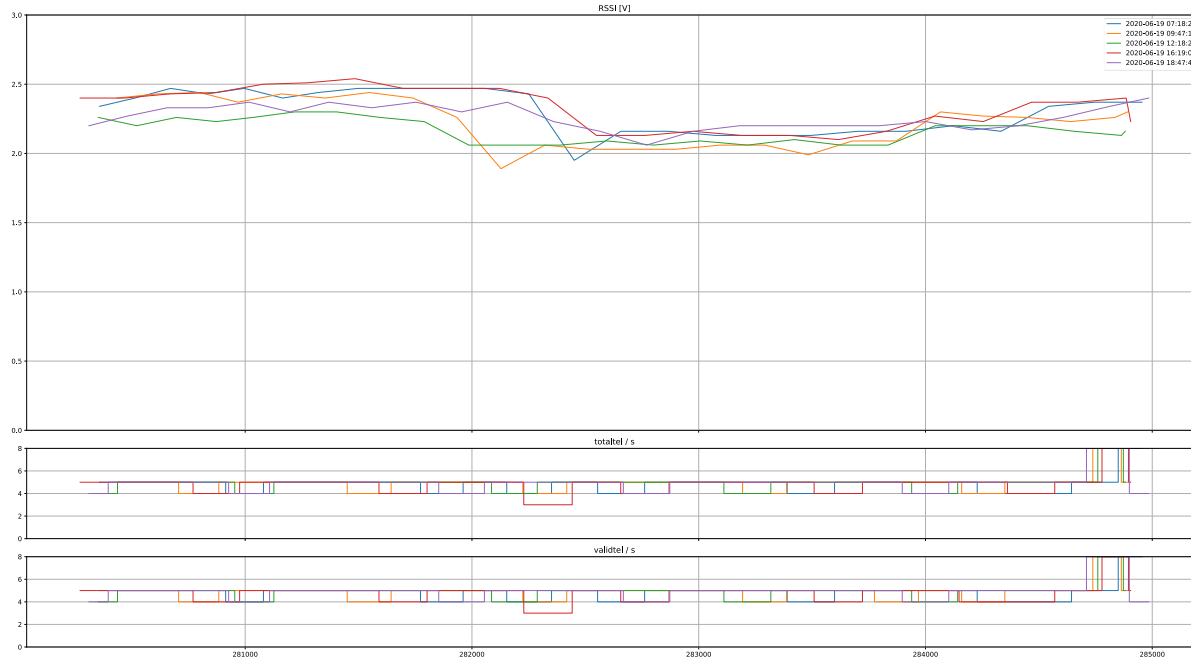


- During heavy snowfall in January '21, degradation of a cable coupling, caused by corrosion, led to massive loss of signal quality
- Location: [36200m – 38100m] (stations Zetzwil – Leimbach)
- Event time:
~January 2021
2021-01-25
- Repair date: 2021-02-01

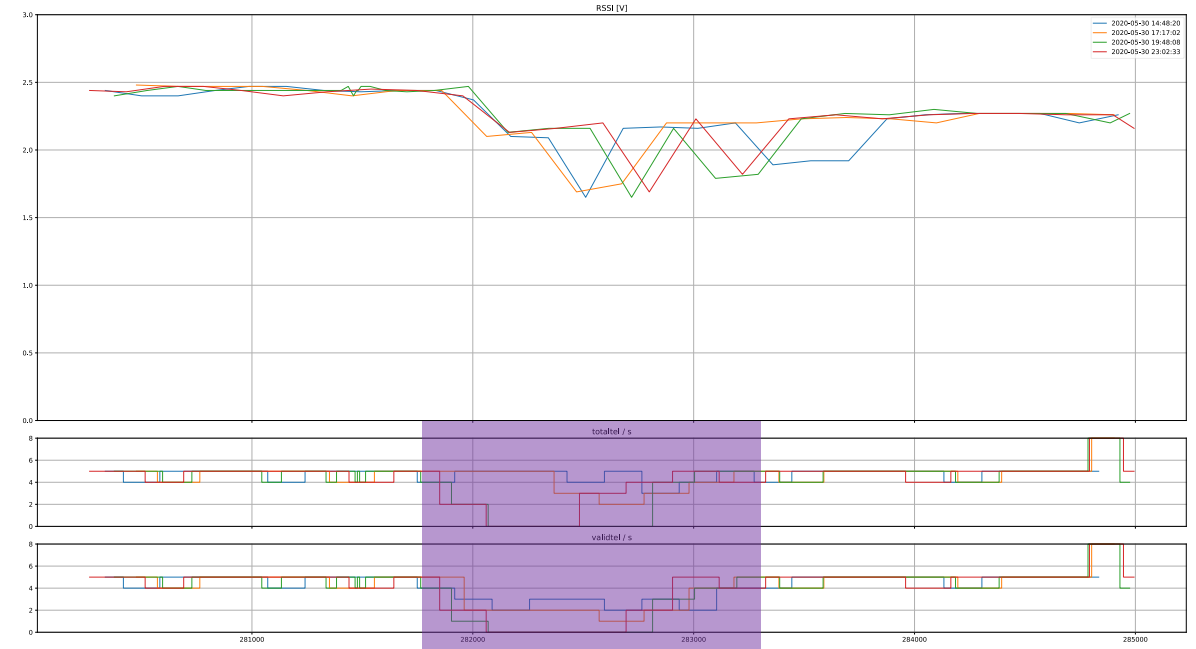


Deep dive into signal data: External interfering transmitter

rss.csv



- RSSI is still 'good', but both telegram counters drop and additionally the counters diverge.
→ This indicates a bad signal to noise ratio (SNR), possibly caused by an external interfering transmitter.
- The cause for this example was an electric cow fence



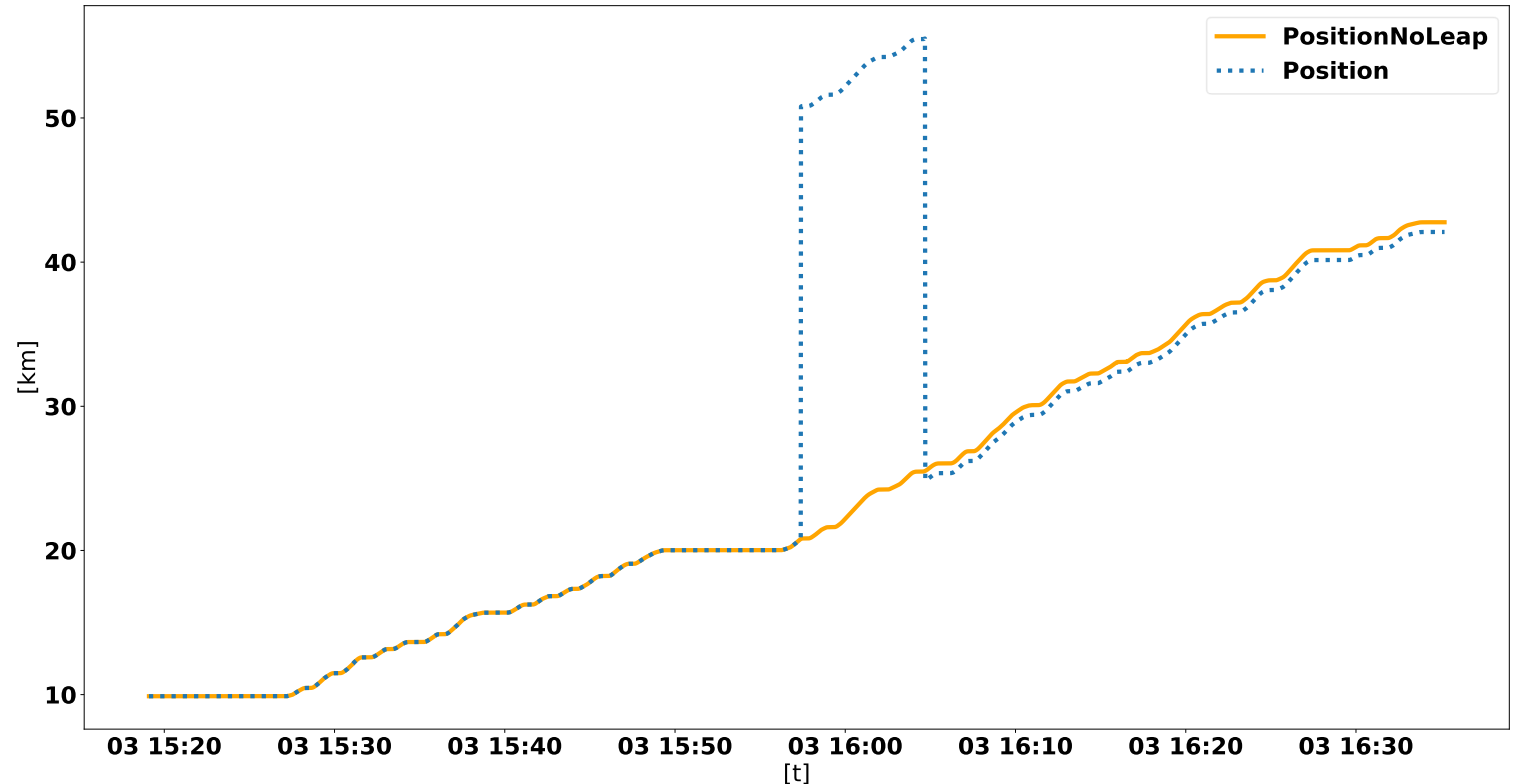
Location:

- [28000m – 28500m]
(near station Bleien-Liebegg)

How to use the data provided: Train position data

rss.csv

- **Position**
holds the trains position on an operator specific km scale ranging from ~9 km up to ~43 km and ~52km to ~55km
- **PositionNoLeap**
corrects these positional leaps in column "Position"



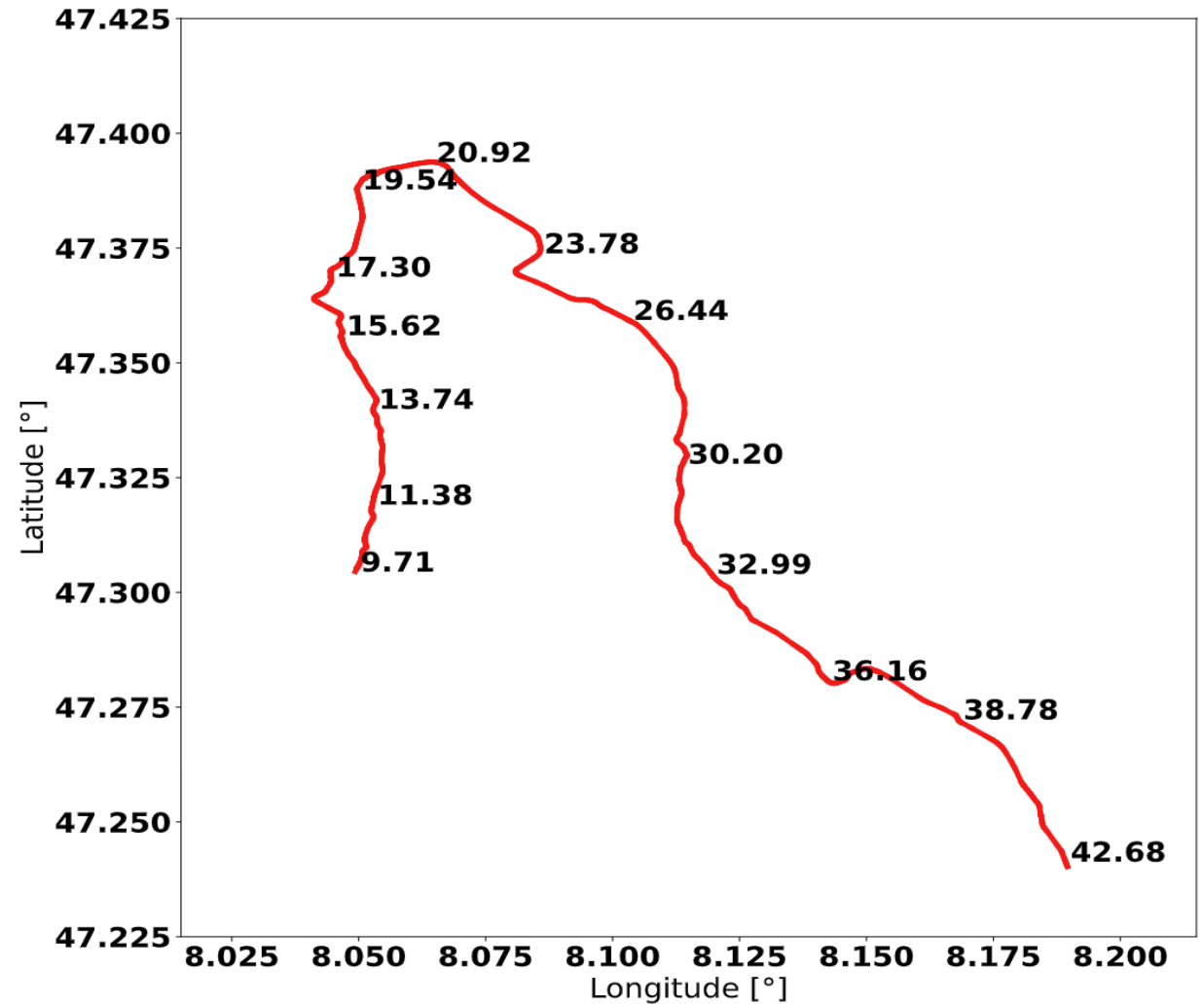
How to use the data provided: Train position data

rss.csv

- **Latitude**, **Longitude**
represent the corresponding geo-positions

[for the challenge most likely not relevant]

- **Track** holds the trains track number
- **AreaNumber** holds the station number

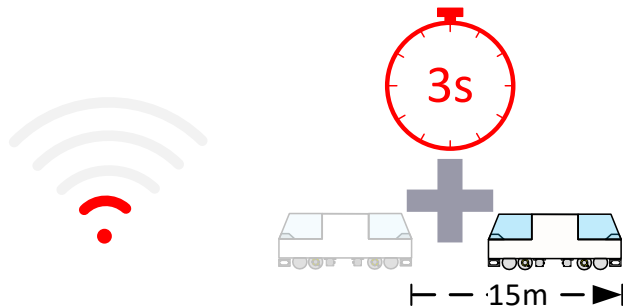


How to use the data provided: Disruption and event data

disruptions.csv

events.csv

The dataset “disruptions” contains all detected disruptions during the period of operation.
Of all the disruptions and events, the following three are primarily of interest:



DateTime: "14.10.2020 06:21:03",
DisruptionCode: "960862258",
Description: "Keine Linienleitertelegramme empfangen"
(no loop telegrams received)

DateTime: "14.10.2020 06:21:03",
DisruptionCode: "960862267",
Description: "Zwangsbremse wurde aktiviert"
(emergency stop activated)



DateTime: "14.10.2020 06:21:03",
EventCode: " 1698873074",
Description: "Zwangsbremse Signal ME_A"
(emergency stop activated)

How to get the data

How to get the data

<http://hackzurich.siemens.cool>



Downloads

Description	Link
Performance metadata	rssl.zip
Disruption data	disruptions.zip
Event data	events.zip
Disruption/event mappings	Mapping_Events_Disruptions.zip
Speed data	velocities.zip
Workshop slides	Workshop_Siemens_Mobility_20210924.pdf
Workshop Zoom recording	Workshop_Siemens_Mobility_ZoomRecording_20210924.zip

We look forward to working with you at the HackZurich 2021!

You have questions, ideas for your own project, or just want to chat with us? Reach out on Slack or directly at our booth:



We are available on Slack and at our booth throughout HackZurich at the following times:

Day	Presence time at booth/slack
Friday	until 01:00 CEST
Saturday	08:00 to 00:00 CEST
Sunday	08:00 to end

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Debug our train tracks together with us!

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 - Friday until 01:00 CEST
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 - Sunday 08:00 to end
- ❖ Talk to us at our booth or over Slack!
- ❖ We are happy to have live meetings with you on:
 - ❖ Slack
 - ❖ MS Teams
 - ❖ Jitsi, Zoom, ...