Rail Accident Investigation Branch

Establishing a timeline from electronic data

Rail Accident Investigators Seminar

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Turning data into information

- Identify and preserve the available evidence
- Validate the data
- Synchronise and draw together
- Define what you want to find out
- Extract the information

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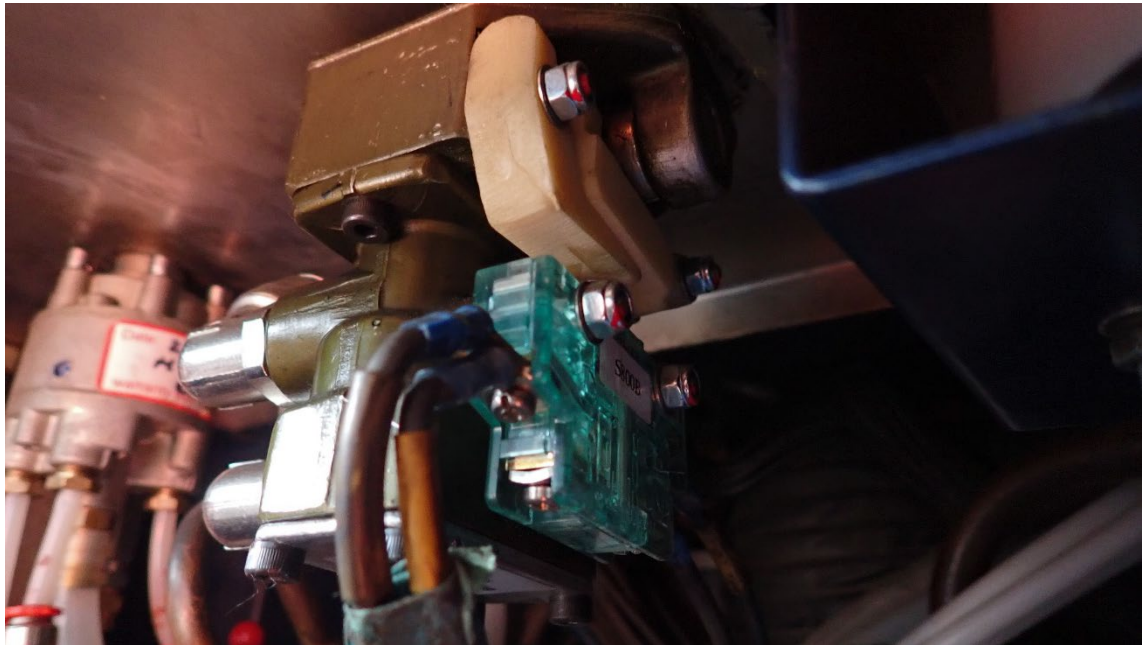
Acquiring data

- What might be available?
  - On Train Data Recorders
  - CCTV
  - Railway operations data, including voice communications and signalling data
  - Data from other trains
  - Personal Electronic Devices
  - Other information – monitoring equipment, open source intelligence

1. Where is it?
2. Has it been preserved?
3. What condition is it in?

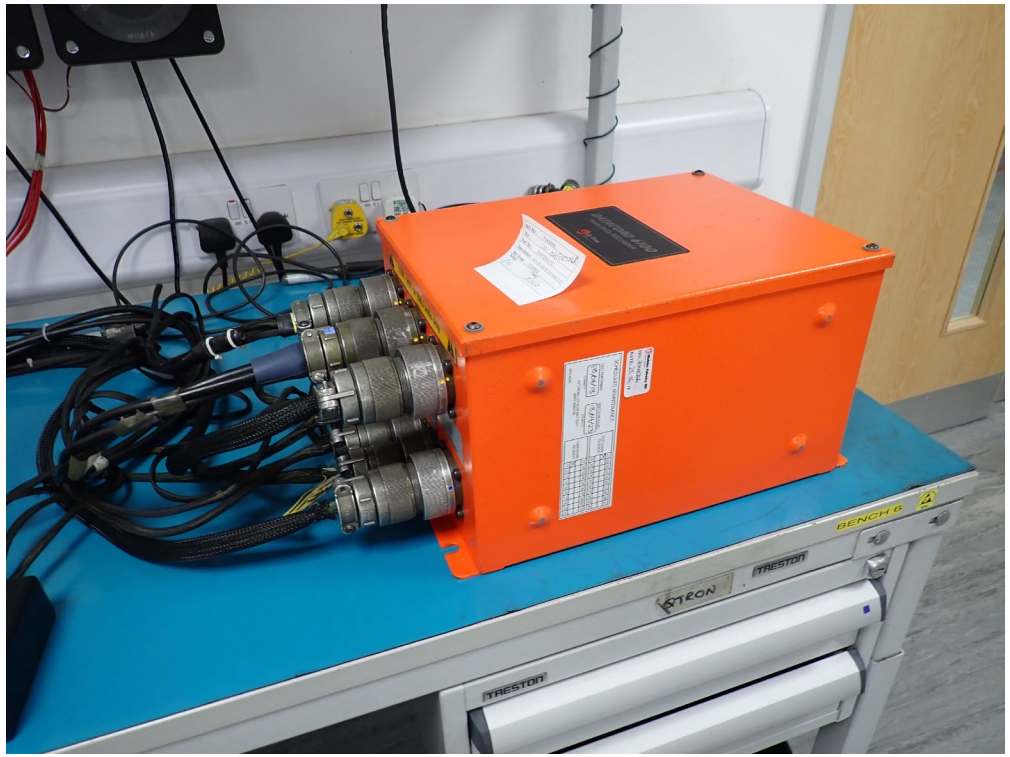
Understanding and validating data

- Before analysis can begin, it is **vital** to understand what the data you want to use **actually** means.
- Several ways to accomplish this:
  - Documentation
  - Conversations with the supplier / maintainer / operator / owner
  - Testing
- Pay particular attention to any **limitations** of the data.



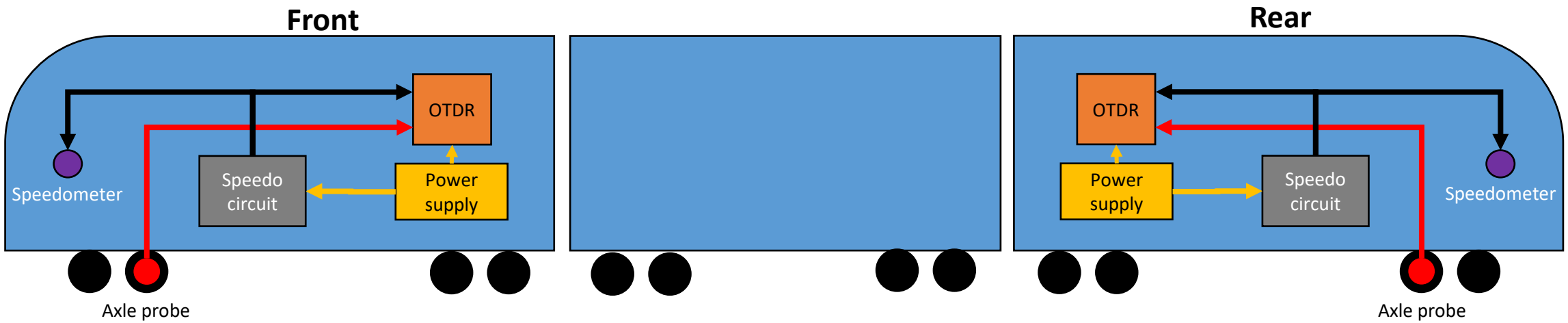
Understanding and validating data

- Gain an understanding of how each system records its data.
  - For example, OTDR systems may receive their speed inputs from frequency generators or current loops – is it recording the speed at the wheel, or the speed shown to the driver?
- Understand whether, and how, it might be affected by other systems.
- This allows you to understand the tolerances on the data and hence the limitations on your analysis.



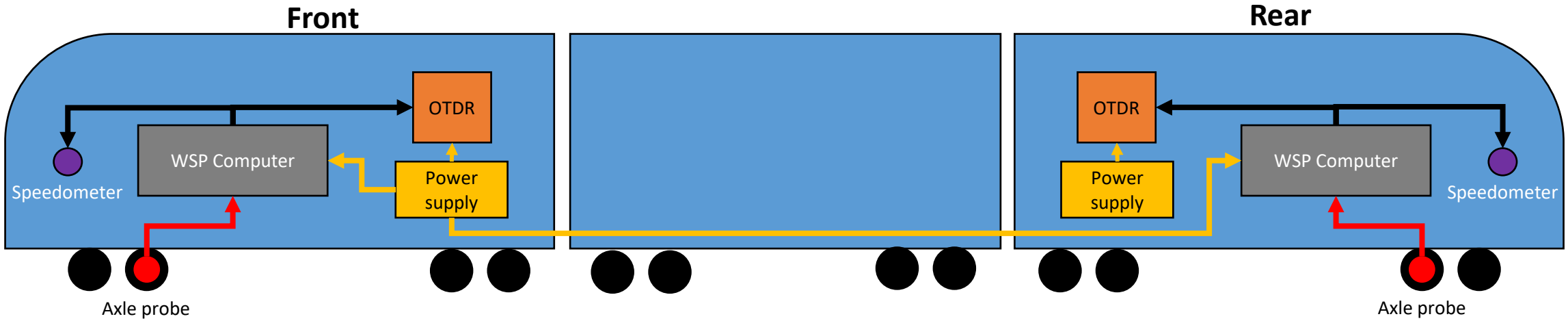
Interaction of systems

- For example, on a typical train, the OTDR will record either a speed signal directly from the axle probe, or the speed signal from the speedometer circuit.
- If the front vehicle derails, it is usually possible to use data from the rear vehicle to extract information from further into the derailment as they are two independent systems.



Interaction of systems

- On some trains, including Scotrail HSTs such as at Carmont, the rear wheelslide protection computer (which feeds the speed signal to the OTDR and speedometer) is powered by the leading vehicle.
- Therefore a loss of power at the front of the train (e.g. due to damage) means that the speed and distance signals on the rear OTDR will no longer be valid, although other channels will continue to record.

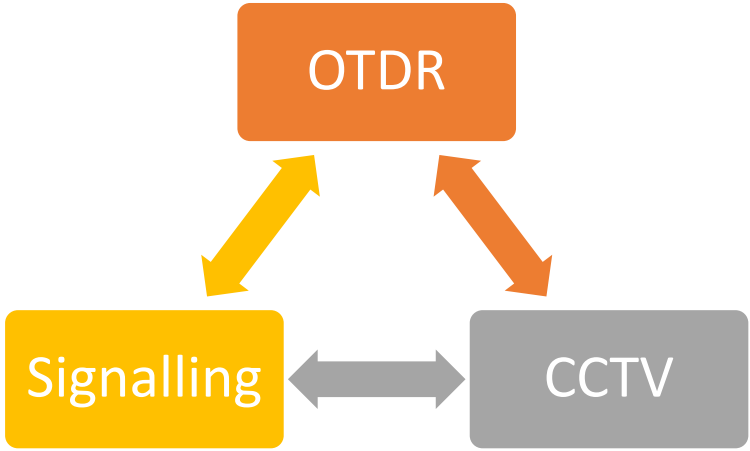


Understanding and validating data

- Now consider a GNSS-enabled device which records time, position and speed, alongside a few analogue and digital channels relating to a piece of equipment.
  - Is the GNSS time accurate?
  - How accurate is the position data? Is it recording to an unrealistic level of precision?
  - How is speed recorded? Is it time between two positions, or recording an input from somewhere else?
- Positive engagement with the supplier / maintainer / operator / owner is likely to be very useful
- Other AIBs may be able to help as well

Synchronising data

- All data sources must be on a common time base, otherwise it is impossible to state the order of events.
- This usually means adjusting the time of one or more sources using an offset – obviously this must be done on a copy of the data.
  - Ideally multiple data sources will monitor the same signal
  - Some judgement may be needed otherwise – for example, CCTV and OTDR data
  - Corroborate offsets wherever possible



Synchronising data

- CCTV from multiple trains and stations
- Multiple OTDRs
- Signalling and railway operations data
- Telephone voice recordings
- Aerial photography
- Witness information

Analysing data

- Define what you want to find out
  - Sequence of events?
  - Speed at collision?
  - Driver's actions?

	T-3	T-2	T-1	T = 0	T +1
Data Source 1				Event	
Data Source 2		Event			Event
Data Source 3				Event	
Data Source 4	Event			Event	

- How best to extract the answers from the information available?
- Swimlane analysis – using a separate lane for each data source, synchronised in time
  - Makes it easier to identify concurrent events across data sources
- Ensure the analysis is checked internally by someone independent, prior to publication.

Final thoughts

- Look for other sources of data
- Liaise with operator / maintainer / owner
- Fully understand the systems which create and record electronic data
- Confirm the validity of recorded data, and understand its limitations
- Seek expert advice

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