Piece by Piece with System

Forum ÖV-Planung | Centre Löwenberg | 29.09.2022

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Key Data

- (integrated) Bus & Rail company with around 460 employees (FTE)
- around 90’000 trips per day (2019)
- Network: 54 km Rail, 171 km Bus
- 39 EMUs, 9 Trams & 45 Buses
- 3.0 mio. Train-, 3.1 mio. Bus-km
- 40 stations, 237 bus stops
- Punctuality Rail: 99.3% (2021)

Opening Remarks

- Small, self-contained railway system
  - ► comparison with (inter)national railways only possible to a limited extent
- Fully integrated system: optimisation in the planning triangle
  - ► allows timetabling to take full advantage of all performance limits
- Small management, generalists rather than specialists
  - ► many "bottom-up" approaches, often without theoretical underpinning
- Technical-operational corporate culture
  - ► executive board has been staffed about half with engineers for decades
- Will to innovate in "RBS DNA" for over 50 years
  - ► "RBS innovations" are usually adaptations of good ideas from abroad

History (Rail)

From a security risk…

Bern Felsenau 1971

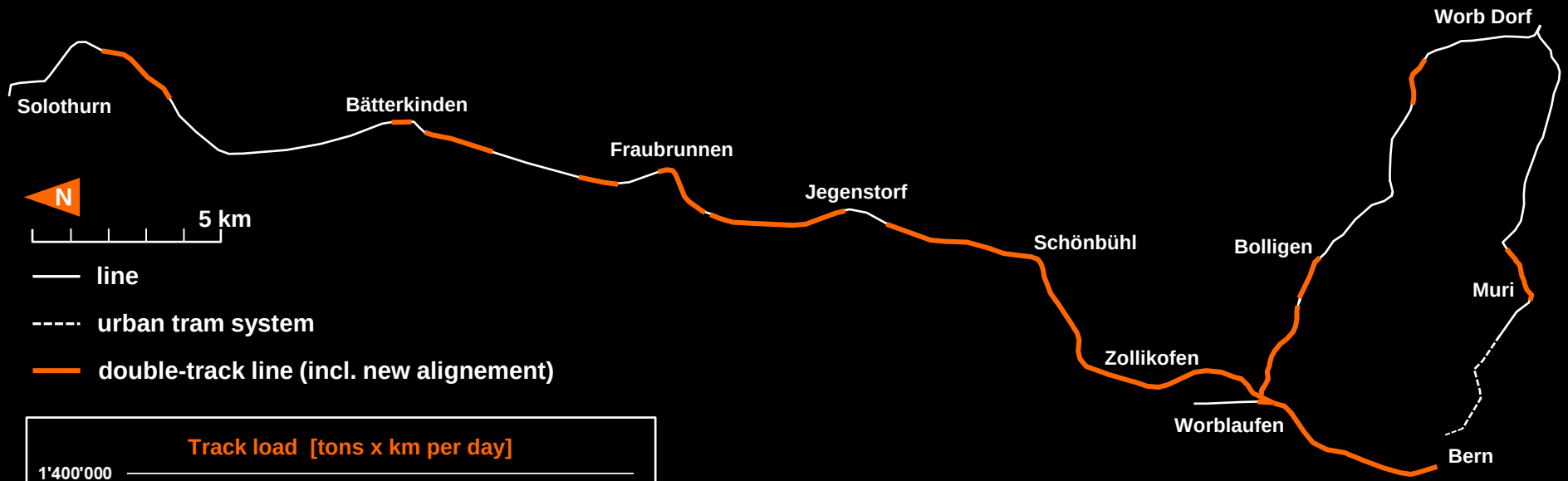
History (Rail)

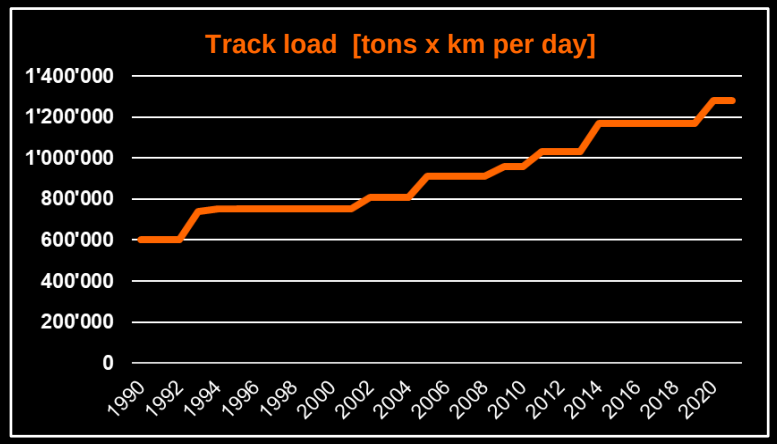
…to the first S-Bahn-system in Switzerland

Bern Felsenau 2016

Network Development

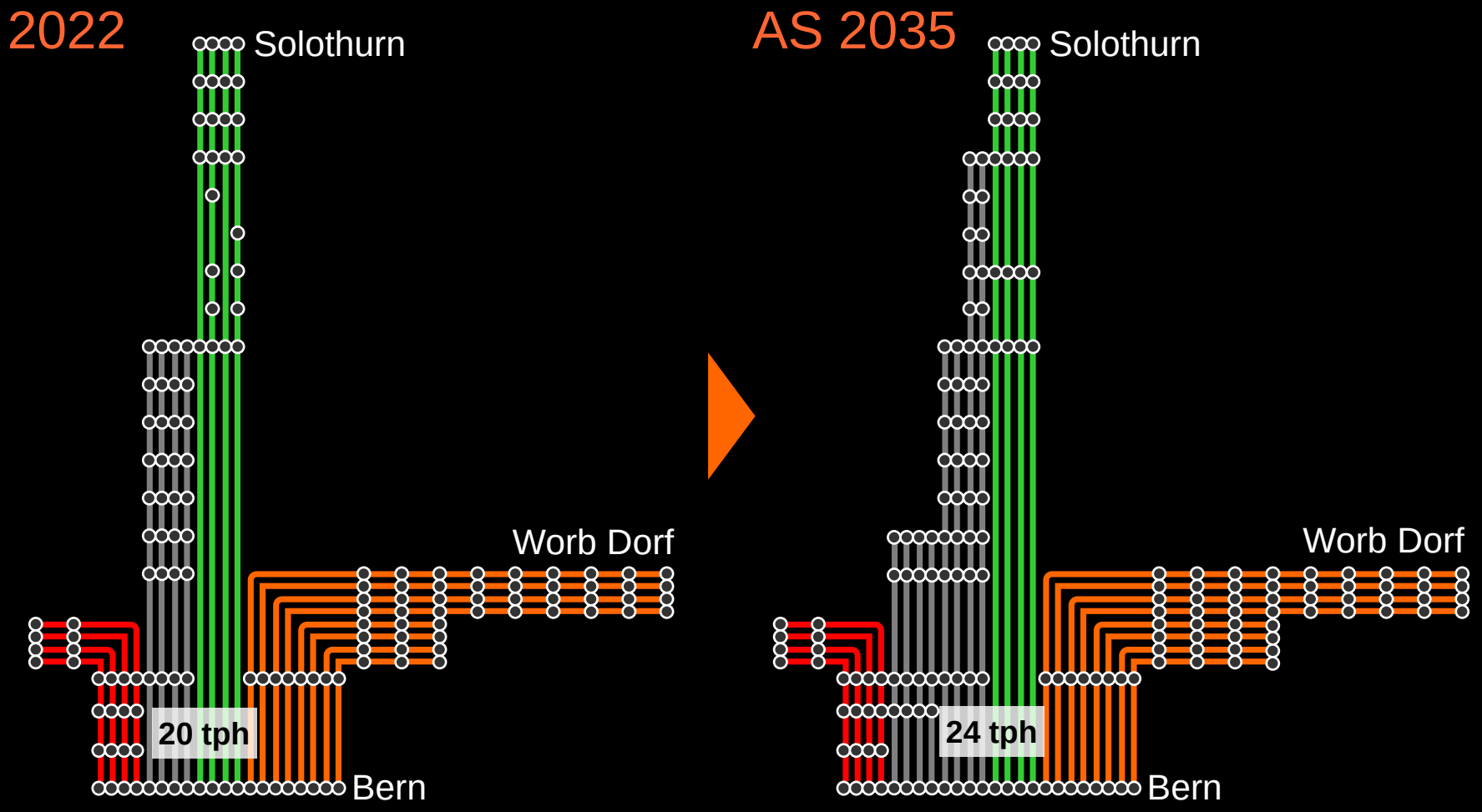
(incl. tram Bern-Muri-Worb)





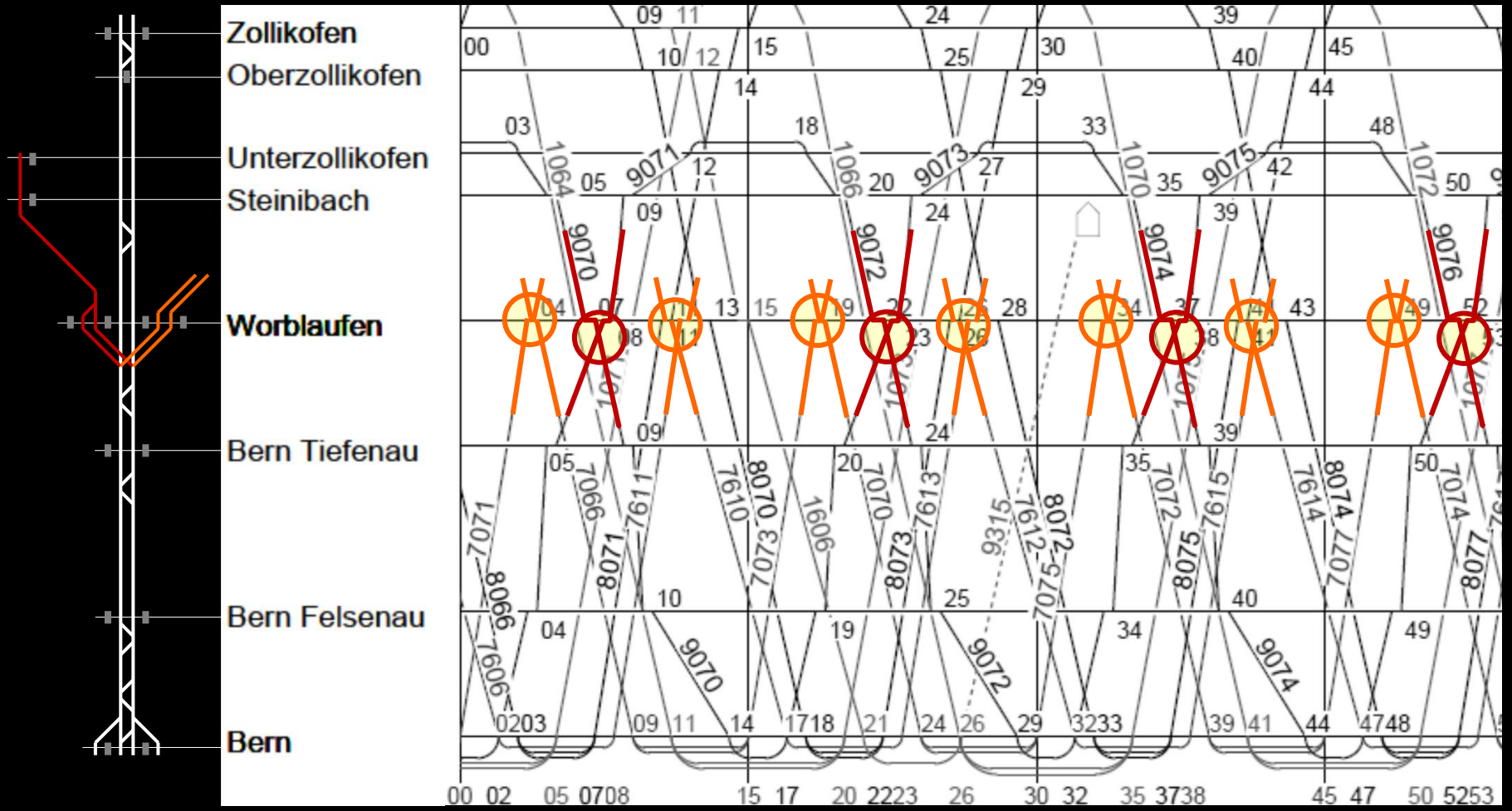
- 1898–1924: Formation
- 1965–1974: New «trunk route»
- 1975–2020: Double-tracking core network

Service Patterns on Rail Network



Network Effect on Timetabling

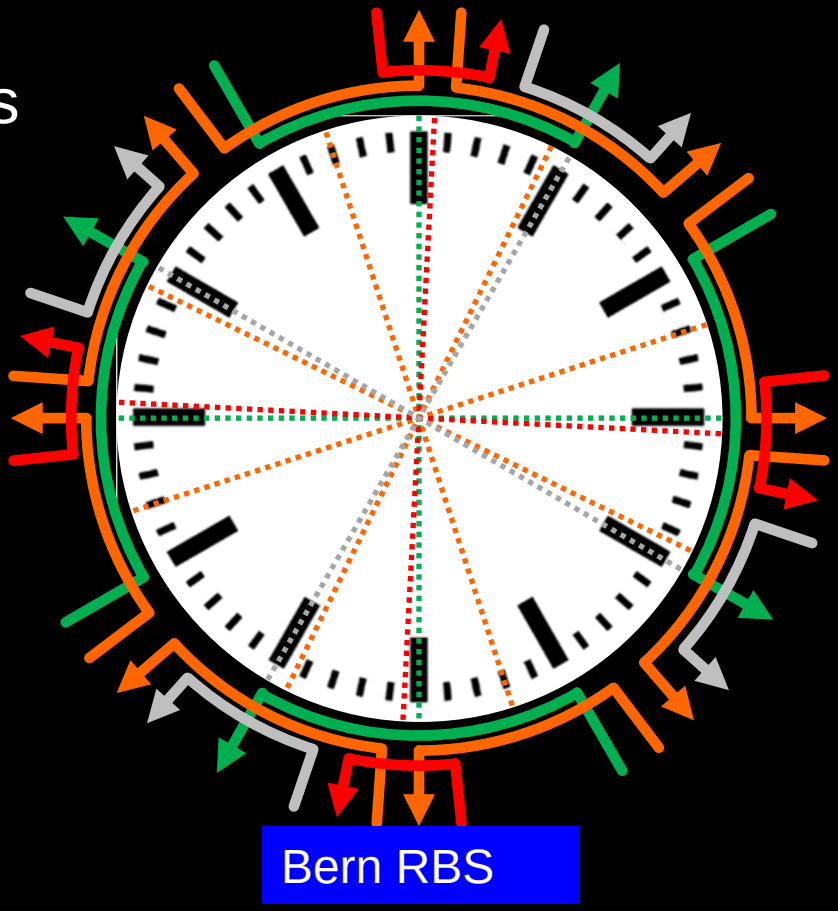
Timetable structure developed from Worblaufen



Minimal Infrastructure Needs

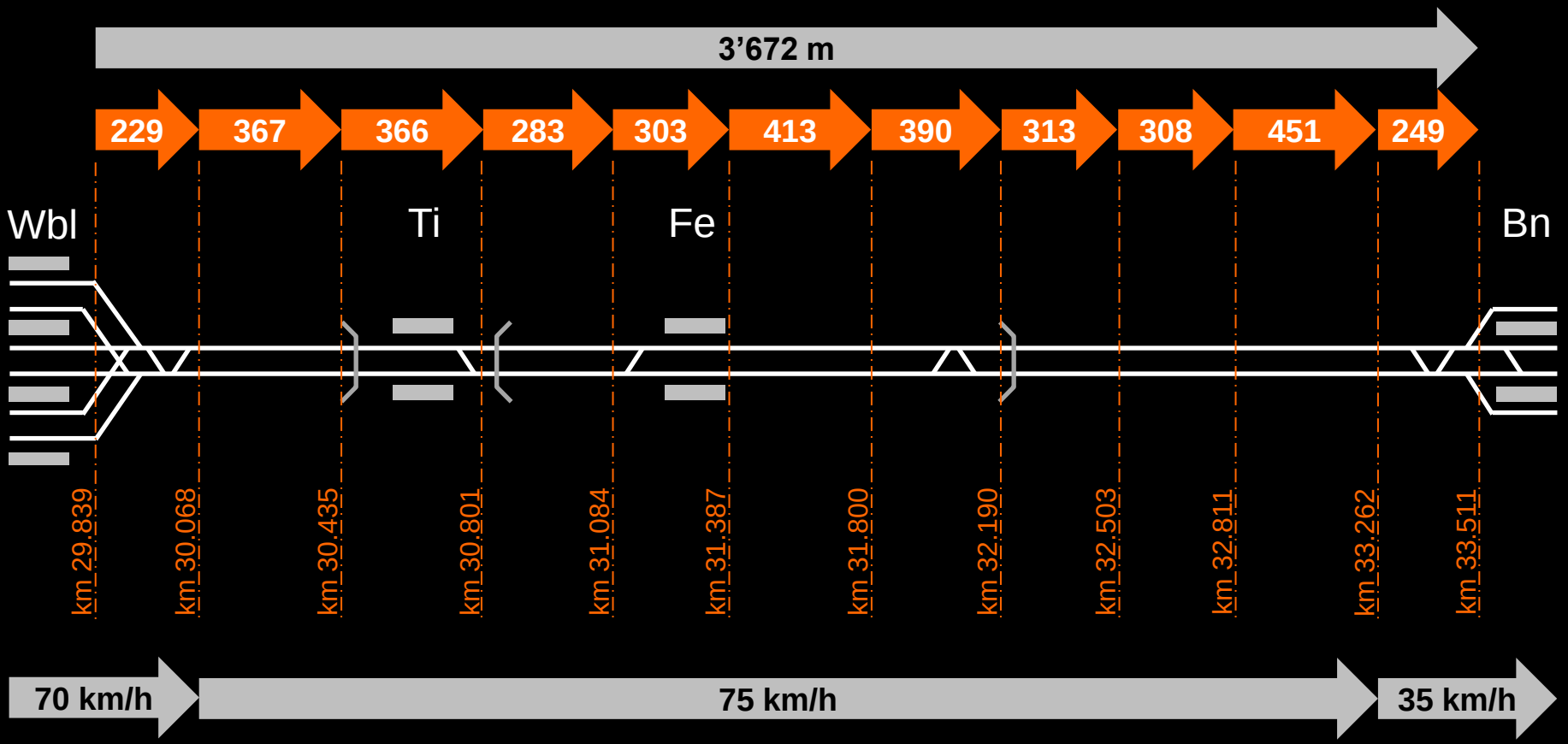
Example: Line-specific symmetry times

- 5 route bundles with 15' intervals (plus "relief routes")
- RegioExpress Bern-Solothurn in «national» symmetry 00/30
- Other symmetries result from track use in Bern
- Service density enables flexibility for connections in Bern



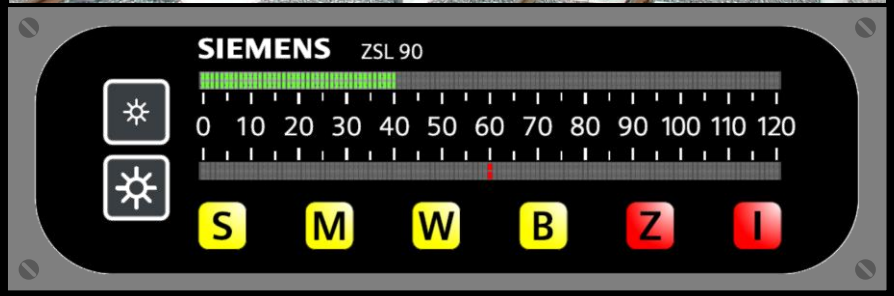
Dense Block Division

Example Worblaufen → Bern: Train sequence ≤ 75 sec



High-performance ATP

ZSL 90 with braking curve sharp monitoring



- Supervision with cable loops; «intelligence» on vehicle (main difference to LZB)
- Allows supervised stopping directly in front of the danger point, also during shunting
- Very high-quality system; *«equal ETCS-Level 2½»*

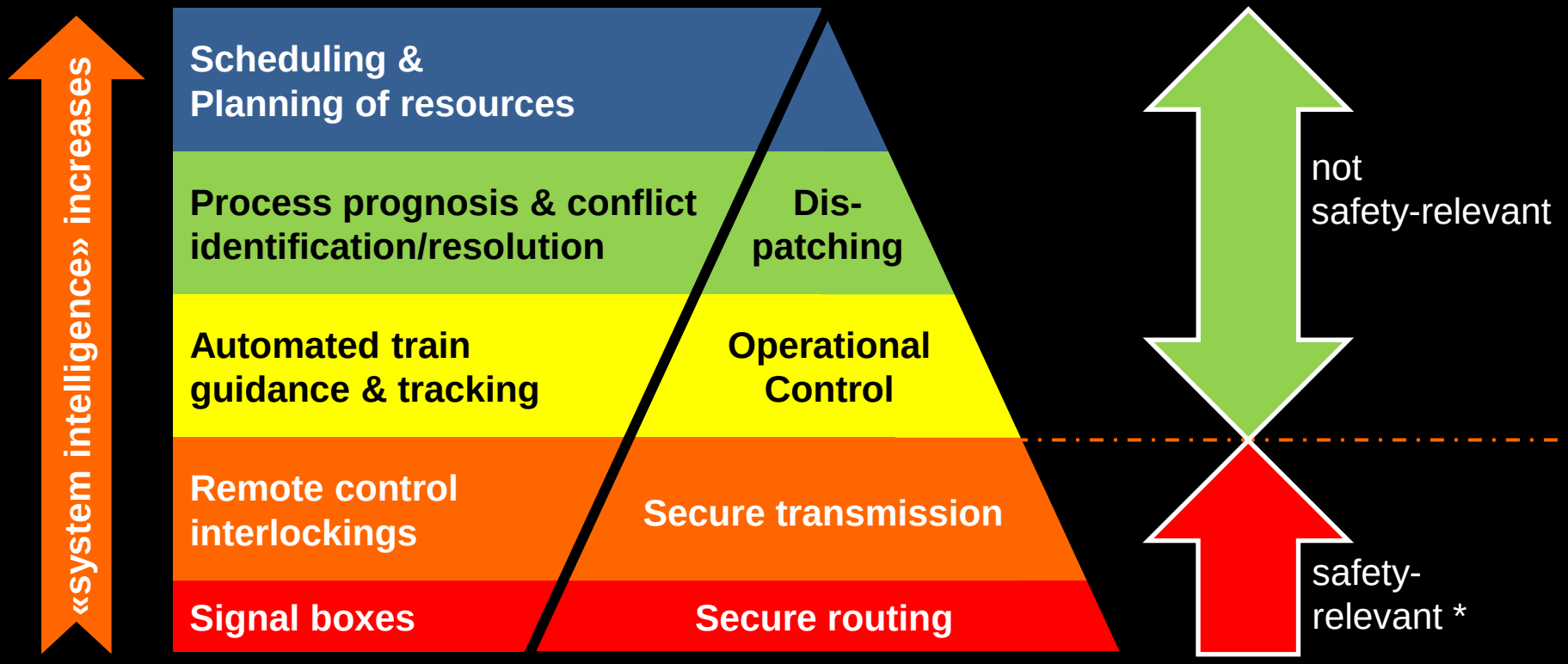
Operation Control

Conventional and innovative

- 16 signal boxes in relay technique
  also new ones (Domino 67/69)
- Simple remote control
  but «smart» ITCS
- «New» division between
  remote control & ITCS
- Operating approach of tram/bus:
  «Dispatching vehicles
  instead of setting routes»

Operation Control

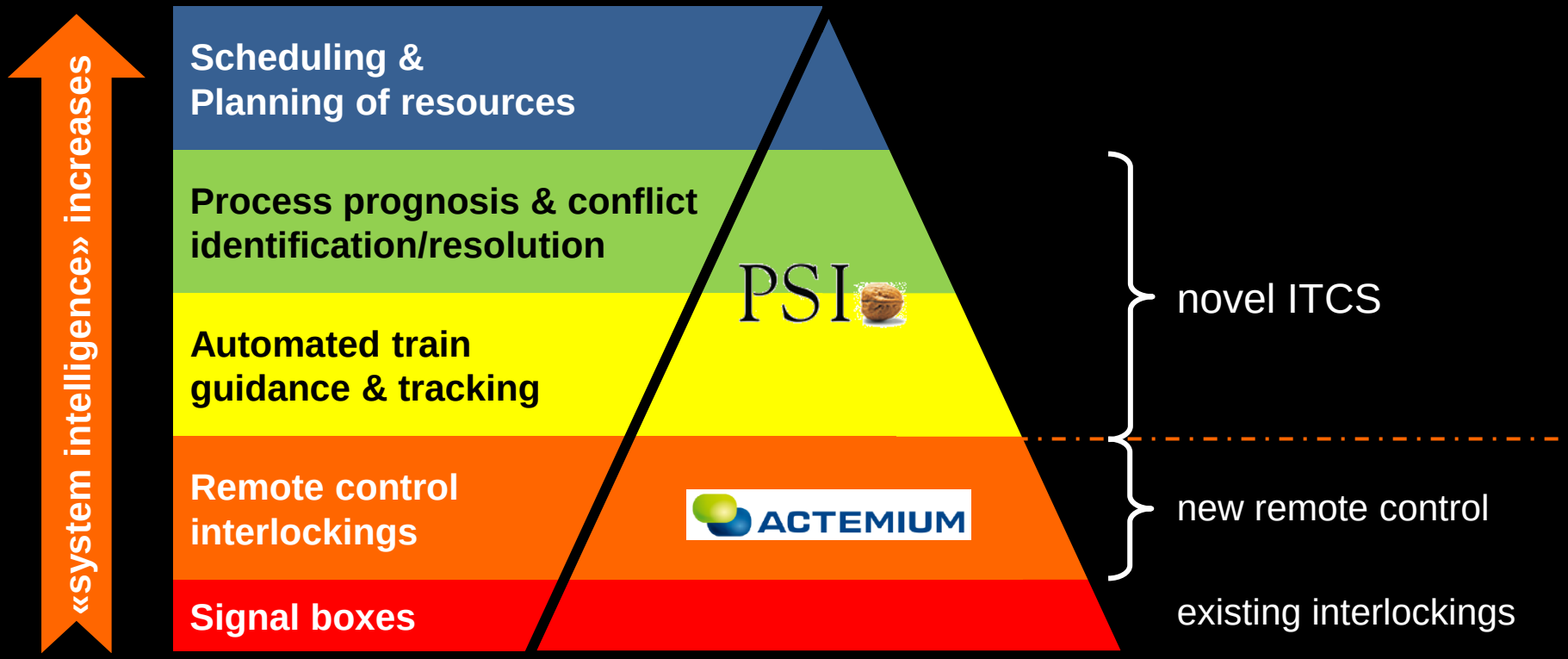
Functional overview & requirements



* Verification in accordance with BAV safety guidelines

Operation Control

Functional overview & requirements



Operation Control

Dispatching trains instead of setting routes

User Interface No. 1 (progression on graphic timetable)

Rolling Stock

- 4 generations of EMUs till now
- Focus on «Operations»:
  - Fully automatic (un)coupling (incl. brake test) within seconds
  - Cab change w/o dismantling/upgrading
  - Boarding & disembarking
  - Door opening/closing
  - Circulation inside the vehicle
- Current challenges: Specifications and technology!

Rolling Stock

Technical door running times 1974 / 1993 / 2009 / 2018

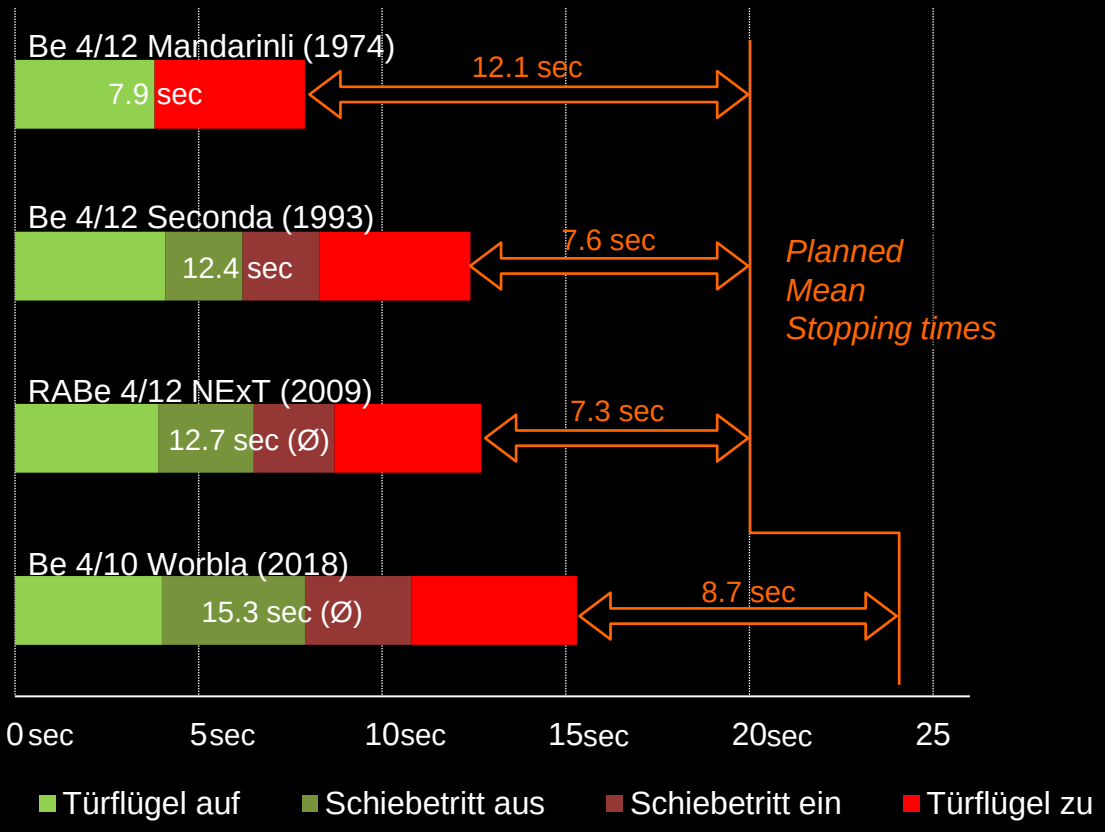
Pivot-sliding door with

…folding step (high-floor)

…simple sliding step

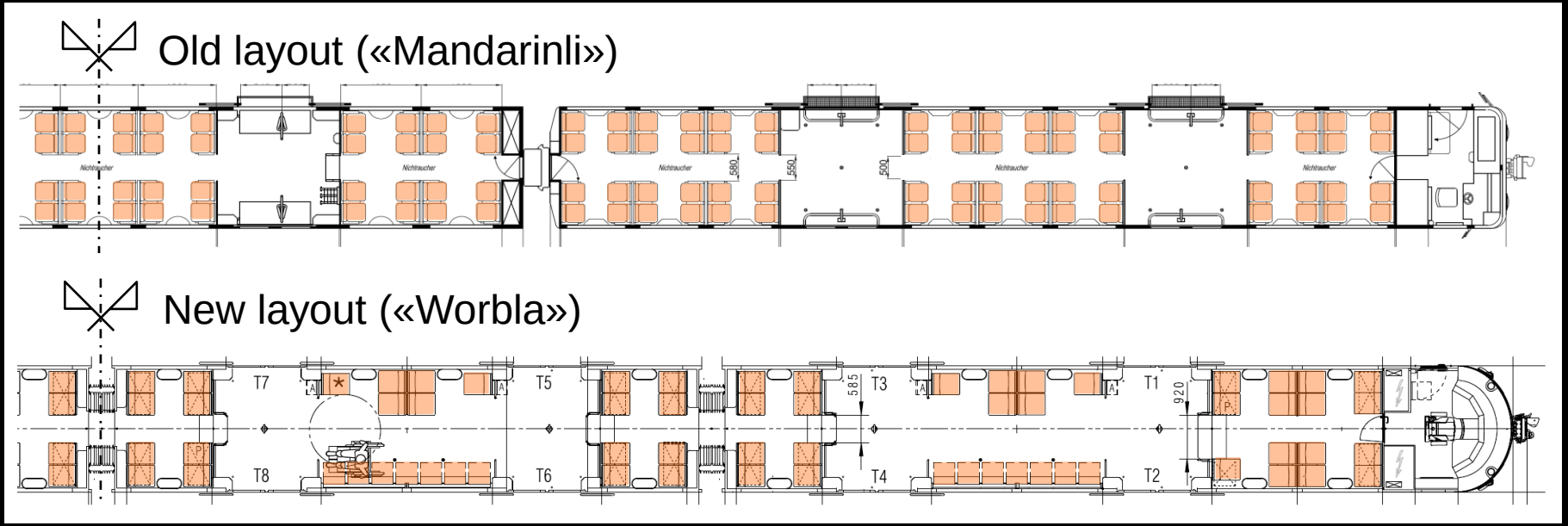
…two-stage sliding step

…variable sliding step



Rolling Stock

Circulation on the train: «The same behind every door»



- New layout developed with crowdsourcing
- Low-floor areas can be used multifunctionally
- Focus on great simplicity & clarity

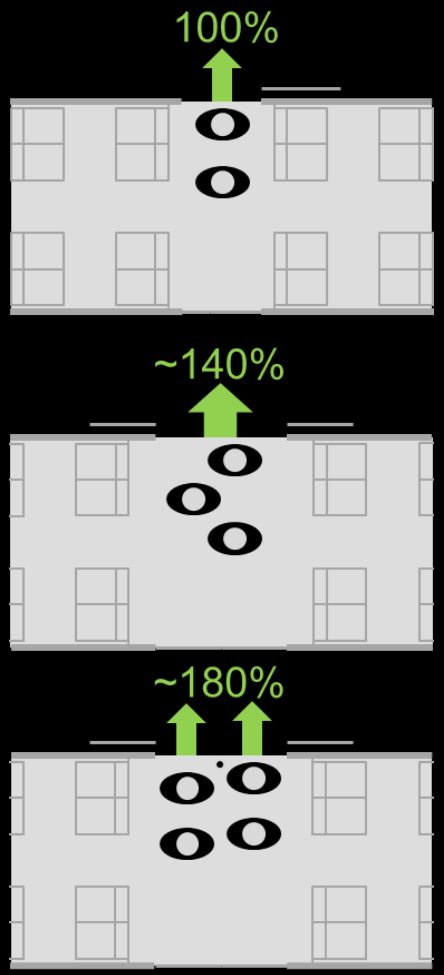
Rolling Stock

Good design is inexpensive

Rolling Stock

«Deep Tech» to reduce dwell times

- With low-floor centre door poles disappeared
- Efficiency of double doors is significantly increased by the use of centre door poles!



Conclusion

(from the RBS perspective)

- Operating at the performance limit keeps fit & sharpens priority setting
- The RBS network was developed piece by piece, always (mostly) with a long-term perspective
- But: “leap investments" cannot always be avoided: performance reserves and/or expandability are important!
- With digitalisation, always focus on processes first: efficiency and/or quality improvement is imperative!
- Orientation is often provided by much larger systems abroad; but learning from tram & bus is not frowned upon

Thank you for your attention