Banedanmark TMS

ETCS as the foundation for attractive and efficient railway service

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Outline

1. Introduction: ETCS – ERTMS
2. Banedanmark TMS
3. How does Banedanmark TMS work?
4. Service Intentions and Production Plans
5. TMS for attractive and efficient railways
6. Questions

1. Introduction

ERTMS = GSM-R + ETCS + ETML

European Rail Traffic Management System

=

Global System for Mobile Communications–Railway

+

European Train Control System

+

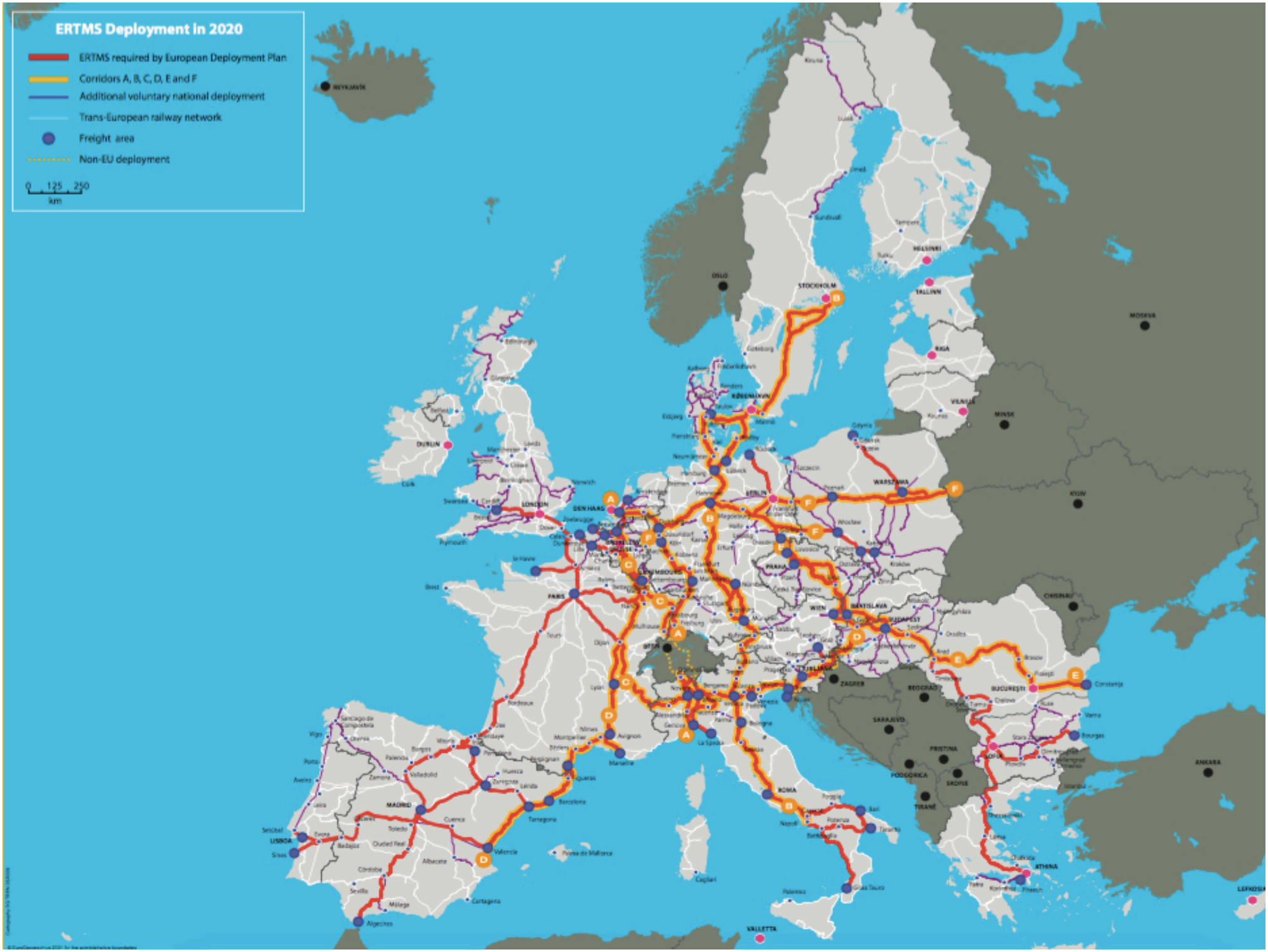
European Traffic Management Layer (TBD)

Levels

- ***ETCS Level 1*** = Movement authority sent to trains via balise. Trackside signals generally remain. Train position detected by occupancy detection.
- ***ETCS Level 2*** = Movement authority sent to trains via radio. Trackside signals often removed. Train position detected by occupancy detection.
- ***ETCS Level 3*** = Movement authority and train position data sent by radio ("moving block").

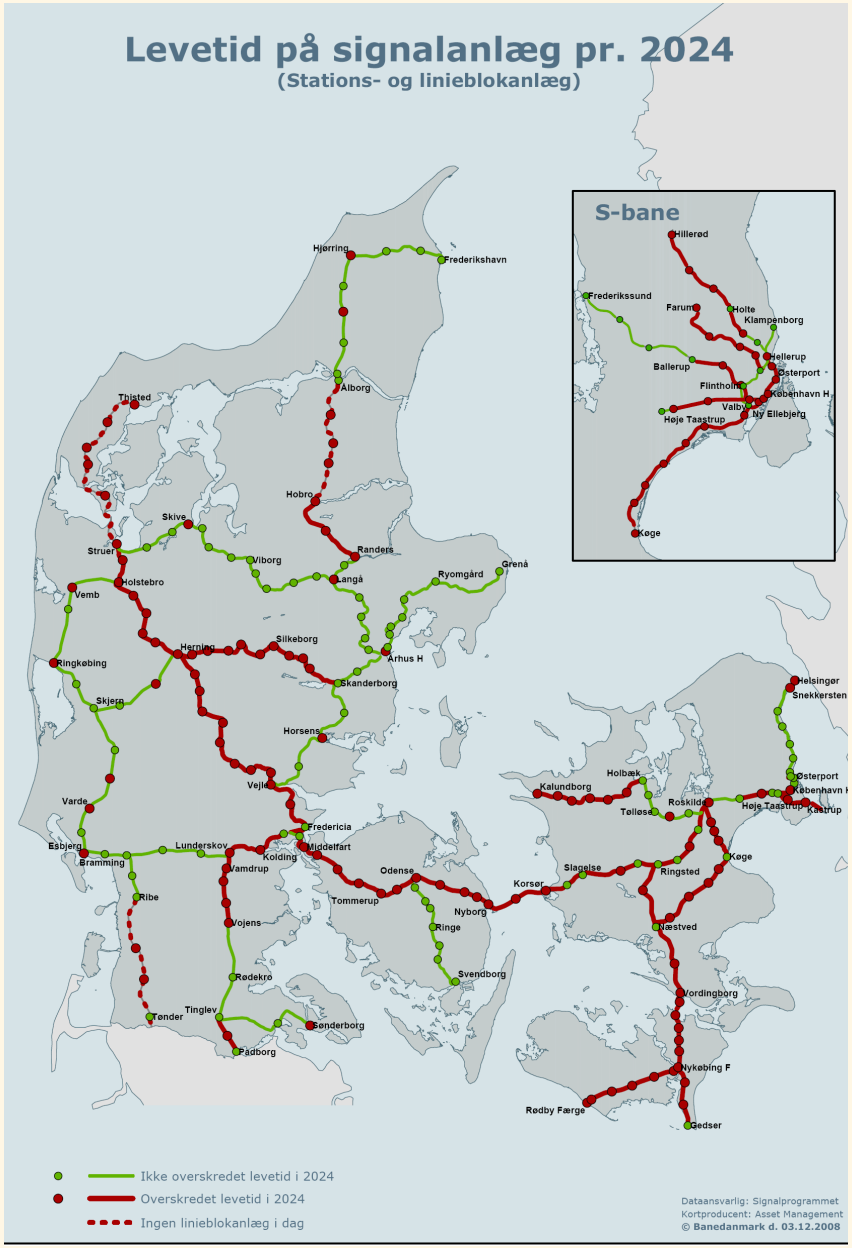
ERTMS in Europe

- ERTMS in service/construction in 20 EU countries;
- Approximately 19,830 km track as of Sept. 2013;
- National governments/infrastructure owners responsible for implementing ERTMS;
- European Commission (EC) focused on policy, research and supporting implementation of international corridors;
- EC is currently addressing the political, technical, and financial challenges delaying international corridor implementation.


ERTMS Deployment in 2020
ERTMS required by European Deployment Plan
Corridors A, B, C, D, E and F
Additional voluntary national deployment
Trans-European railway network
Freight area
Non-EU deployment
0 125 250
km
REYKJAVIK
OSLO
STOCKHOLM
HELSINKI
TALLINN
RIGA
VILNIUS
MINSK
MOSKVA
KYIV
KØBENHAVN
DUBLIN
LONDON
DEN HAAG
BERLIN
WARSZAWA
PARIS
WIEN
BRATISLAVA
BUDAPEST
CHISINAU
LUXEMBOURG
BERN
LJUBLJANA
ZAGREB
BEOGRAD
SARAJEVO
PRISTINA
PODGORICA
SKOPJE
TIRANE
ROMA
BUCUREȘTI
SOFIA
ANKARA
ATHINA
LISBOA
MADRID
VALLETTA

ETCS implementation strategies:

- ***Migrate:*** install ETCS on new lines and when existing equipment reaches end of service life.
  - (Germany), France, Spain, Switzerland, Austria ...
- ***Replace:*** completely replace signalling system with state-of-the-art ETCS.
  - Denmark, Norway, Netherlands, UK (sector-based).



Denmark

Situation in 2000

- Increasing demand and desire to shift traffic from road to rail.
- Decreasing punctuality: 50% delays caused by signal failures.
- Increasing maintenance costs.
- 60% of signaling will exceed final service-life by 2024.
- DK-ATC life expires in 2020.
- Losing know-how for legacy system maintenance.

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Denmark Strategic Study

Total signalling system replacement is better than piecemeal replacement because it:

- *Reduces costs by eliminating the need for creating provisional interfaces;*
- *Provides economies of scale, although some existing equipment would be written off early;*
- *Reduces maintenance costs (important: loss of know-how in maintaining legacy systems);*
- *Improves the quality of railway operations.*

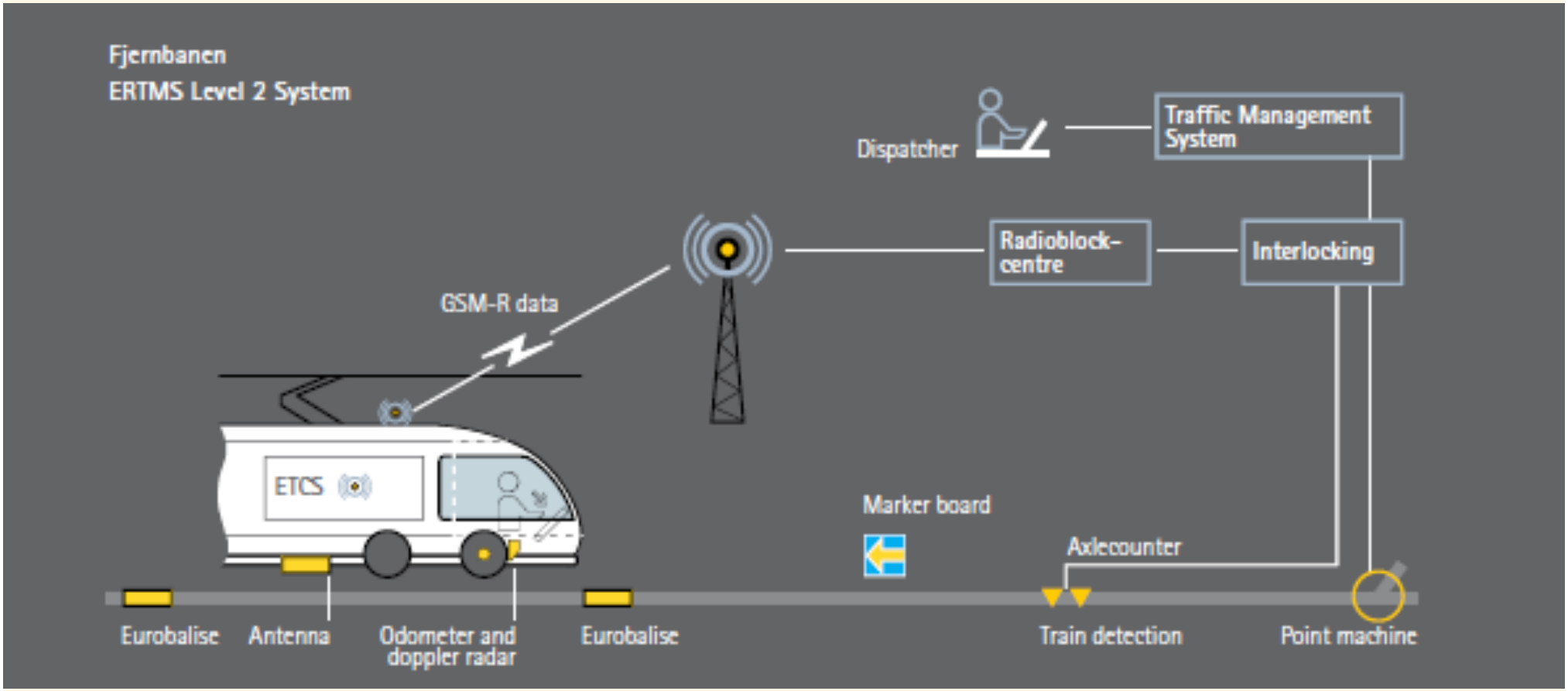
Banedanmark Signalling Programme

Project elements:

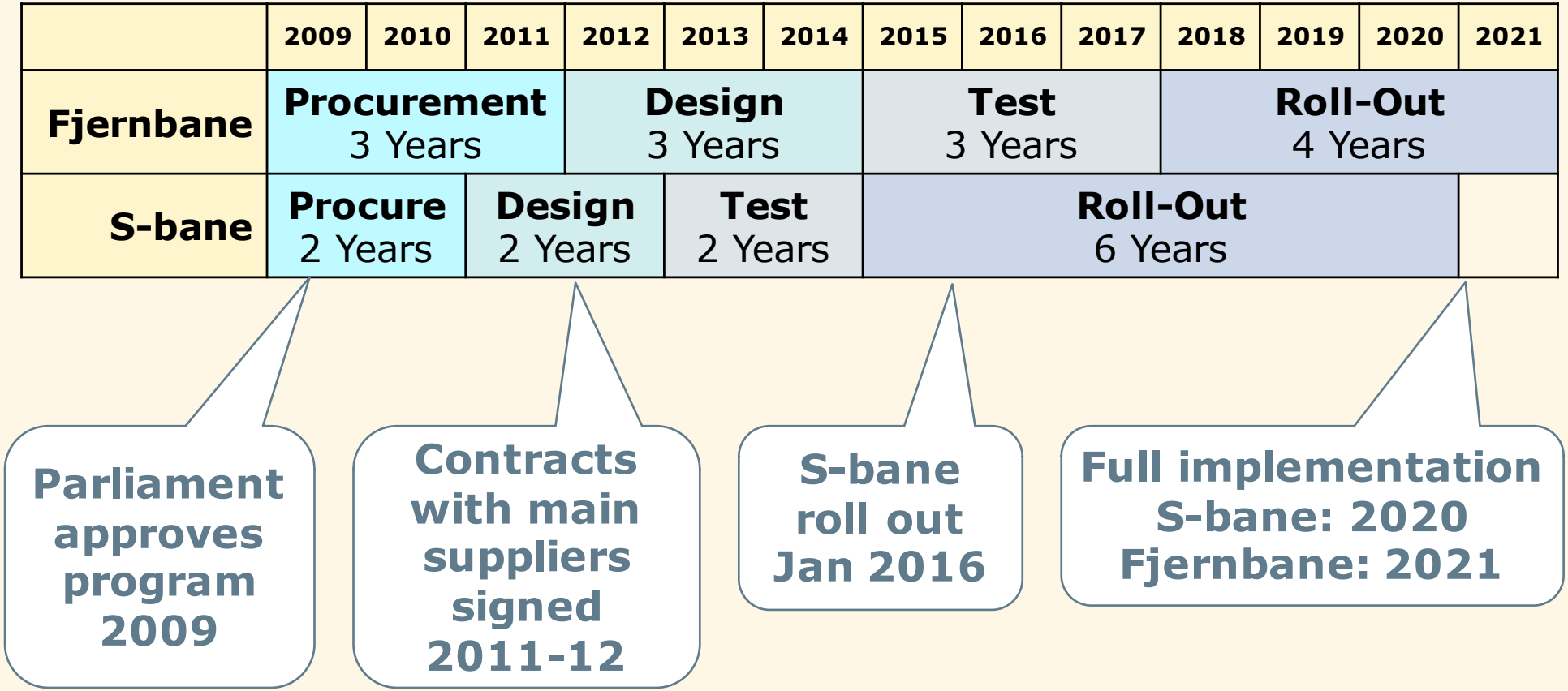
- **S-bane** – Copenhagen regional rail (170 km closed network); CBTC system, completion: 2020 (Siemens).
- **Fjernbane West** – Long distance network; ERTMS Level 2, completion: 2021 (Thales).
- **Fjernbane East** – Long distance network; ERTMS Level 2, completion: 2021 (Alstom).
- **Onboard ETCS Equipment** – (Alstom).

Banedanmark ERTMS System

ERTMS Level 2 – Baseline 3



Signalling Programme Timeline



ETCS designers recognised:

The data required for ETCS provides an excellent foundation for creating an advanced traffic management system ...

... Banedanmark TMS

2. Banedanmark TMS

What is the Banedanmark TMS?

An advanced

traffic management system

*to **precisely***

***plan and provide** railway*

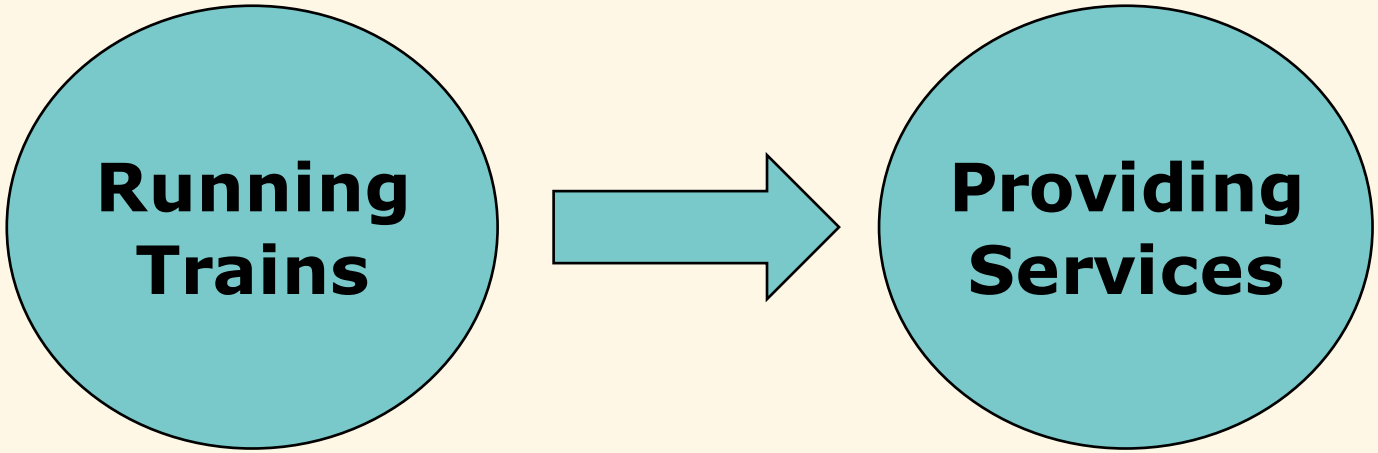
*service for our **customers.***

TMS is based on 3 key ideas:

1. Customer focus: ***services not trains***
2. Control: ***precisely defined tasks***
3. Integrated management: ***planning & execution***

Customer Focus

Customer focus:



Why? Travellers don't care about trains ...

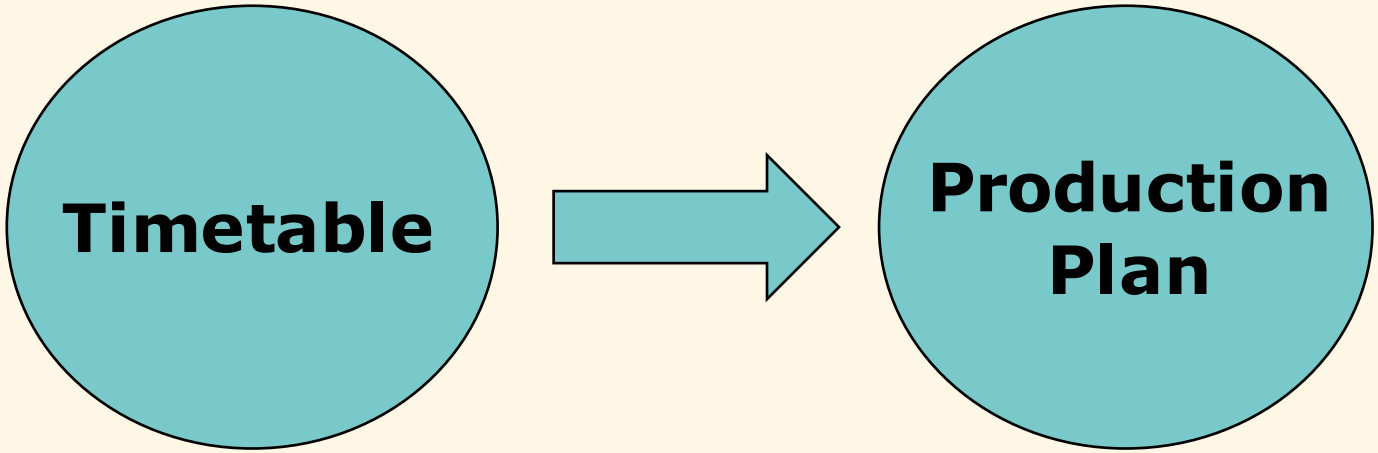
... they care about travelling.

Service Intentions

… are a way of describing customer needs in terms of services.

Precise Control

Precise control:



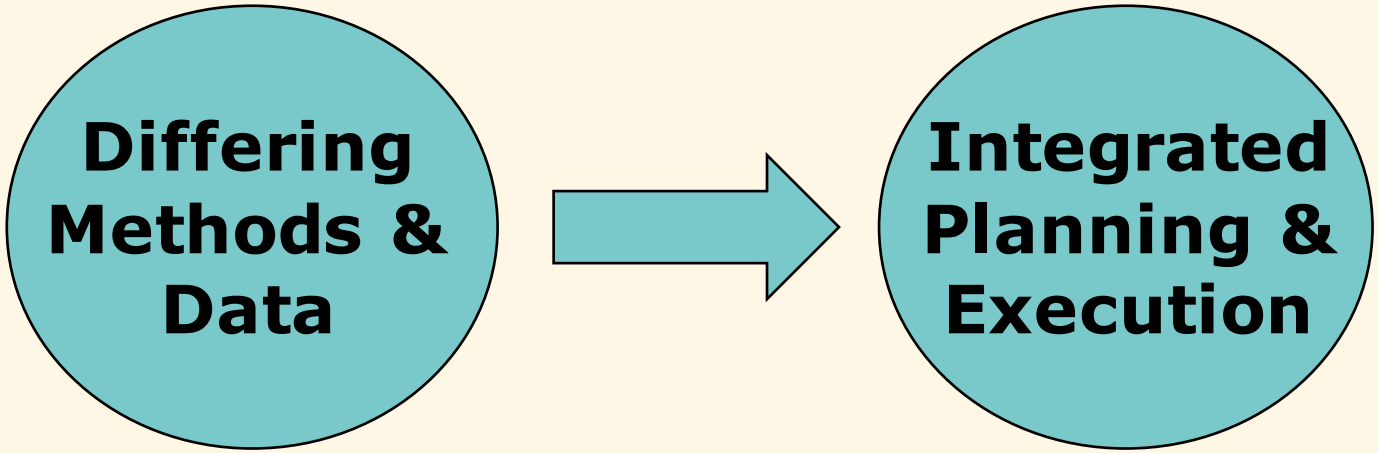
Why? Timetables do not provide sufficient information to control trains effectively in complex and busy rail networks.

Production Plans

... precisely describe how to operate the railway system.


Integrated Planning & Operations

Integrated management:



Why? Using congruent methods and data supports more accurate planning and faster recovery from disruptions.

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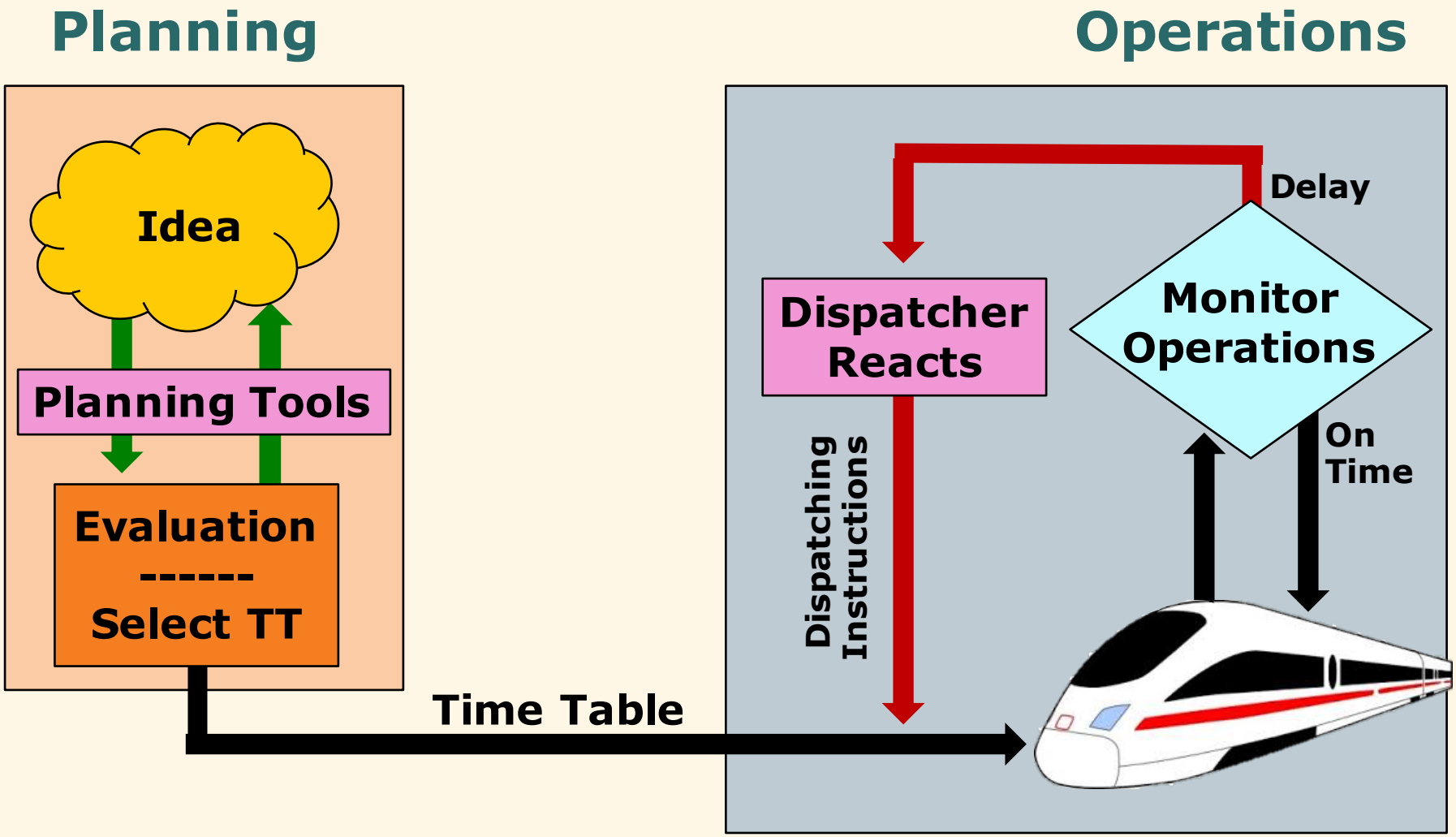
Integrated Management

… means using the same methods and data to plan and execute railway service.

3. How does TMS work?

Railways Today



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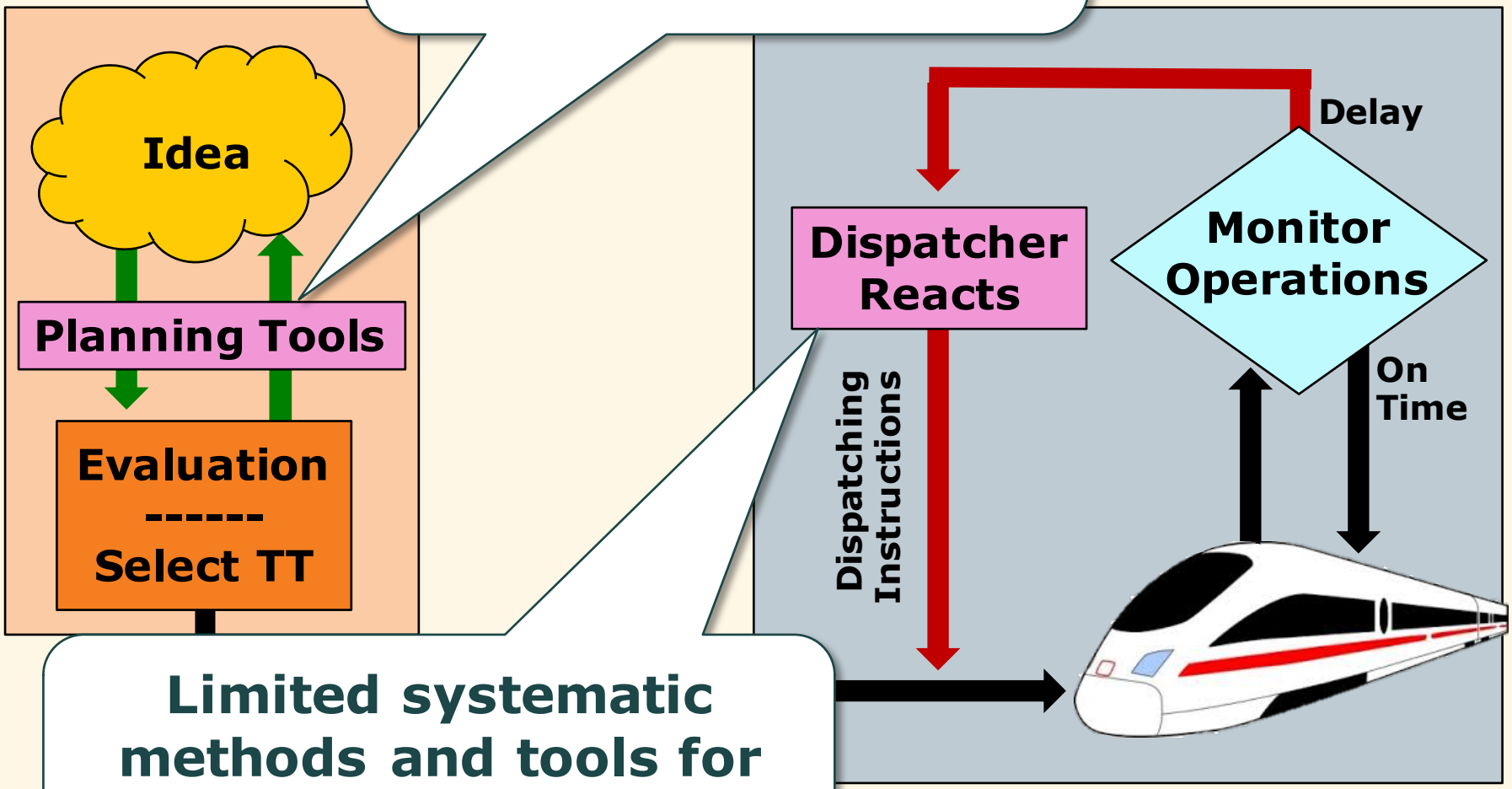
Many tools at different levels of detail to develop timetables.

Planning

Operations



Limited systematic methods and tools for addressing disruptions.

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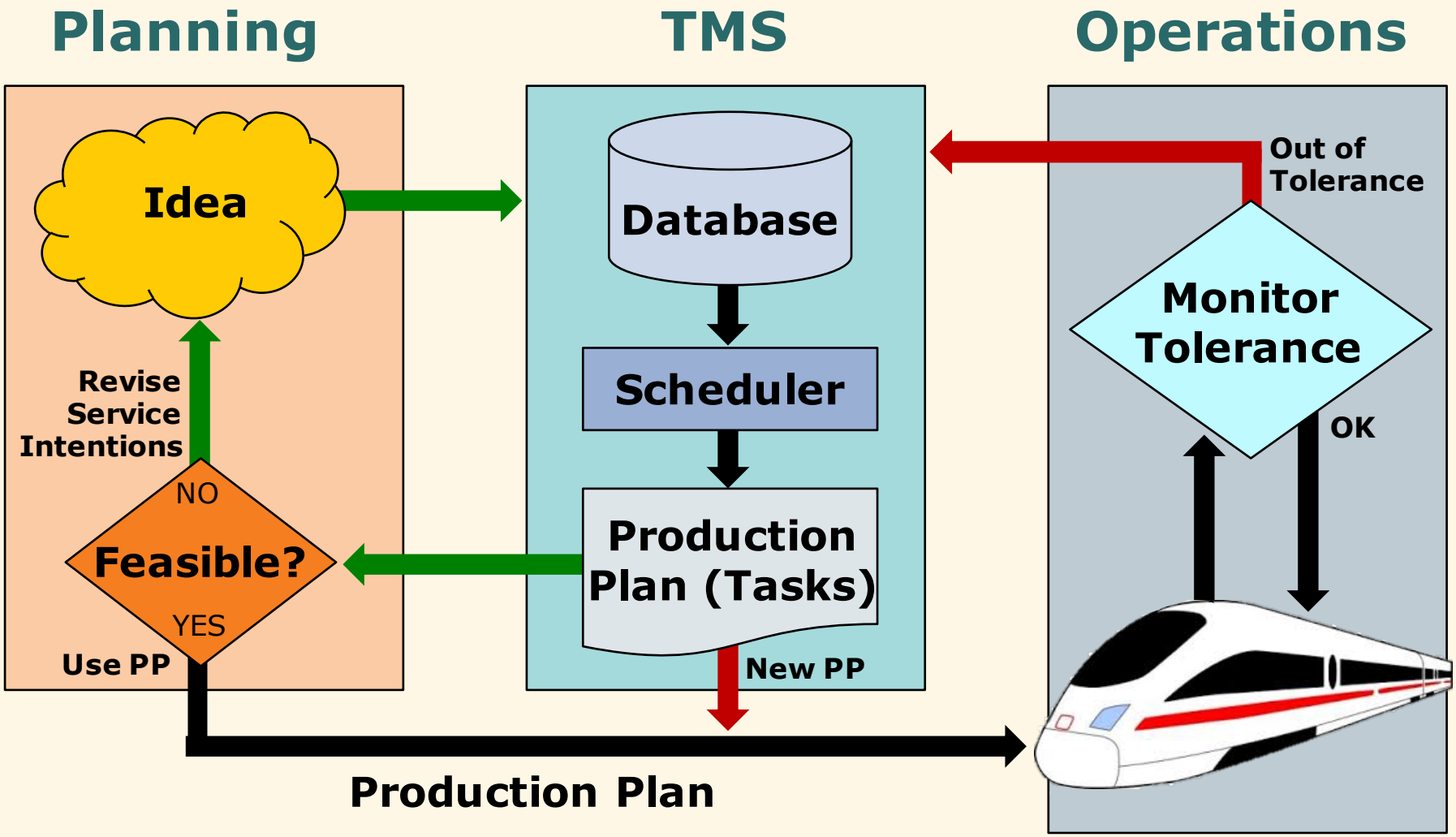
TMS integrates railway management …

… by using the same data and functions to plan and operate railway service.

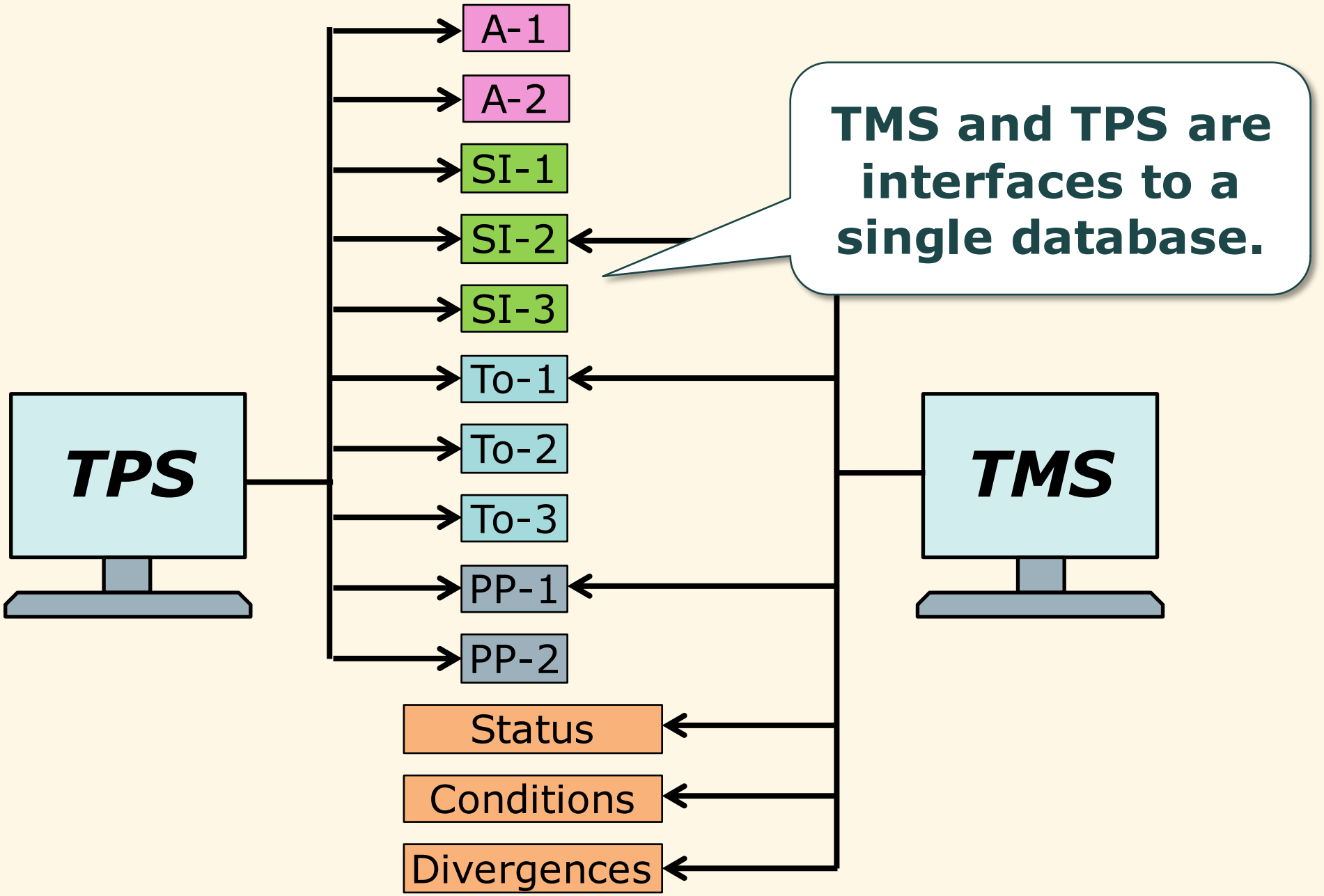
TMS: integrates planning and operations



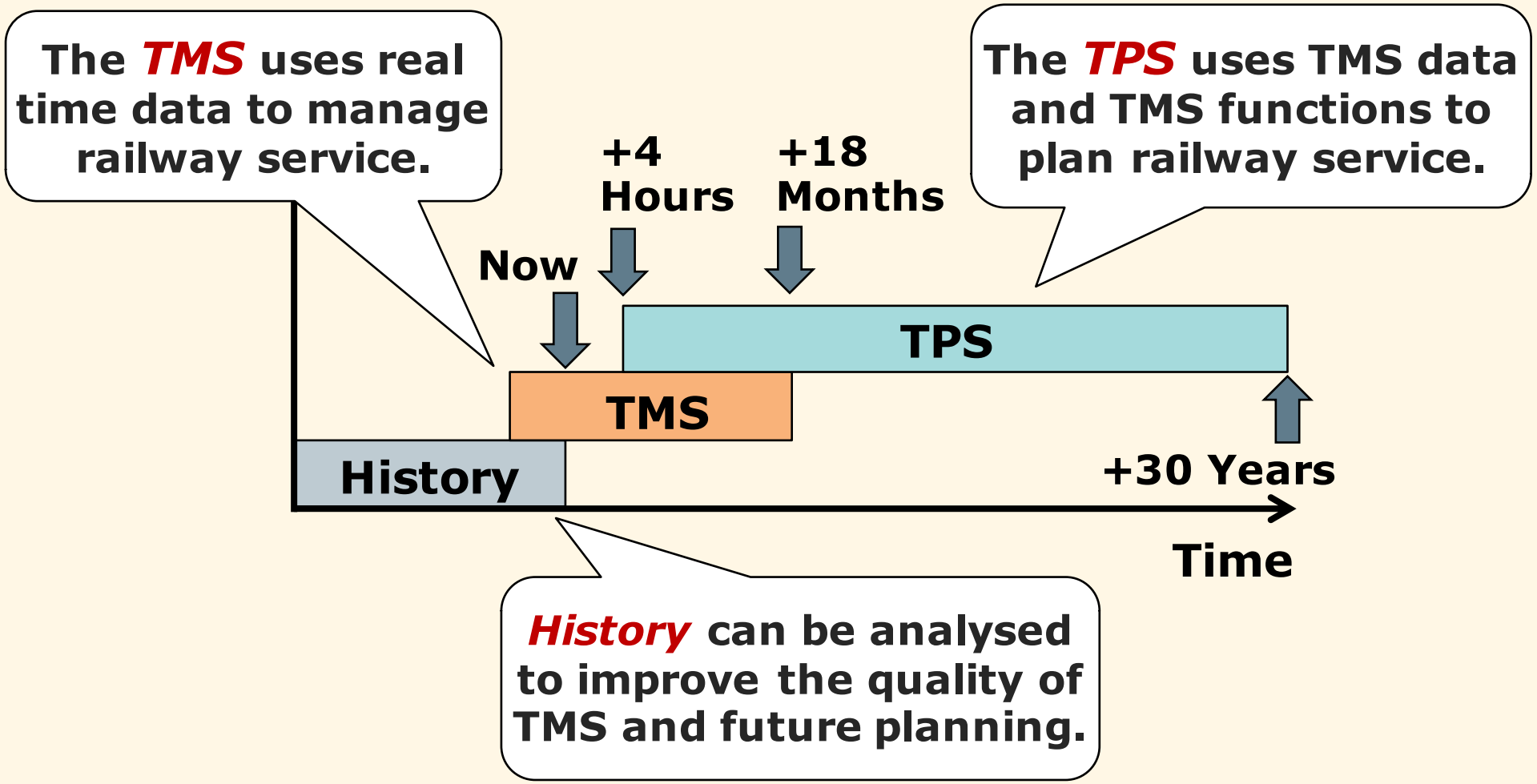
TMS Applications:

- **TMS** = Traffic Management System = interface for managing service (dispatching);
- **TPS** = Traffic Planning System = interface for planning schedules and investments;
- **History** = Database for learning and improving service.

All applications share the same functions and data.

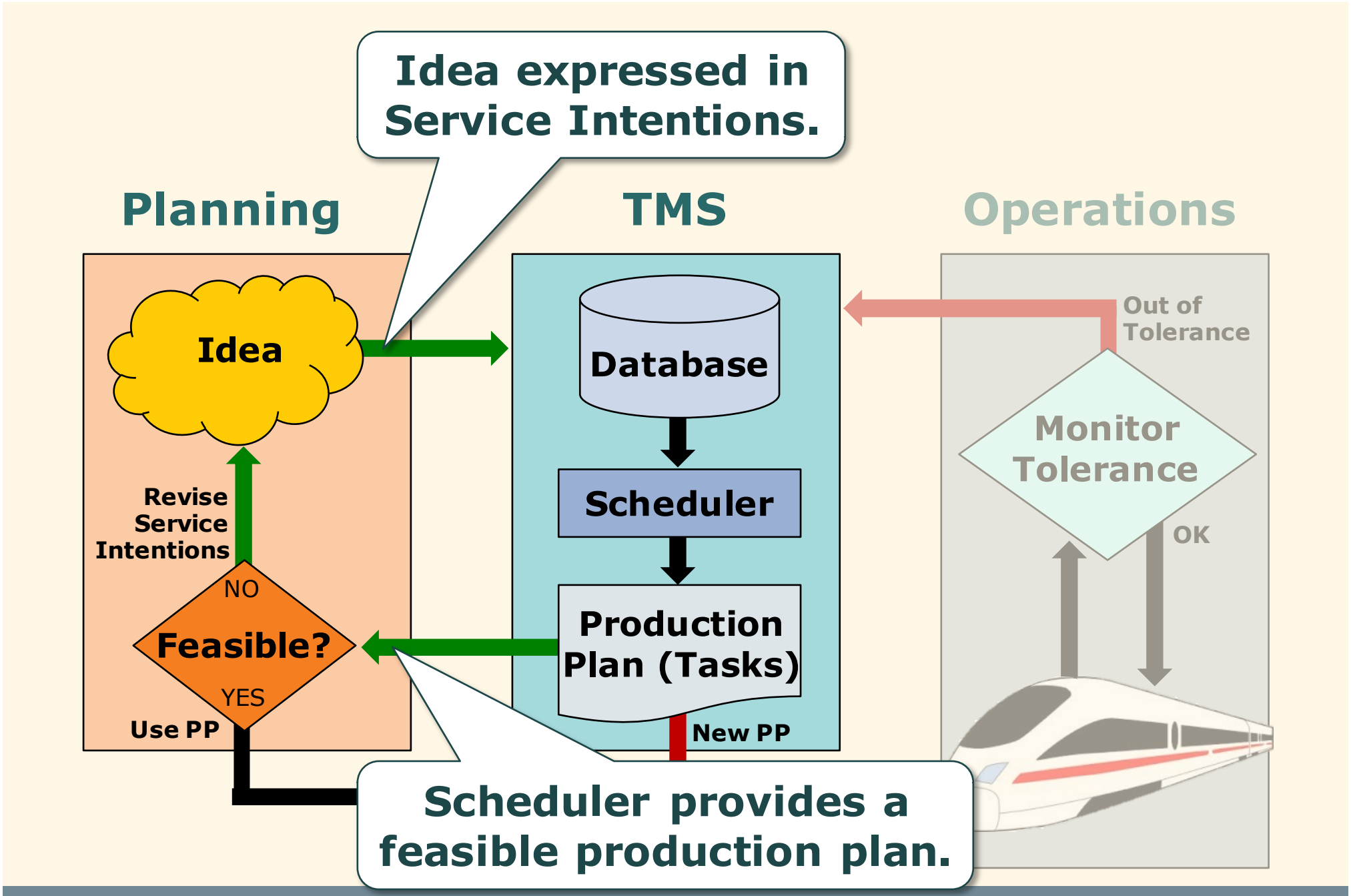

A-1
A-2
SI-1
SI-2
SI-3
To-1
To-2
To-3
PP-1
PP-2
Status
Conditions
Divergences
TPS
TMS
TMS and TPS are interfaces to a single database.

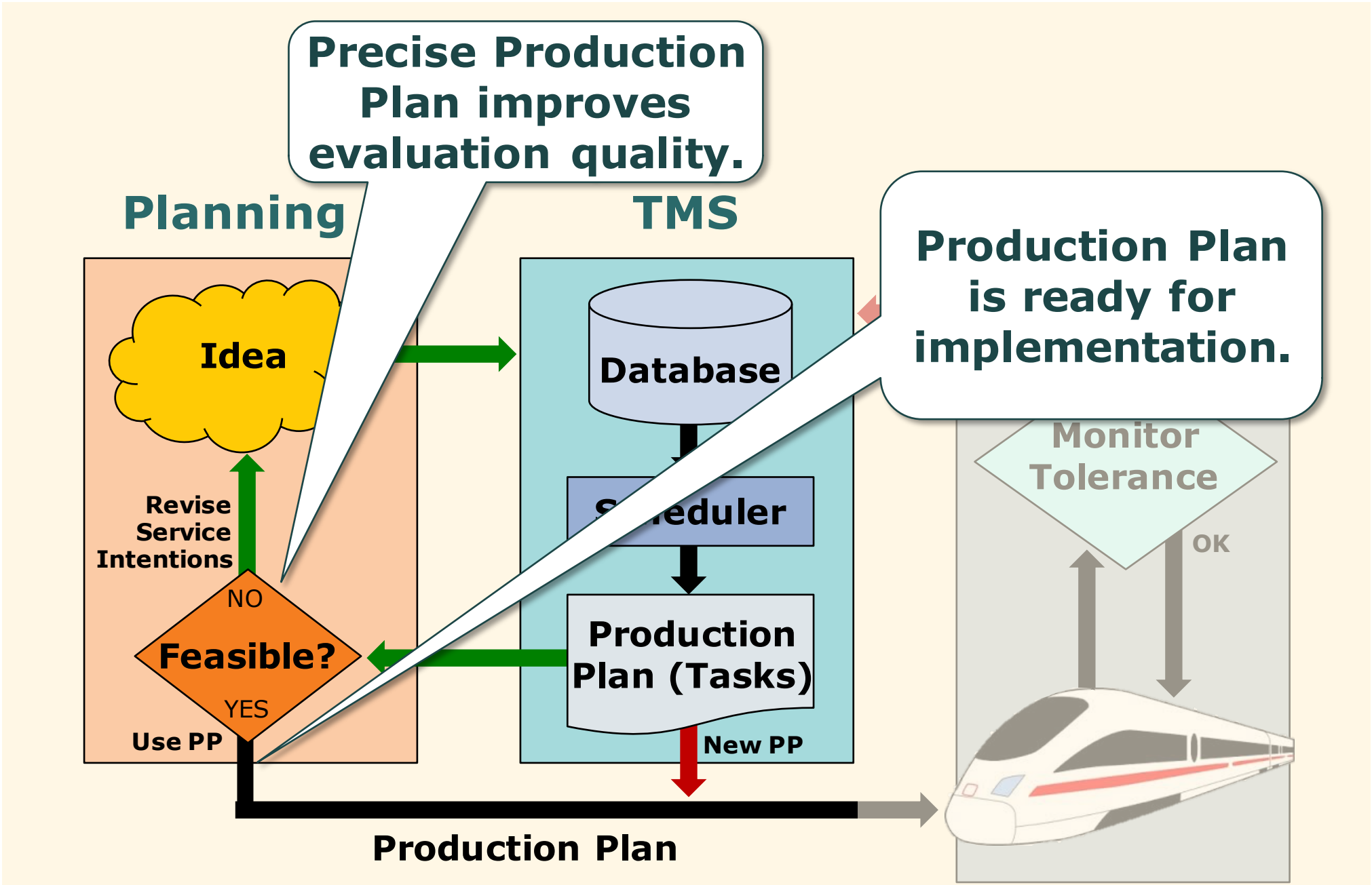
Planning and operations timeline



Benefit:

TMS increases the efficiency and accuracy of planning.

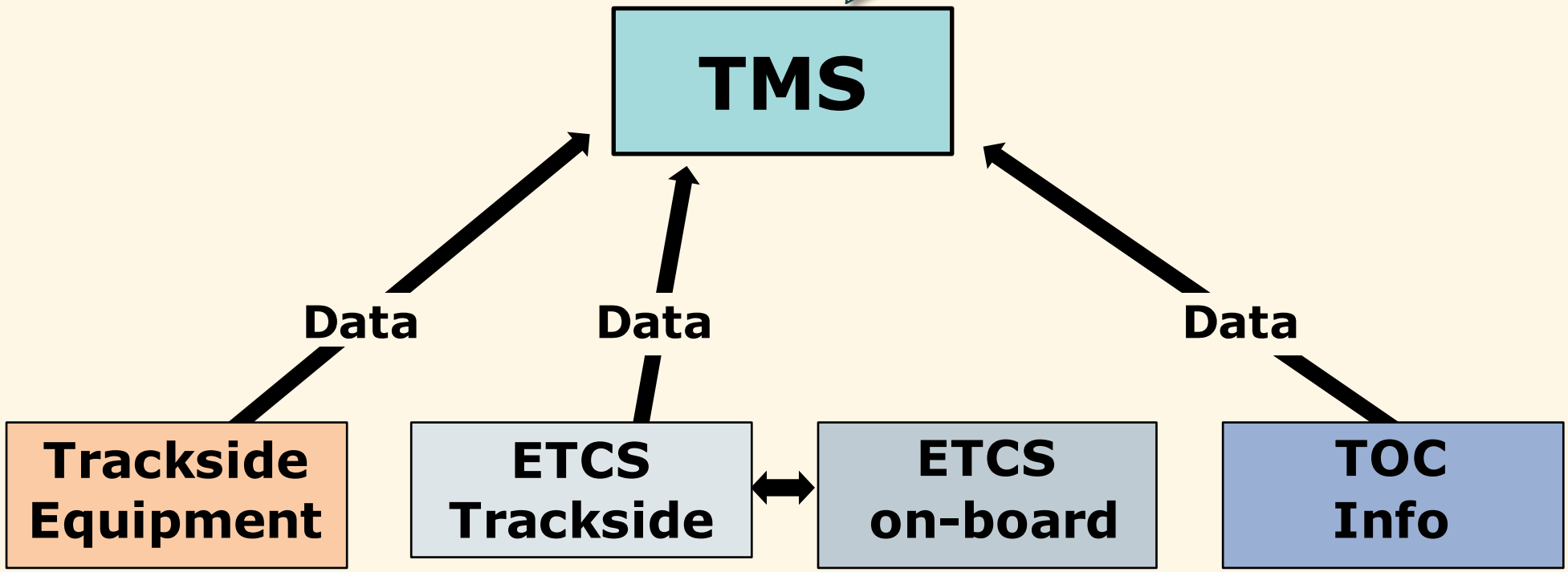

Idea expressed in Service Intentions.
Planning
TMS
Operations
Idea
Database
Scheduler
Production Plan (Tasks)
New PP
Out of Tolerance
Monitor Tolerance
OK
Revise Service Intentions
NO
Feasible?
YES
Use PP
Scheduler provides a feasible production plan.


Precise Production Plan improves evaluation quality.
Planning
TMS
Production Plan is ready for implementation.
Idea
Database
Revise Service Intentions
Monitor Tolerance
OK
NO
Feasible?
YES
Use PP
Production Plan (Tasks)
New PP
Production Plan

Benefit:

TMS increases the effectiveness of dispatching.

TMS uses data from multiple sources to *monitor production plan task tolerance*



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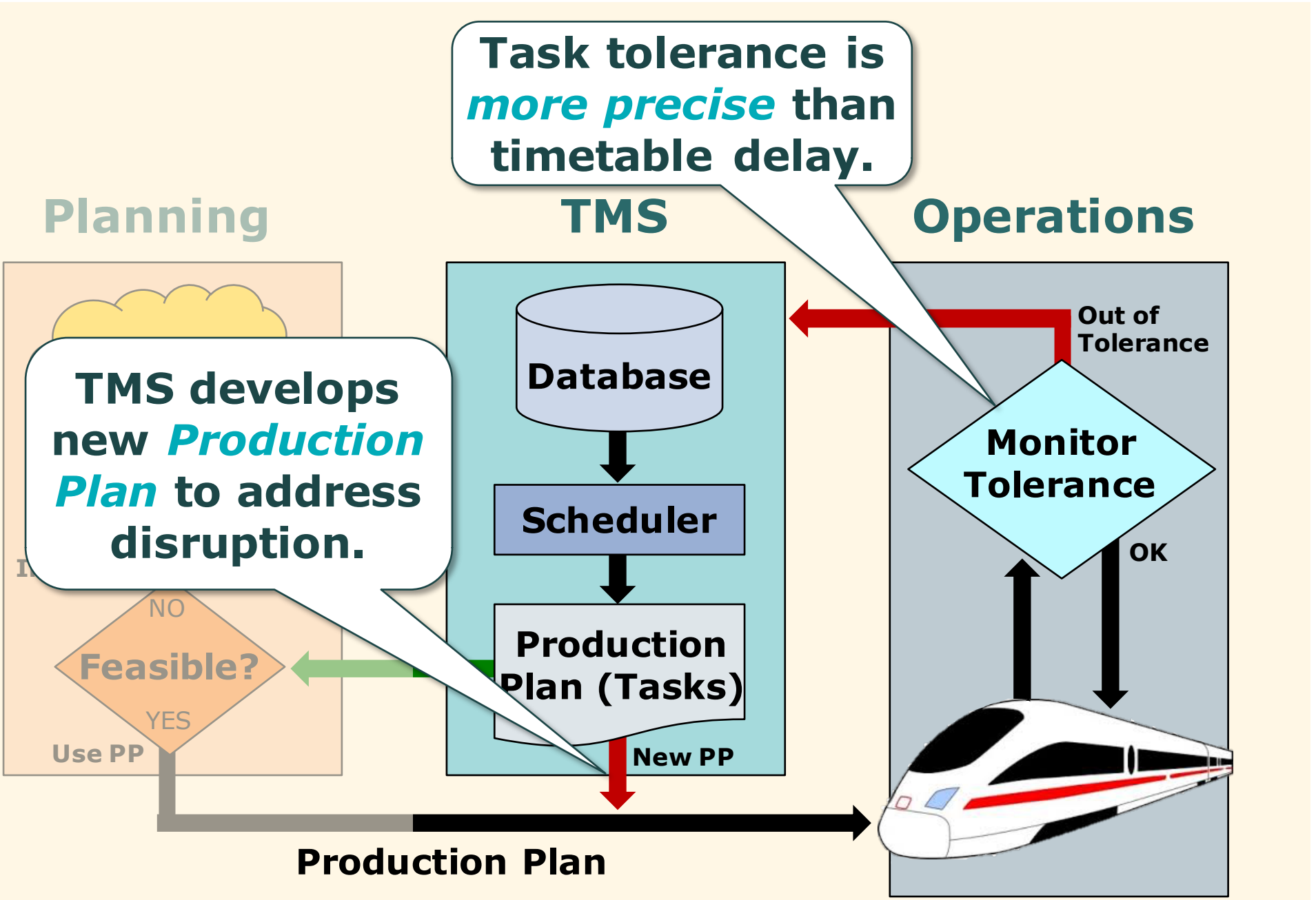

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4. Service Intentions & Production Plans

Service Intentions

... precisely describe railway objectives in terms of their elementary customer service components.

Railway Customers & Services:

- **Passengers & Freight**
  → transport services;
- **Maintenance**
  → track access: possessions;
- **Train Operators**
  → resource management (rolling stock, staff).

Different customers use different types of service intentions …

Types of service intentions (SI):

1. **Transport** (SI-T) – represent a transport service (passenger or freight);
2. **Link** (SI-L) – connect two service intentions (e.g., passenger transfer, rolling stock used for two services);
3. **Perpendicular** (SI-P) – provide train access/egress (e.g., passengers board a train);
4. **Track Access** (SI-TA) – used to apply operating restrictions to track sections (e.g., maintenance possession);
5. **Handover** (SI-H)

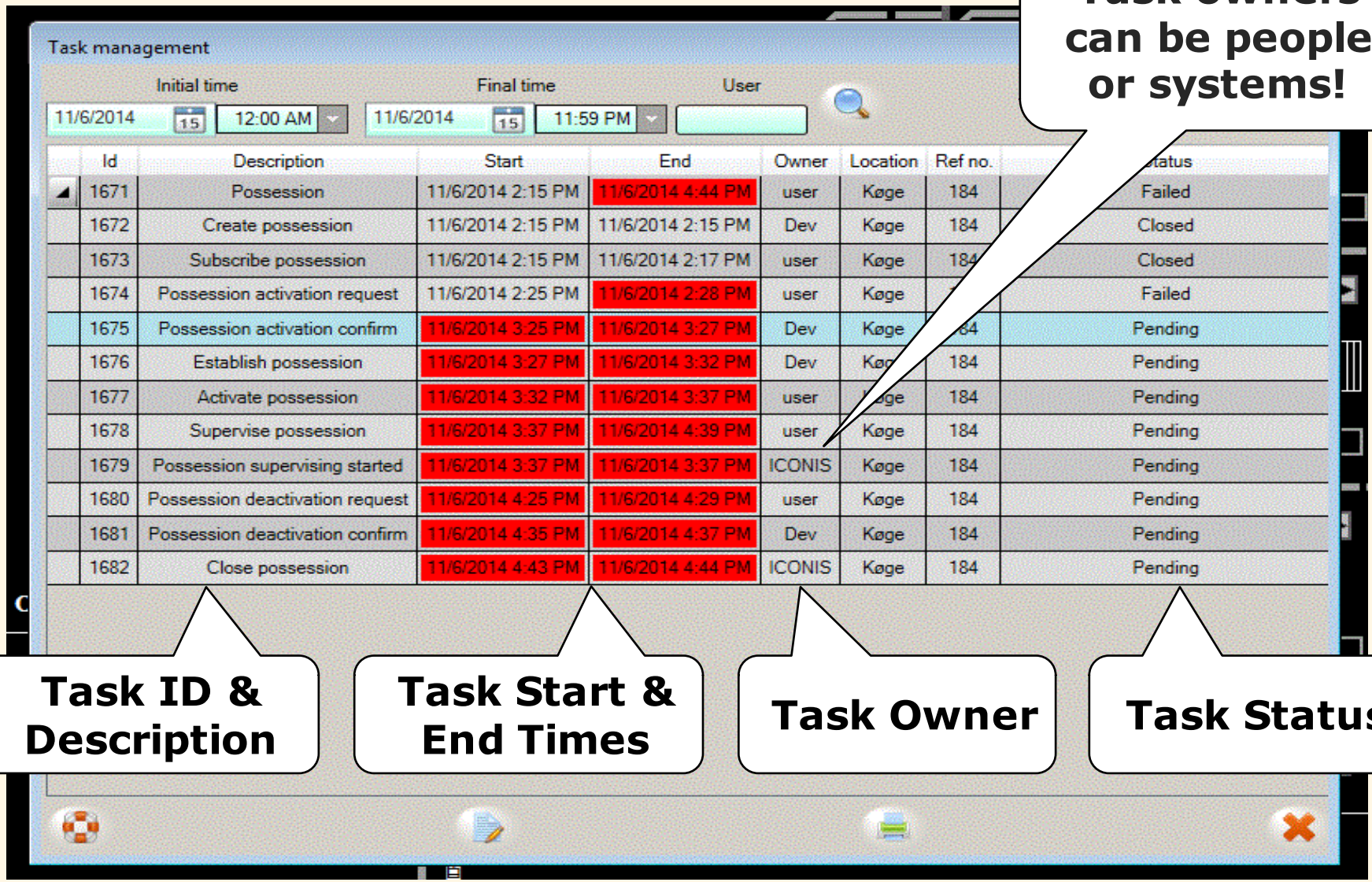
Production Plans

… use tasks to precisely describe railway operations.

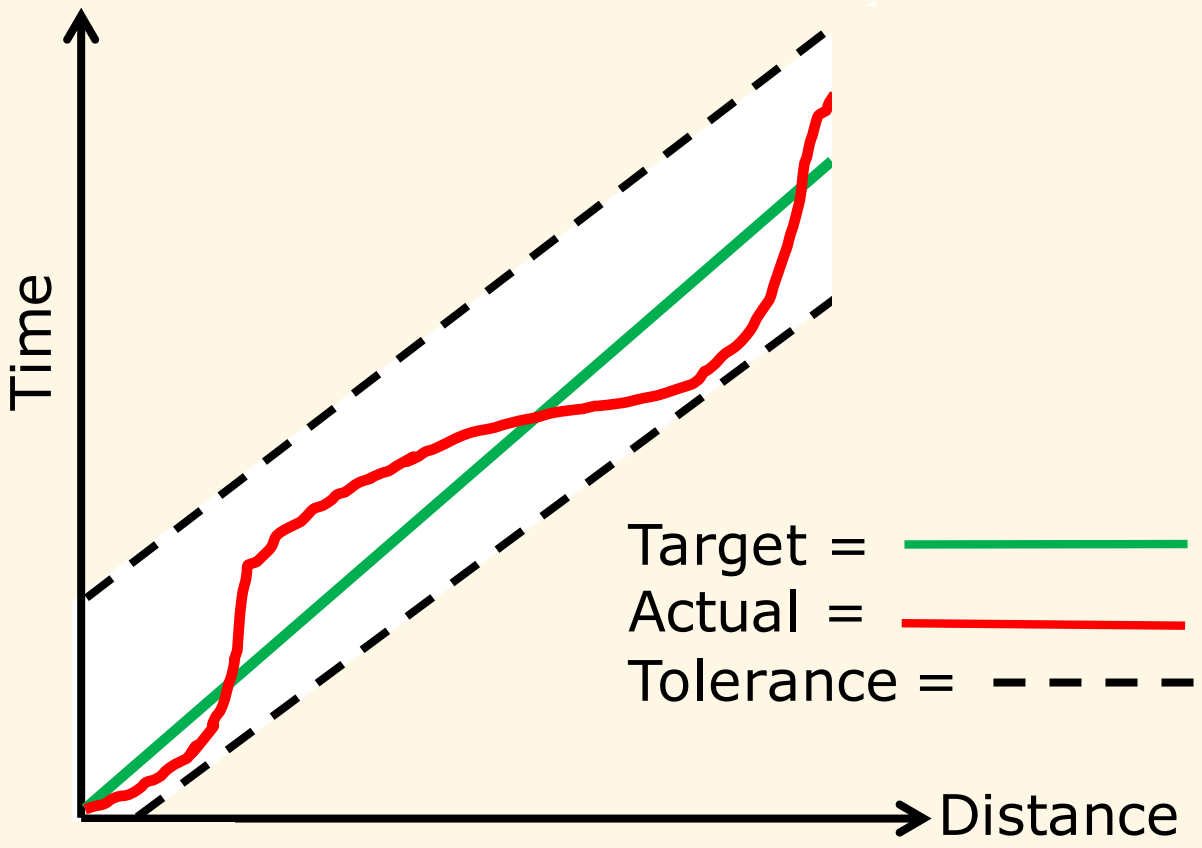
Production Plans:

- **Tasks are the building blocks for Production Plans.**
- **Production Plans …**
  - Describe all tasks needed to fulfill Service Intentions.
  - Assign all tasks to “task owners”.
  - Describe tolerance bands for task performance.
  - Assign resources to tasks.
  - Describe the planned state of infrastructure and trains including how traffic circulates, route setting, train speed, etc.

Task Management Window



Tasks and Tolerance



Task owners perform their assigned tasks “at ease” ... (i.e., within tolerance band).

5. TMS for attractive and efficient railways

TMS can revolutionise the railway business:

- **Increase railway capacity**
  → precise production = more efficient use of resources;

- **Improve service quality**
  → TMS + real time data = effective management of disruptions and accurate customer information;

- **Facilitate innovation**
  → Service Intentions provides a structure for re-imagining railway planning and operations to serve new markets and customers.

But TMS is also …

… a departure from business as usual and therefore will be difficult to operationalise.

TMS and Change Management:

1. **Stakeholder communications** – design team is working closely with all stakeholders to understand needs and develop effective training programs;
2. **Phased implementation** – TMS will be gradually introduced and features will be added over time;
3. **Attractive and efficient HMIs** (human machine interfaces) and support applications.

Banedanmark

Building the railway of the future.

TMS

Building the future for railways.

Questions?