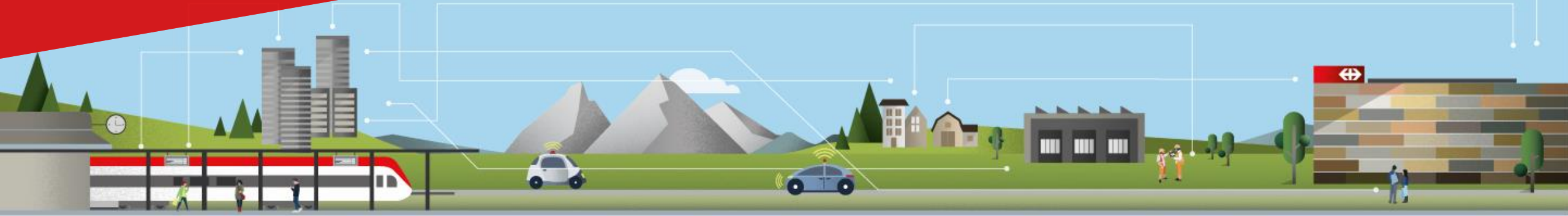


Delay Data Analysis on Event Activity Graph, by Examples.

Mayra Bermúdez Contreras, PhD.
Analytics Service, SBB.



Agenda

1. Introduction
2. Examples
 - Automatic detection of tipping points
 - Other activity types
 - Delay forecasting



Introduction

EAG definition

EAG Introduction

Time table

Abfahrt Départ-Partenza-Departure

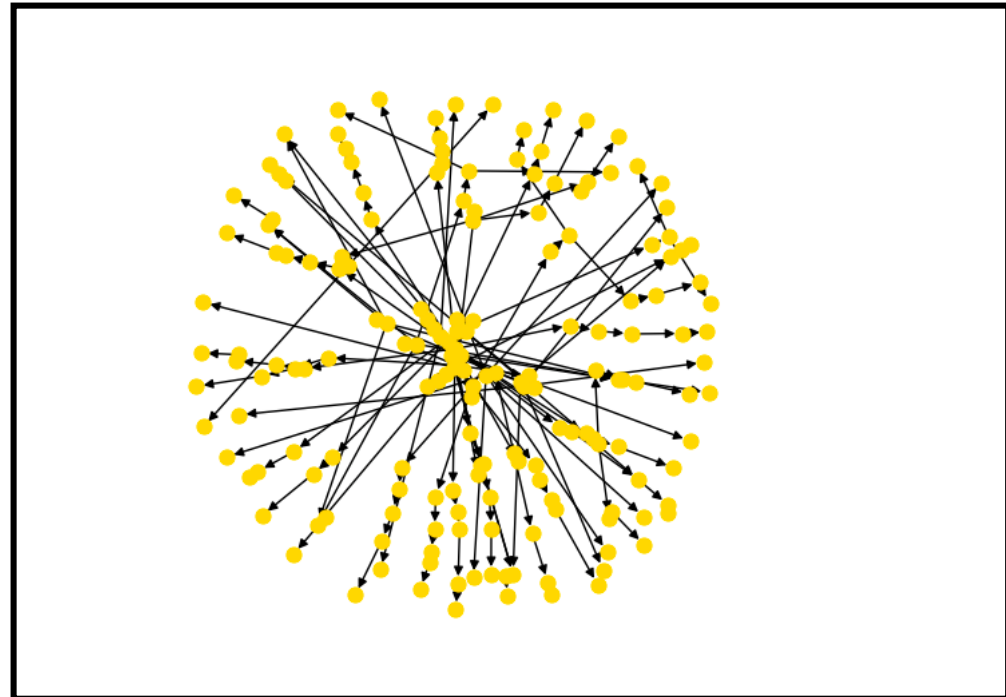
Bahnhof Zürich Tiefenbrunnen

11 Dezember 2005-9 Dezember 2006

Time	Destination	Time	Destination	Time	Destination
5:00	...	16:00	...	0:00	...
6:00	...	17:00	...	2:00	...
7:00	...	18:00	...	3:00	...
8:00	...	19:00	...	4:00	...
9:00	...	20:00	...		
10:00	...	21:00	...		
11:00	...	22:00	...		
12:00	...	23:00	...		

Zeichenerklärung

SBB CFF FFS



EAG Definition

- $EAG = (V, E)$ is an acyclic directed graph.
- V is the set of train departure/arrival events:
(train number, operation point, type event)

Examples: (710, ZUE, dep), (710, ZUE, arr), (710, BN, arr),
(18526, ZUE, dep).

EAG Definition

- E = Set of activities between events.

Activities:

- dwell
- travel
- change
- circulation
- conflict

Example: ((710, ZUE, arr), (18526, ZUE, dep)))

EAG Definition

- Node attributes:
 - planed time
 - actual time
 - delays.
- Edge attributes:
 - edge type
 - hold
 - activity length.

SBB Graph

The graph corresponding to one SBB operation day, considering travel, dwell and change edges, has:

- 170000 nodes
- 250000 edges
- 80000 change edges
- 1200000 nodes with microscopic scale (signals)
- 1300000 edges considering signals.



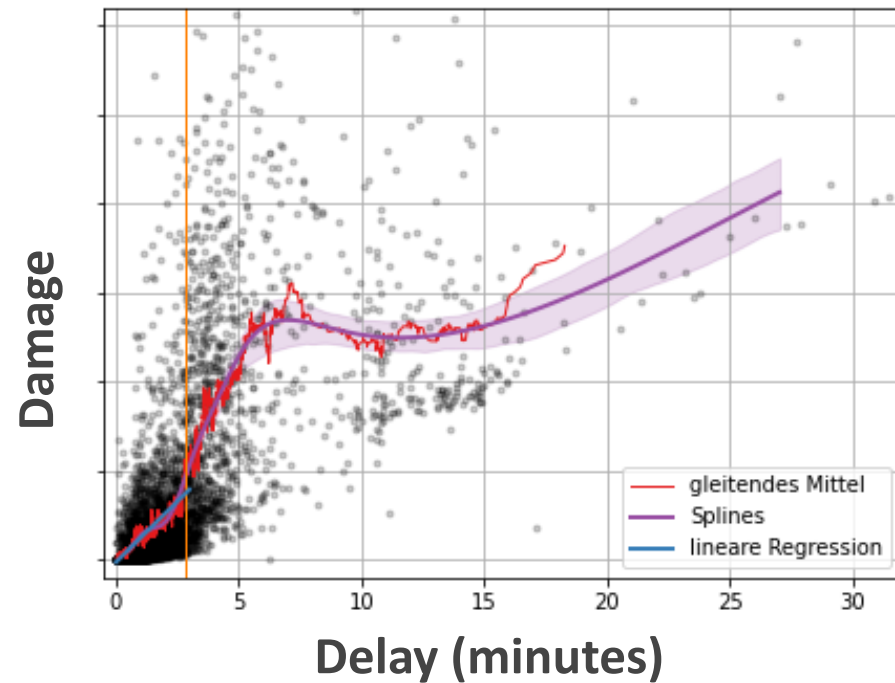
Examples

Examples

1. Automatic detection of tipping points.
 - Successor graphs
 - Damage propagation
 - Propagation stopping algorithms
 - Aggregation of graphs
2. Other activity types
3. Delay forecasting

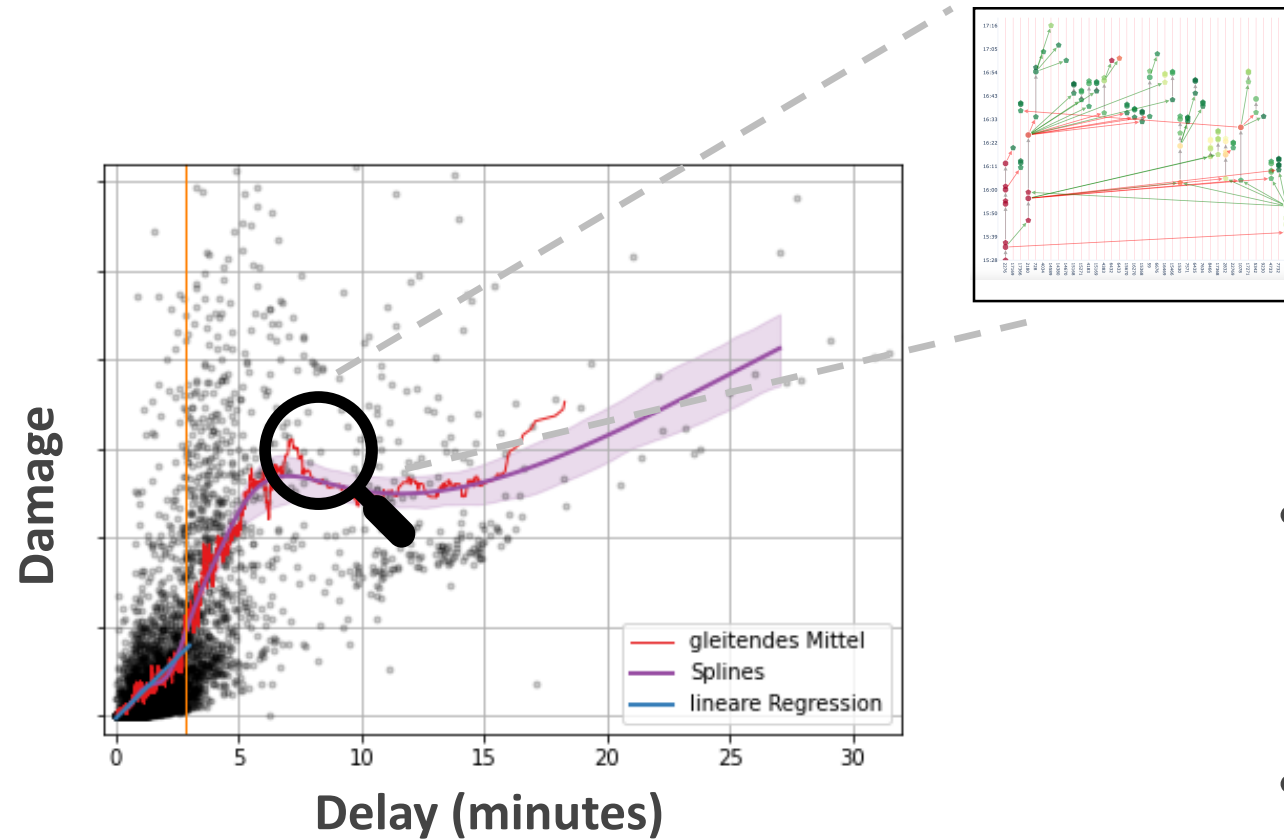
Automatic Detection of Tipping Points

Tipping Points and Damage Propagation



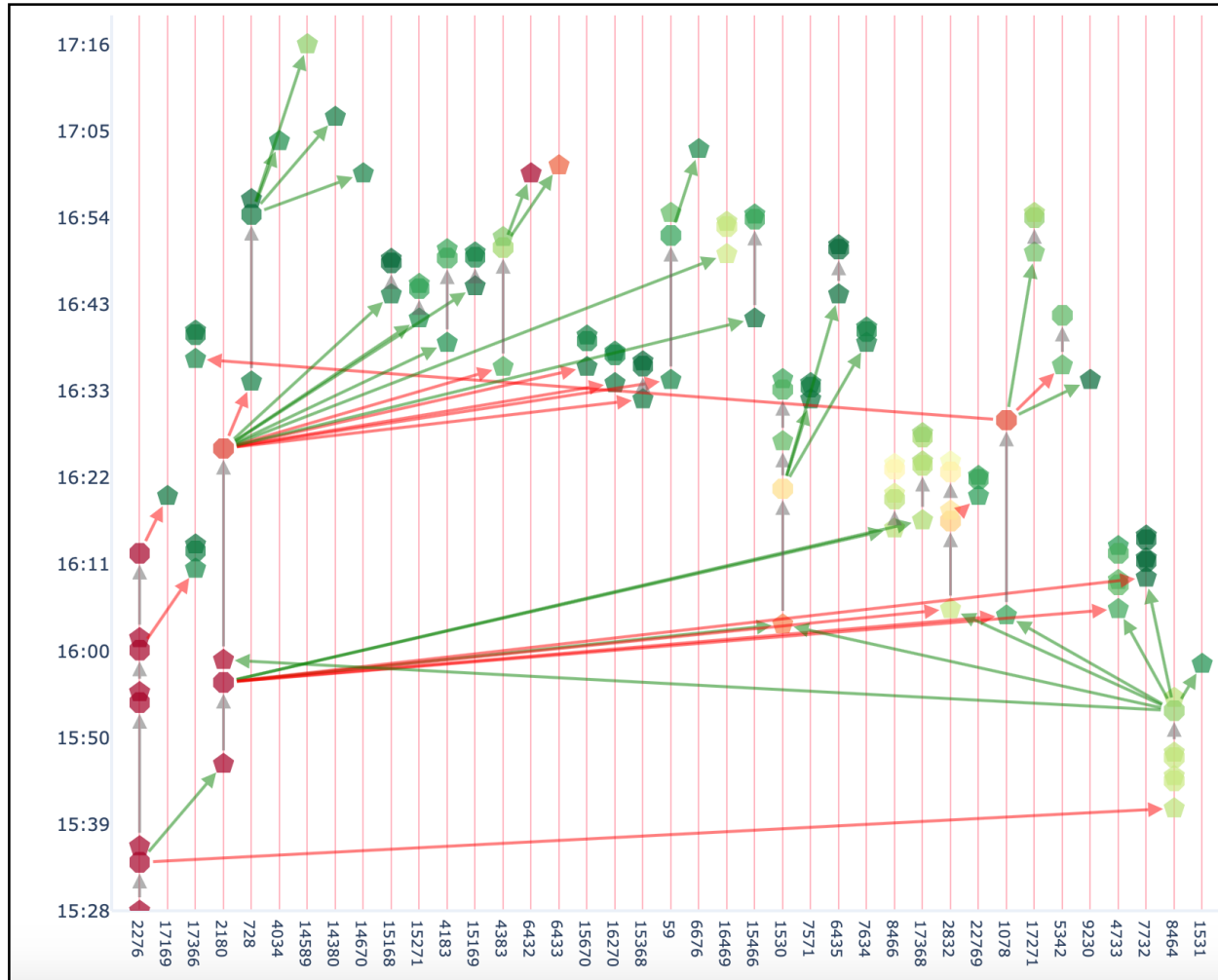
- How do we define damage propagation beyond the train run?
- How do we define the damage caused by a delay?
- How do we define rules for damage propagation?

Tipping Points and Damage Propagation



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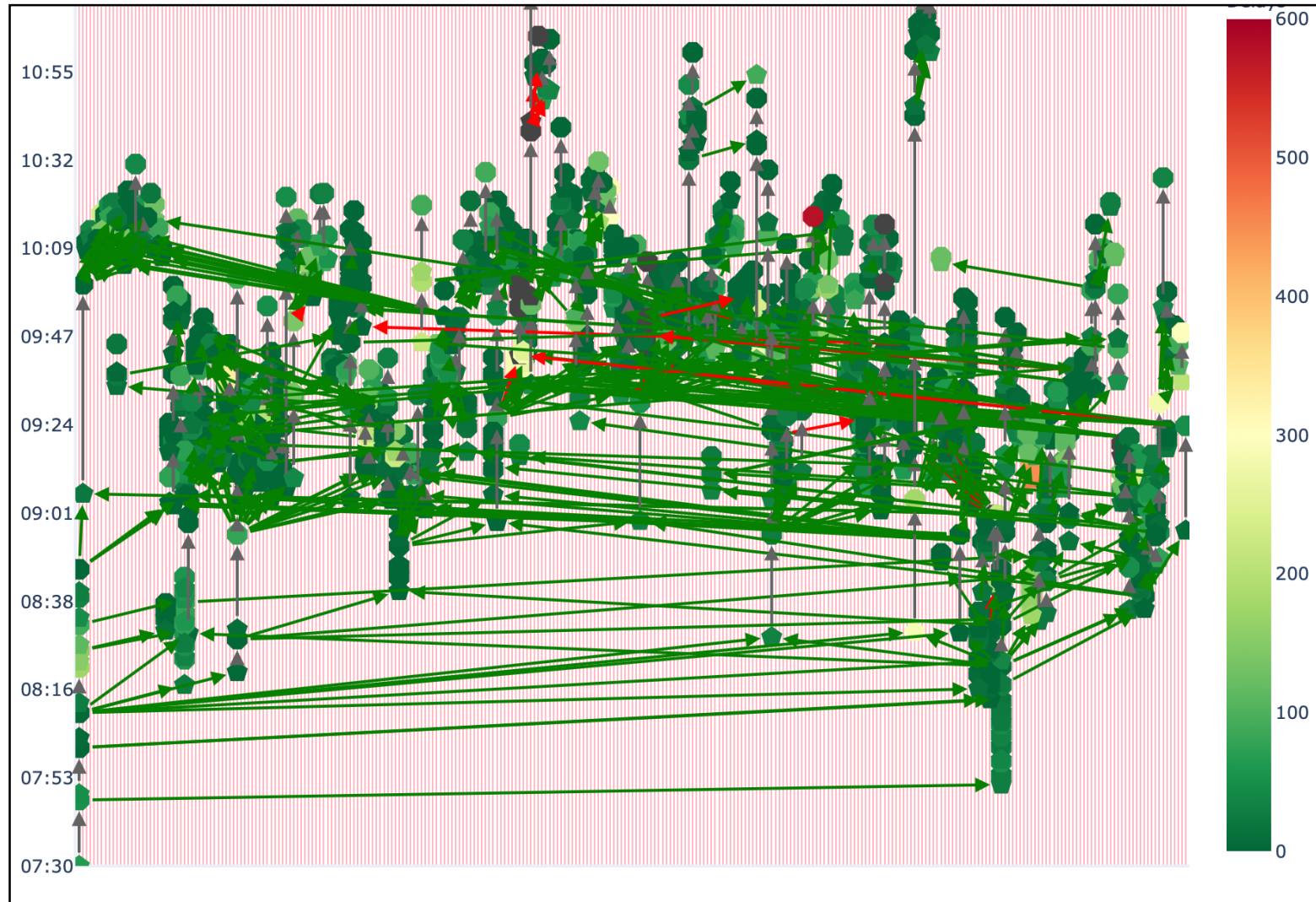
Successor Graphs



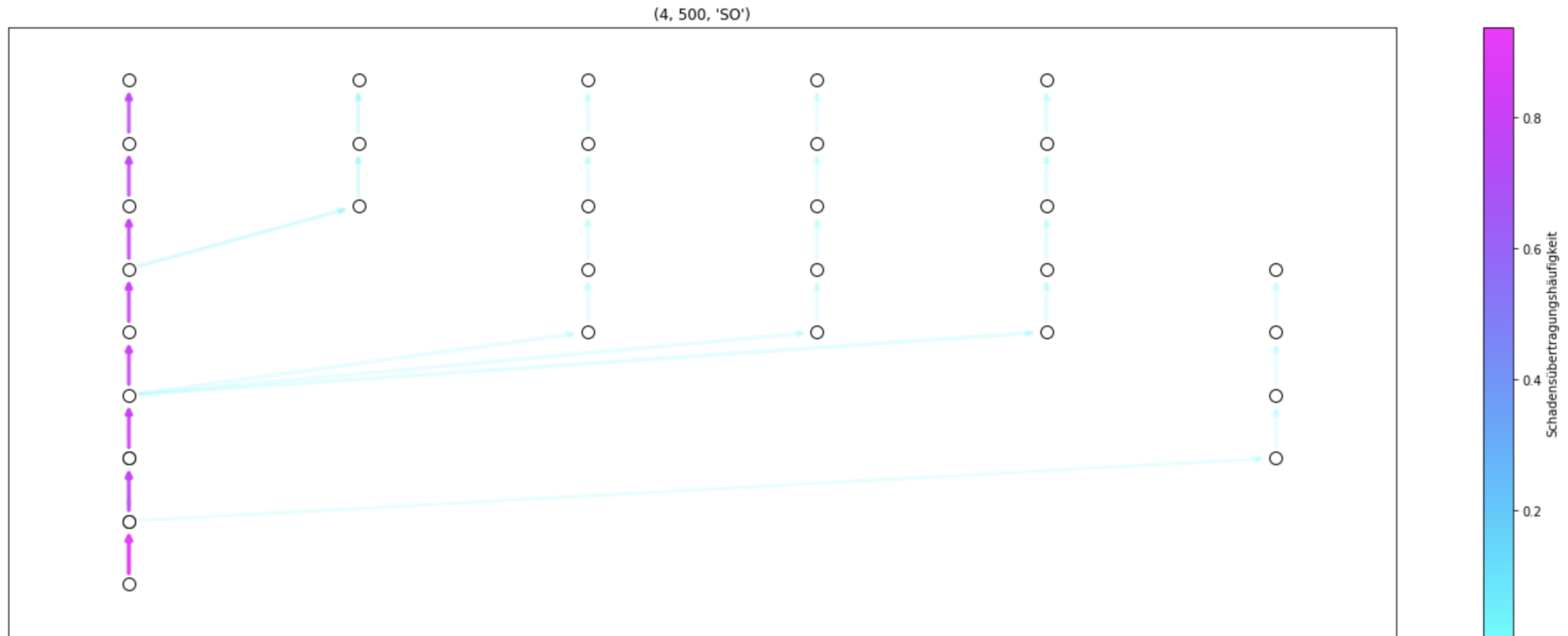
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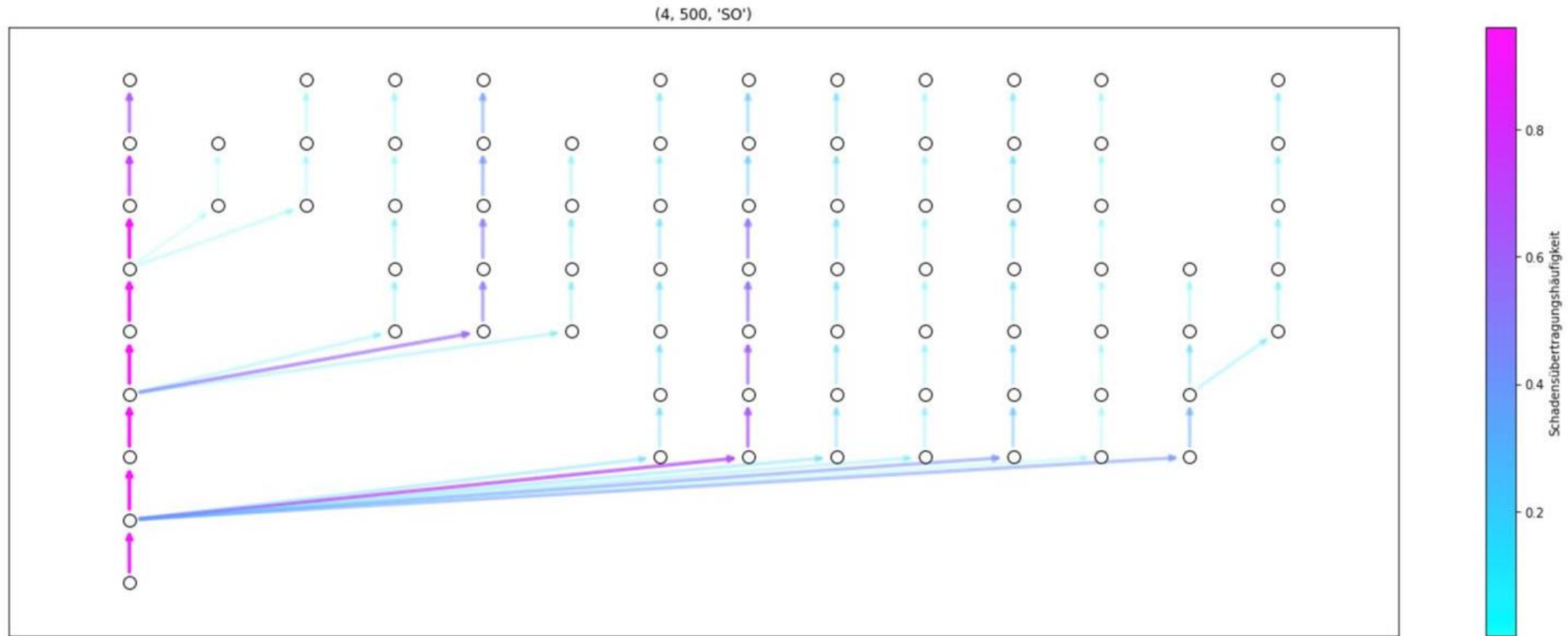
Successor Graphs



Aggregation of Graphs



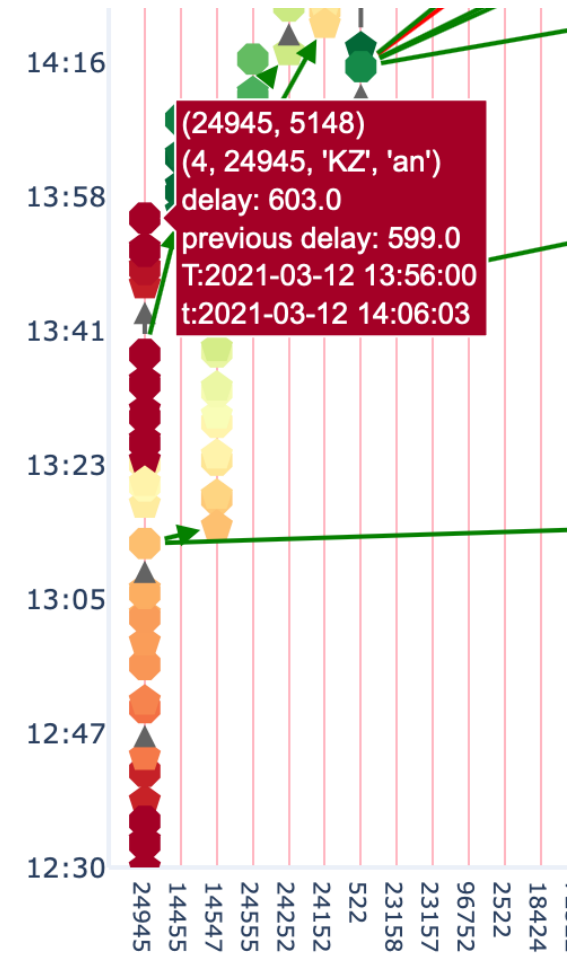
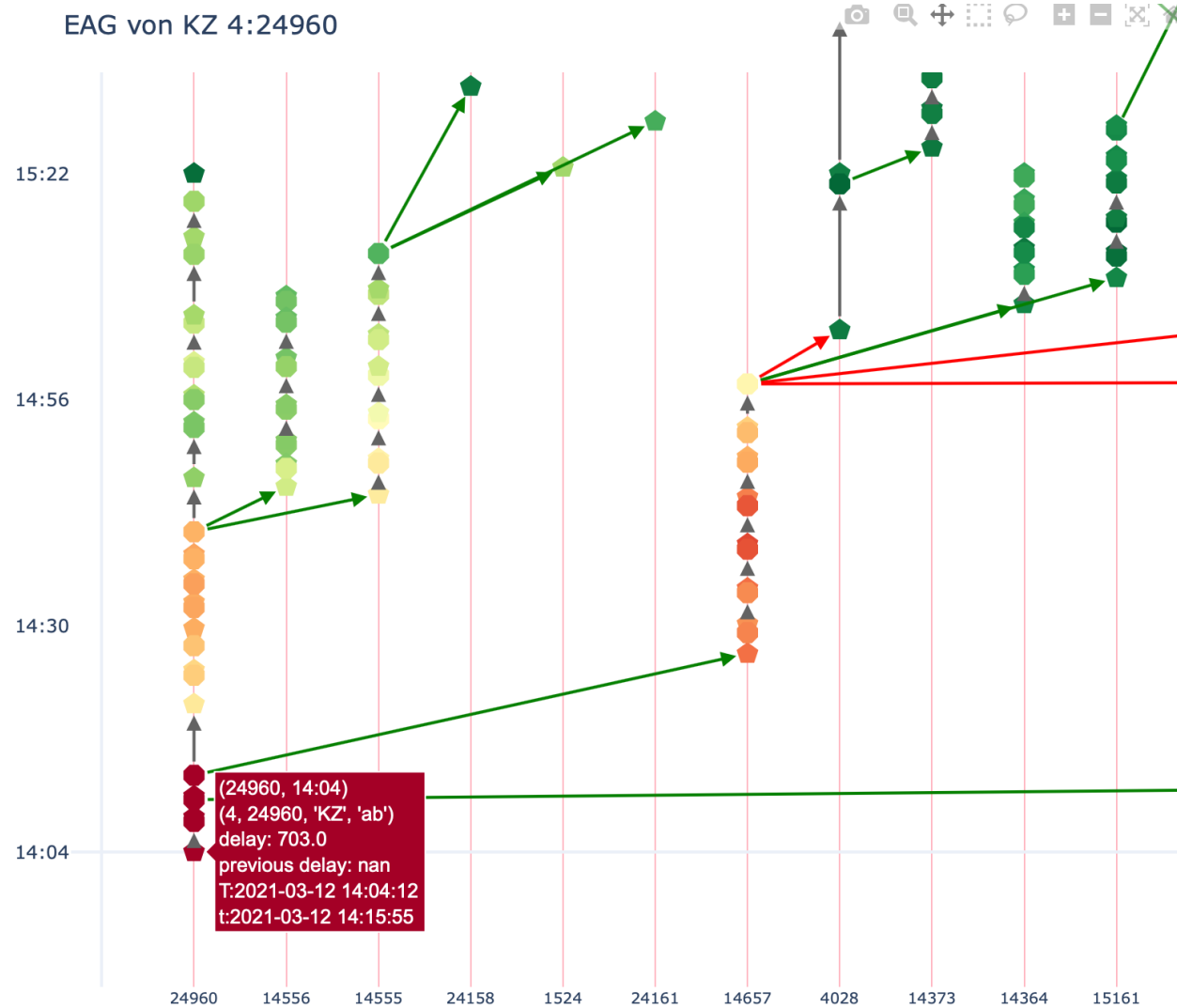
Aggregation Graphs



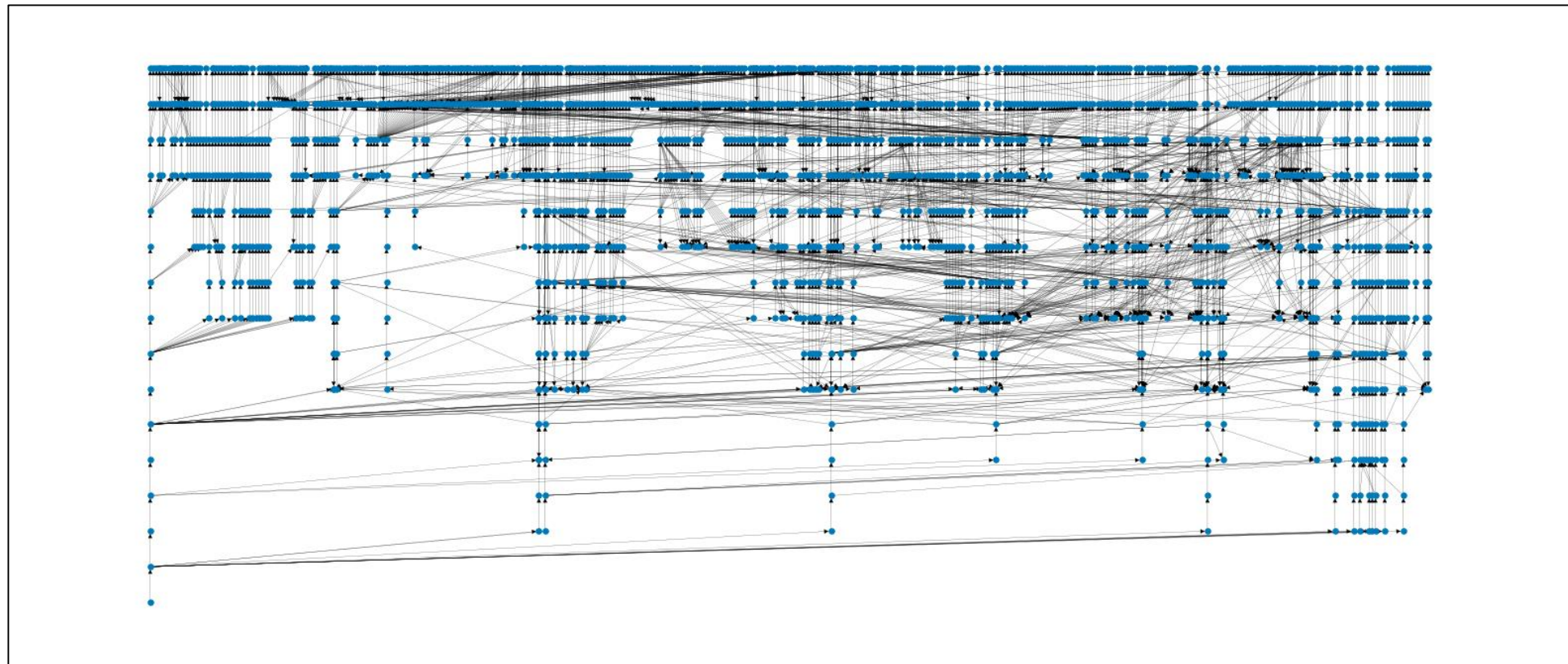


Other activity types

Circulation edges



Conflict edges

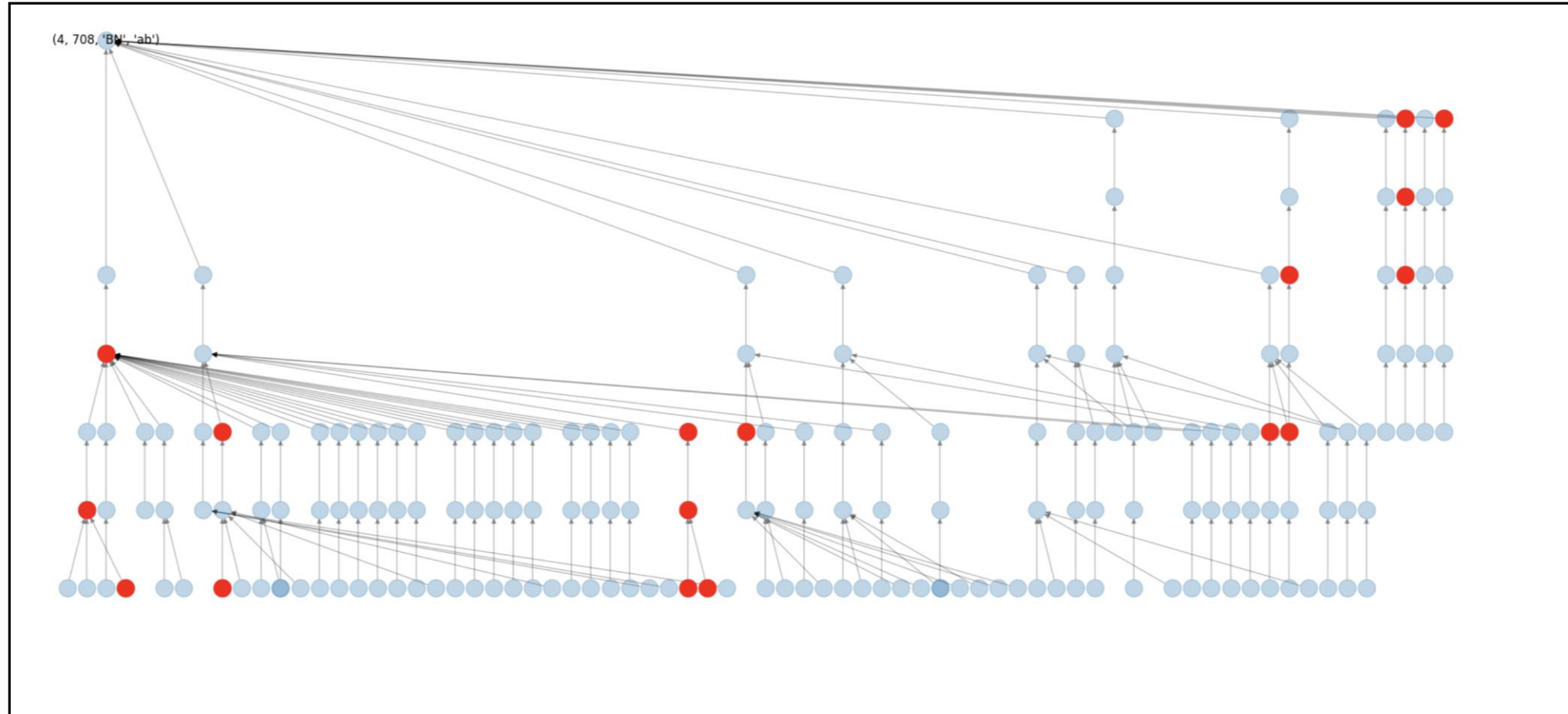




Delay Forecasting

Ancestor Graph

Ancestor Graph



A close-up photograph of a person's hand holding an orange reusable coffee cup on a grey metal tray table inside a train. The person's profile is visible on the left side of the frame. The background is blurred, showing the interior of the train.

Danke, merci,
grazie, thank you.