ETCS:
A Driver of Innovation through Interoperability

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RailTech Europe LIVE ´21

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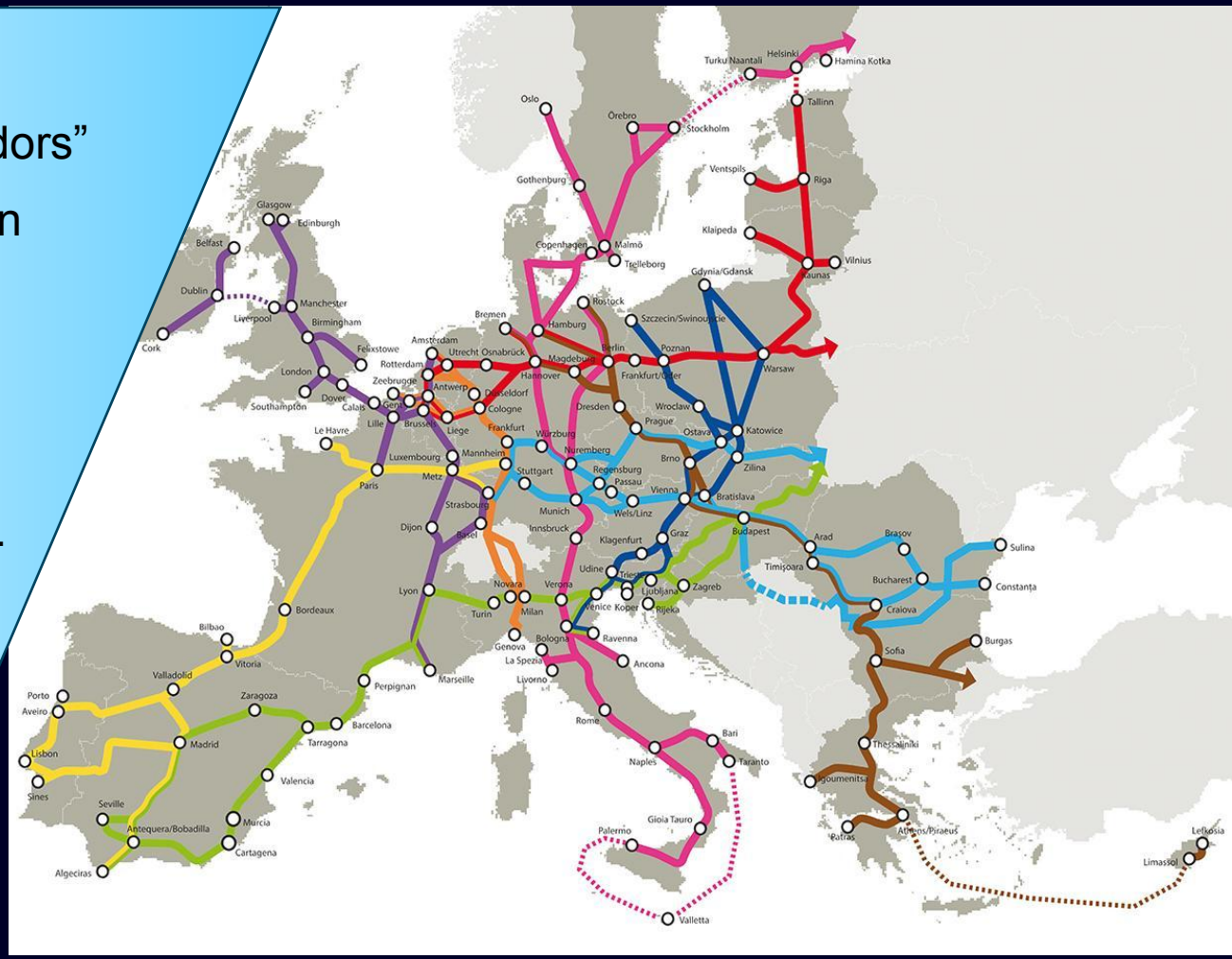
ETCS reached a high level of maturity and interoperability

- **Targets of the** EDP 2016/17
  - Horizon 2023 □ 40 % of the “Core Network Corridors”
  - Horizon 2030 □ 51.000 km of ERTMS in operation

- **History**
  - 1990s: Early pilots in CH, IT, DE, FR, AT/HU, …
  - 2000s: Early adaptors: ES, IT, CH, NL, LX, BE, …
  - 2020: Global success > 90,000 km contracted
  - Several countries strive for a complete migration CH, BE, DK, IT, LX, NL, NO, AT, …



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The 5 „ETCS Game Changer“ as a Chance

„ATO over ETCS“

ETCS is <u>the</u> enabler for automation in an interoperabel way

Grades of Automation (GoA)

Driver assistance – Manual driving (DAS)	Highly automated driving- Surveillance by driver (ATO)	Fully automated driving Supervisor on board (DTO)	Fully automated driving Unattended (UTO)

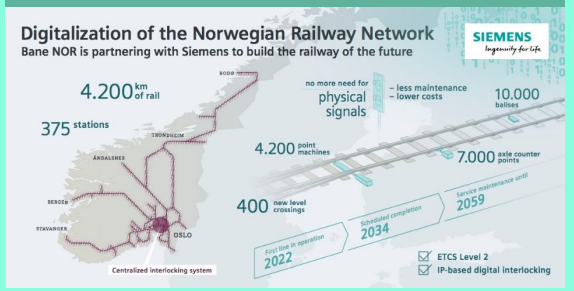
The current ATO activities of Siemens Mobility:
ATO is interoperable and ready for broader implementation

Thameslink
AoE P44 / ETCS BL3.3

Moorgate
AoE P44 ETCS BL3.4
Update ETCS BL3.6

DSH – S-Bahn Hamburg
AoE S2R
ETCS BL3.6

ERTMS Trackside Norway
AoE S2R



X2Rail-1 WP4
AoE S2R: Reference Test Bench
AoE S2R: Network Rail Pilot Train

X2Rail-3 WP10
ATO for DB Cargo / TRAXX Lok
ATO Gateway2 + ETCS BL2

SBB Demonstrator
Gateway Phase1 (SS 126)
Gateway Phase2 (SS 130)

ZBMS* Demonstrator
ATO (S2R) over ZSI127 for RhB
ATO (S2R) over ZSI127 for zb

*** Zugbeeinflussung für Meter und Spezialspurbahnen**

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Hybrid Level 3 is under realization in our Bane NOR project
The next step towards ETCS Level 3

BANE NOR

ETCS Level 2 ✓

Virtual Block with TVD* (following unfitted train)

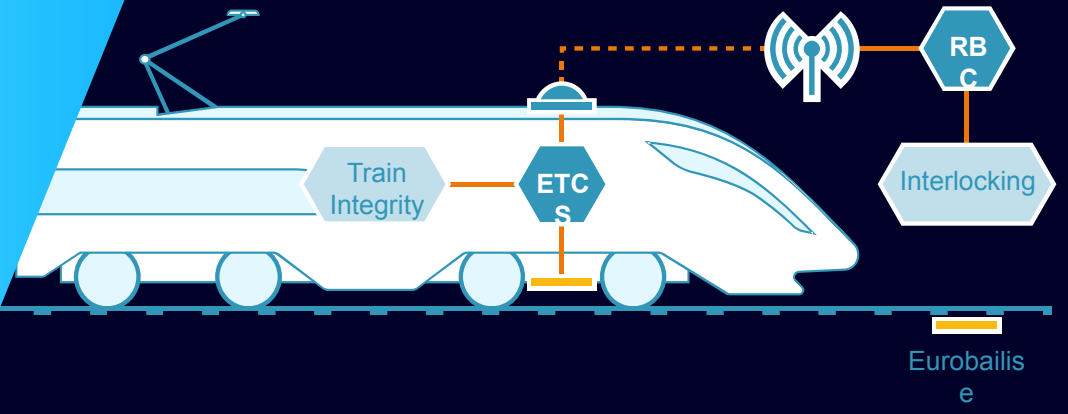
Hybrid Level 3 ✓

Moving Block w/o TVD

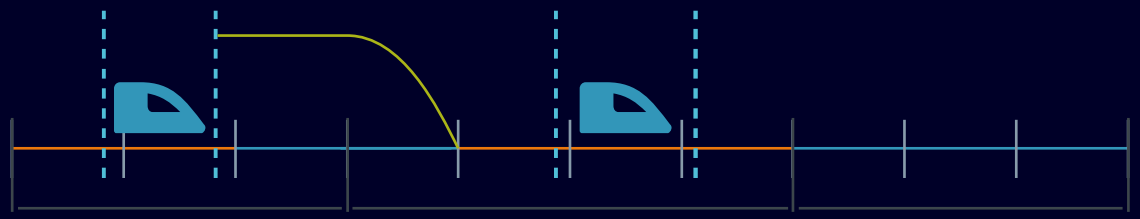
Virtual Block w/o TVD (following fitted train)

Moving Block with TVD

ETCS Level 3 tbd



HBP Projekt Norwegen



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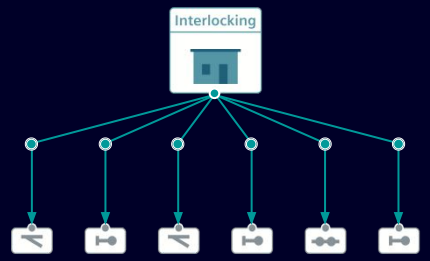
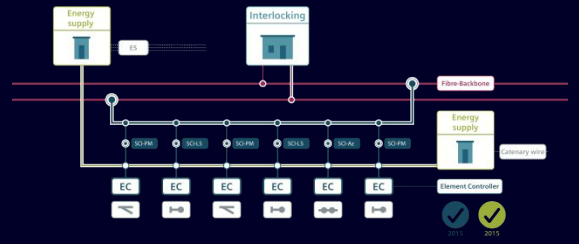
IP based wayside architecture and multicore COTS hardware provide a vision towards centralization and digitalization of the signalling system

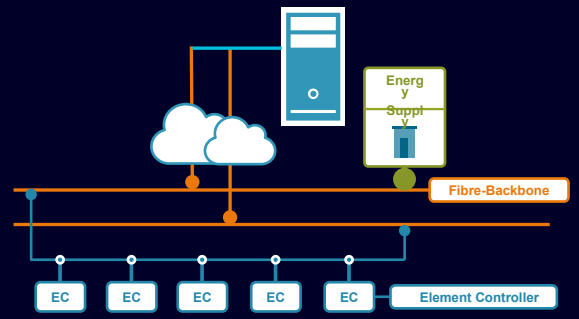
State-of-the-art
Conventional radial cabling



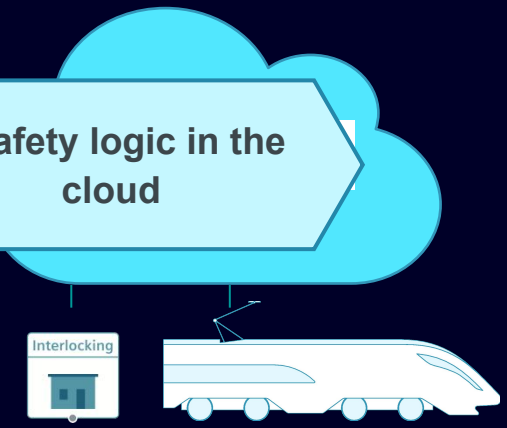
Digital Interlocking
IP based IxL architecture with standardized interfaces



DS³
New safety layer on top of COTS* hardware



Safety logic in the cloud

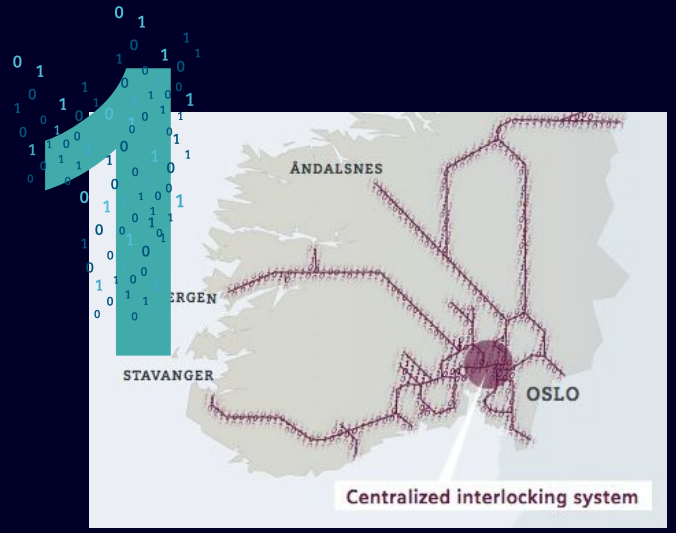


*COTS: commercial of the shelf hardware DS³: Distributed Smart Safe System

Distributed Wayside Architecture

Next Generation of Digitalization

Norway - The digital interlocking becomes reality: One central interlocking for an entire country



Harmonized Diagnosis

- IP-based signaling for Norway
- Collaboration over the next 30 – 40 years and beyond
- Flexibility and Change Management are essentials

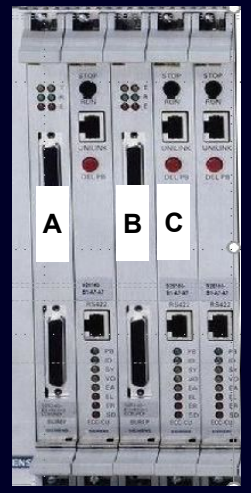
- Customized scalability
- Less cabling
- Standard interfaces
- Easy maintenance

- One overall system
- Predictive maintanence
- Improved analysis of operational data
- Enhanced diagnostic via standard interfaces

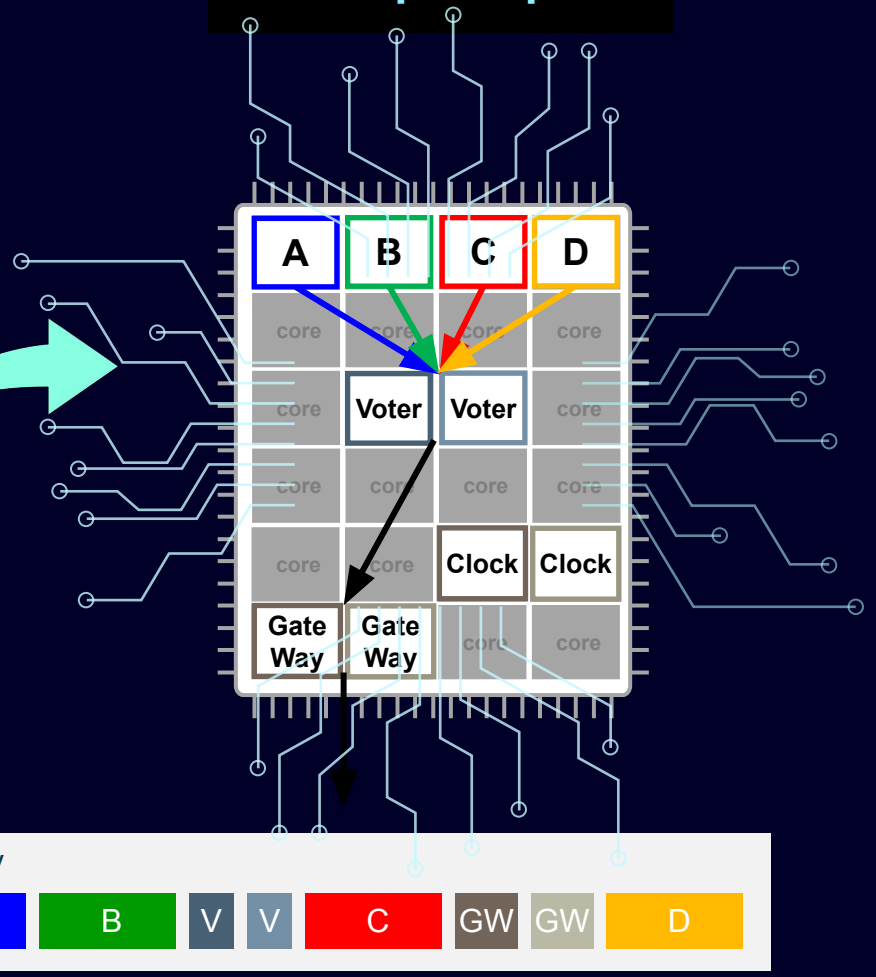
Flexible implementation of centralized or distributed architecture / Centralized logic and data access

Safety @ COTS multicore by Distributed Smart Safe System (DS3)

Proprietary HW platform



DS3 principle



- The safe **logic application** is running in at least two instances **(A,B)** in a **colored code emulation** in a separate CPU core
- Each code emulation uses different (diverse) areas in the memory (= **colored memory management**)
- The **safe CoarseClock (CC)** running in two colored code emulators creates cyclic triggers to the logic application
- The results of the logic application instances are compared by a **safe majority Voting** (**V**) running in two **colored** code emulators
- For increased **availability** additional instances of the logic application can be used **(C,D)**
- Results of the voting are sent out via safe **protocol gateway (GW)** to other systems

Diverse channels and voting Additional channels ▶ **Safety Availability**

colored = diverse safety measures)

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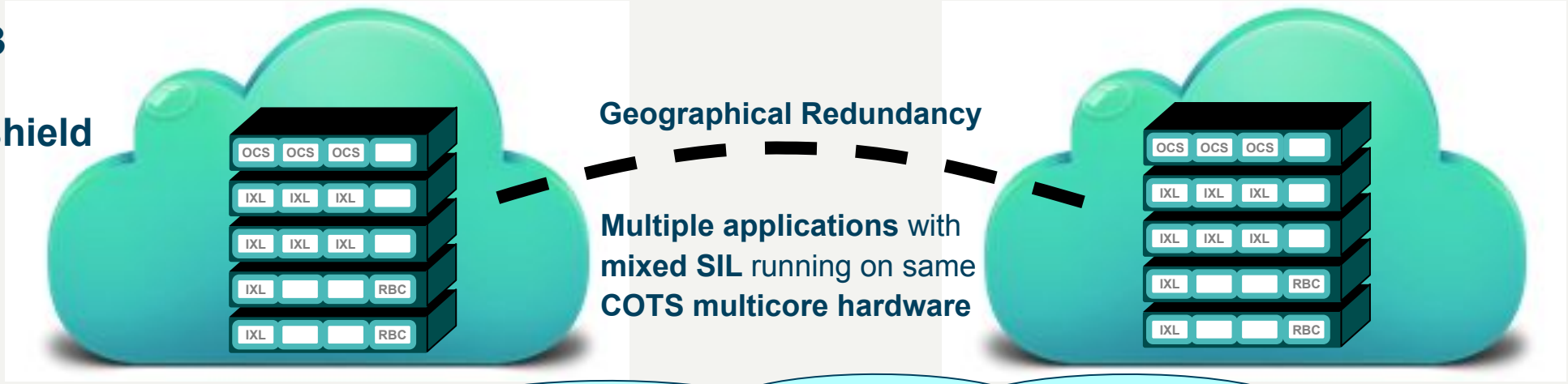
Rail Vision: Rail Data Center („Private Rail Cloud“)

Safet y by DS3

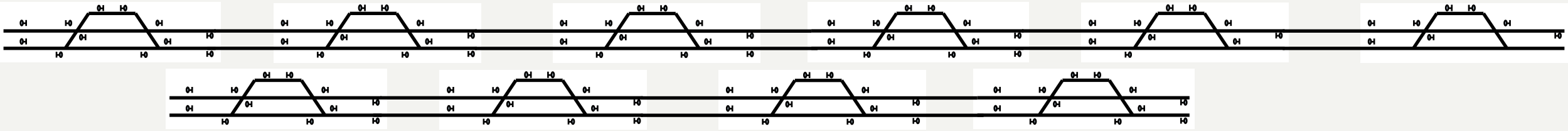
by Coreshield



Standardized communication to all connected systems

EULYNX

ertms



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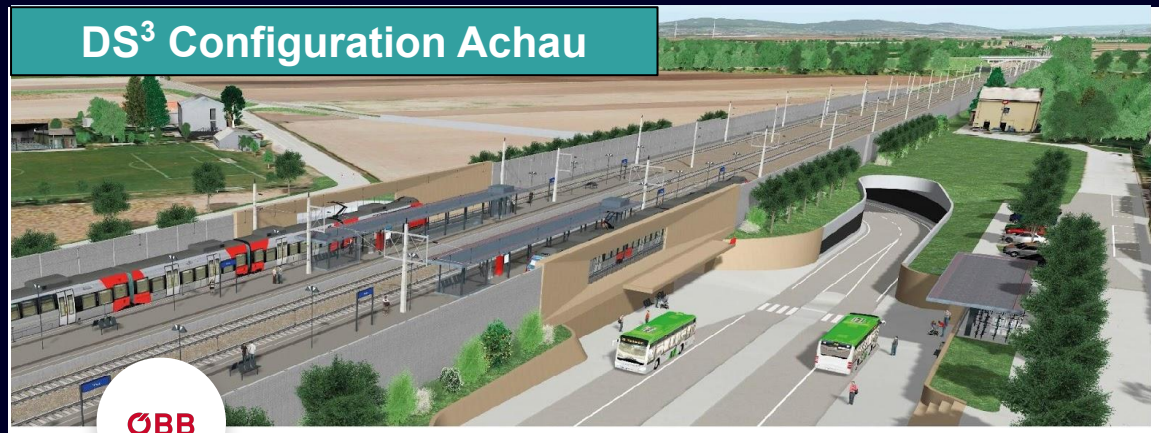
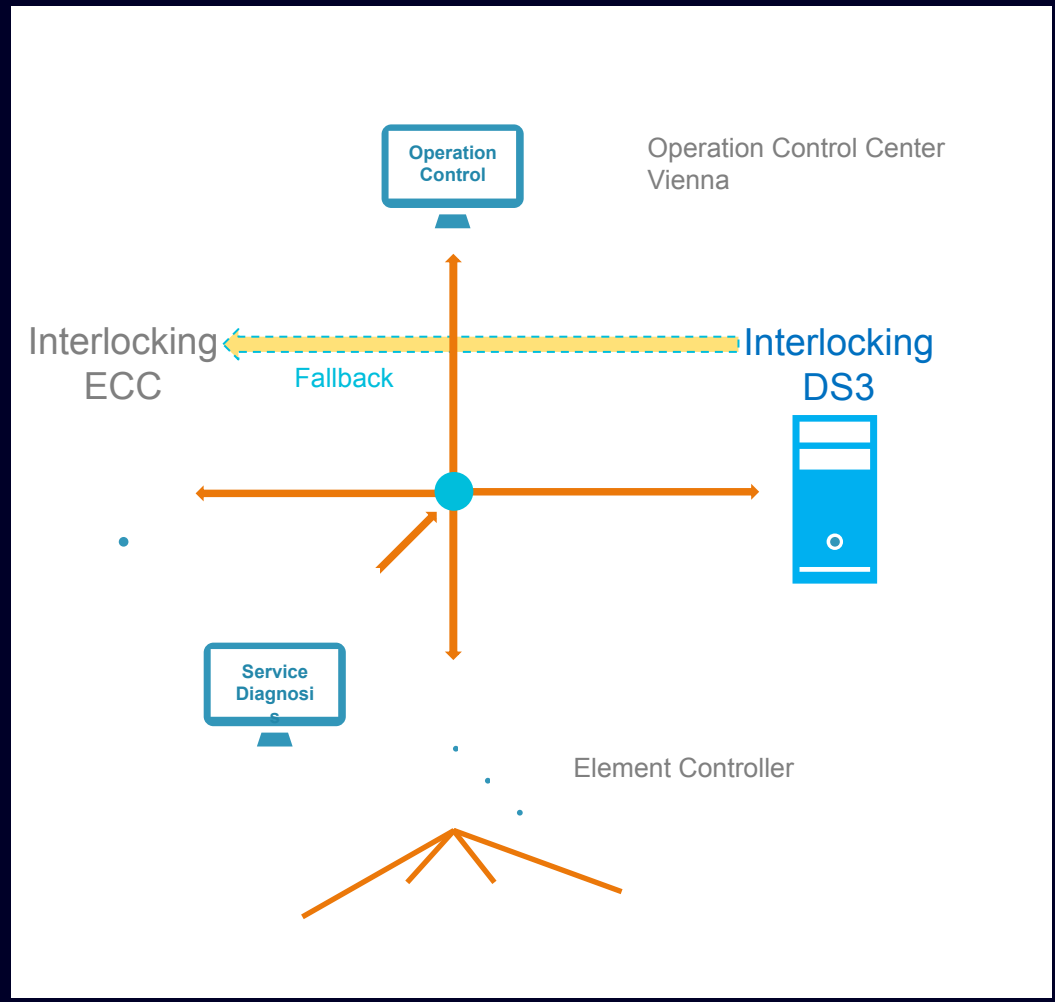
DS³ (Distributed Smart Safe System) reference: Interlocking Achau (ÖBB)



System Data:

- 12 Point Machines
- 16 Main Signals
- 04 Single Shunt Signals
- 01 Level Crossing
- 01 X25 Connection to OCC (redundant)

- Start operational tests without safety responsibility: December 2018
- DS³ operation with full safety responsibility: November 2020
- Fallback: existing electronic interlocking



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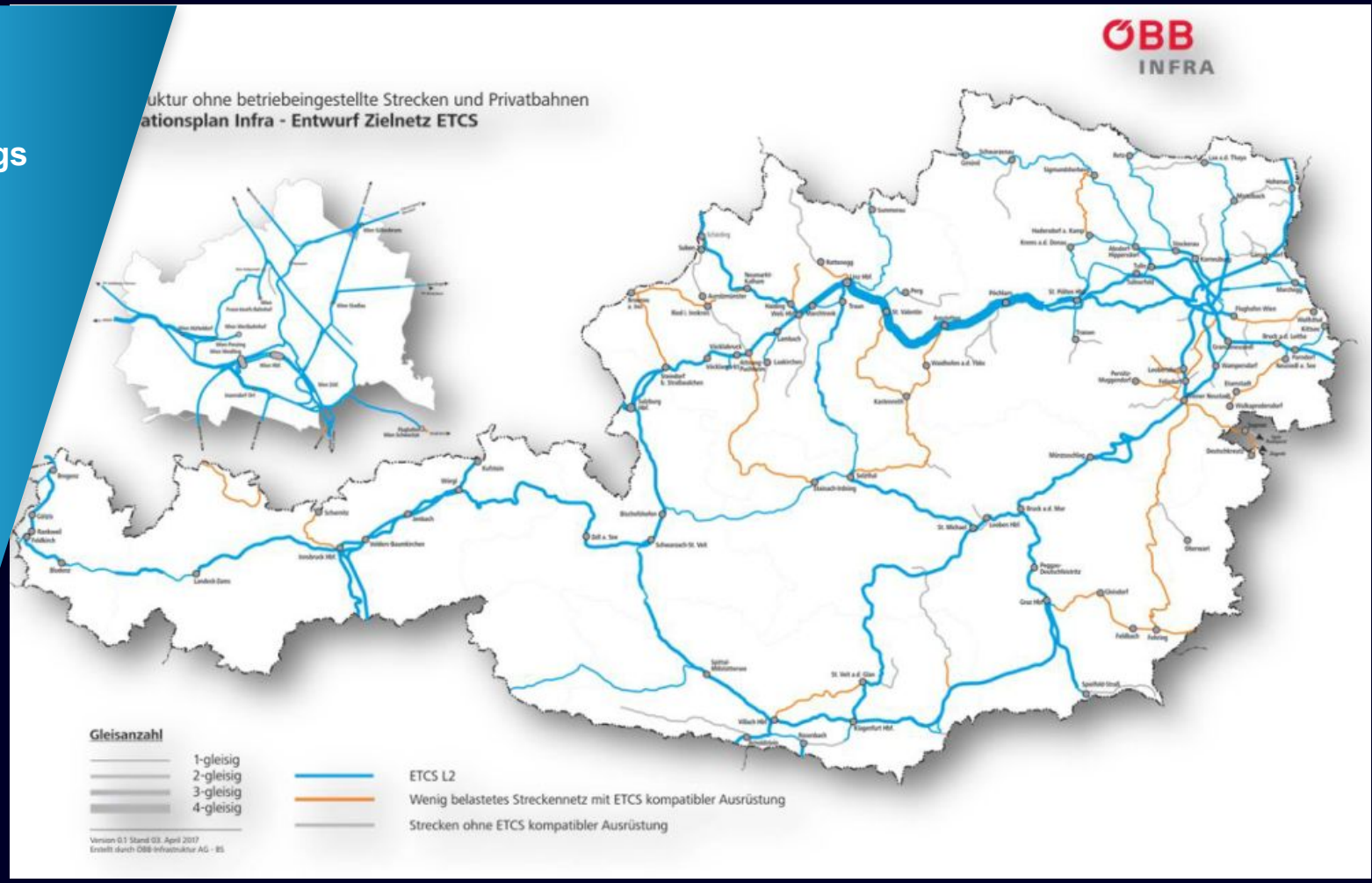
Siemens Mobility is Best Bidder for ETCS L2 in Austria

ETCS Migration Plan of ÖBB SBS 2038 (“Stark belastetes Streckennetz”)

- **ETCS L2 Frame Agreement**
- **ETCS L2 as Overlay on existing interlockings**
- **Migration towards DS^3 COTS multi core HW**
- **Geo-redundancy of Radio Block Centres (RBCs)**



Source: ÖBB Infra, NIP

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Let‘s climb the rock of innovation !

Conclusion

- ETCS has reached a **mature and interoperable** state
- **ATO GoA 2 is in operation**, GoA 3 and 4 will come next
- **Hybrid Level 3** is under development and provides high capacity with Virtual Block Sectioning
- Fully IP based Digital interlocking and COTS multi-core hardware allow **centralization** and **geo-redundancy**
- **Digital Twins and BIM** as Game Changers for asset management
- **Data analytics** and continuous release management

Thank You !

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