

EULYNX Live

Digital Rail Summer School 2023 | 18.09.2023

Robert Schmid

Operating Systems and Middleware

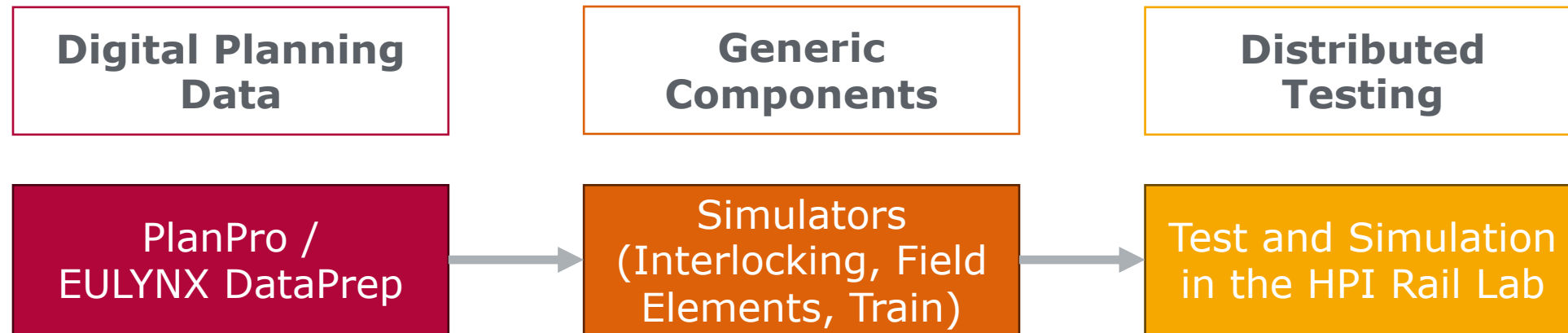
Prof. Dr. Andreas Polze

**Design IT.
Create Knowledge.**

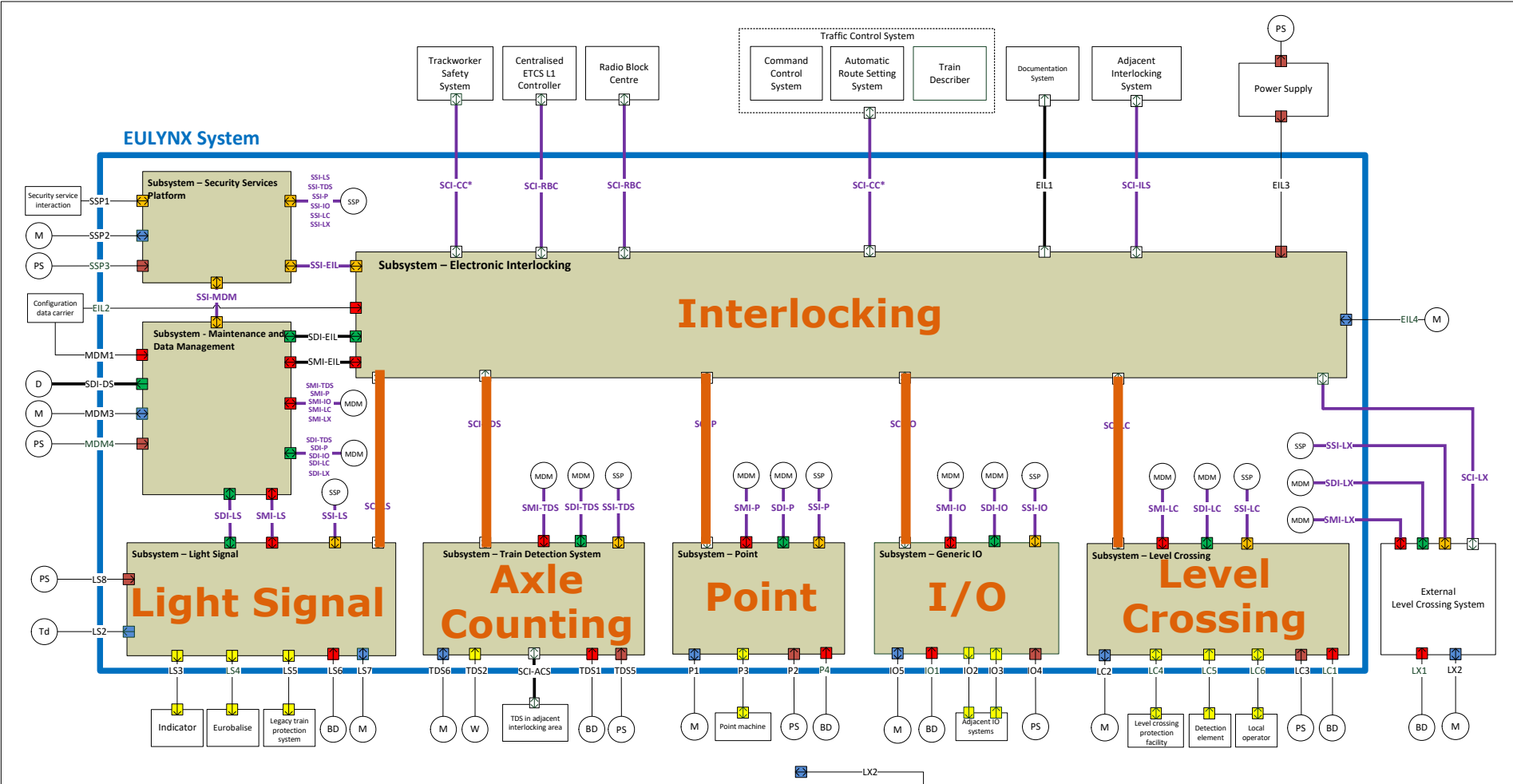
www.hpi.de



EULYNX Live: Bringing a EULYNX CCS System to Live



Architecture of a EULYNX Digital Interlocking



A Testing Environment for System Specifications

Technical Requirements Specifications are the basis for Industry Tenders

Specifications must be validated to ensure:

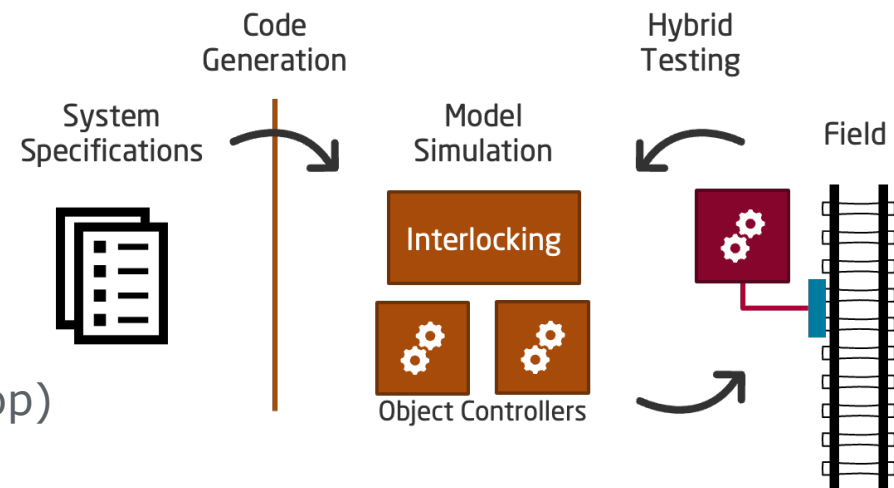
Soundness – a system with the desired functionality can be built according to the specifications

Completeness – the specs do not leave room for interpretation that could lead to incompatibilities

EULYNX uses **Model-based System Engineering**

Approach of **EULYNX Live**:

Test executable system models in their future application environment (real systems, model-in-the-loop)



EULYNX Reference Implementations (Open Source)

For Development and Interoperability Tests
(non-SIL)

RaSTA (UDP/TLS):

<https://github.com/eulynx-live/librasta>

Object-Controller-Simulators:

<https://github.com/eulynx-live/subsystems>

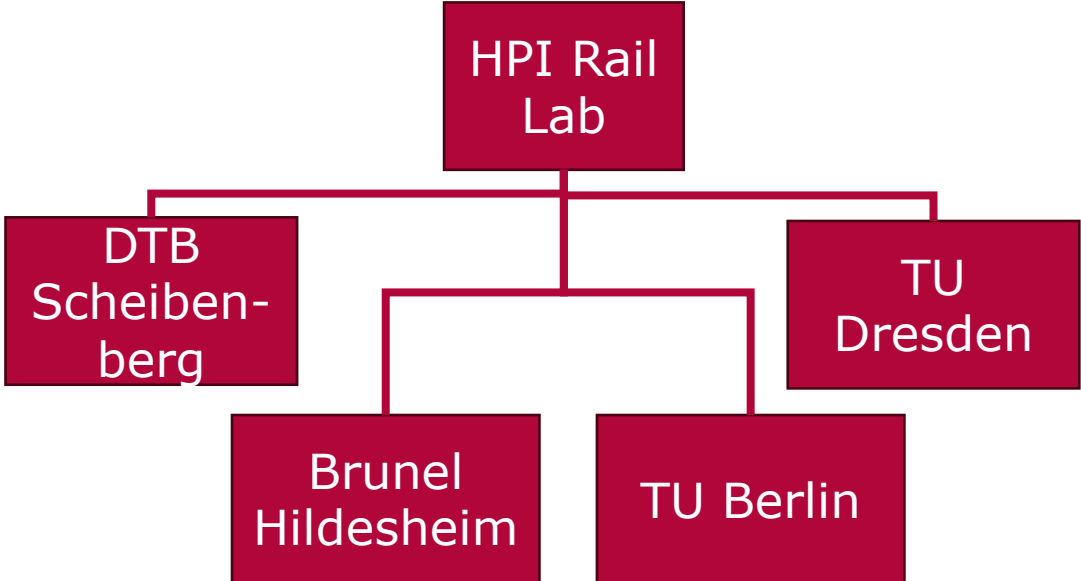


HPI Rail Lab: An Open and Distributed Proving Ground

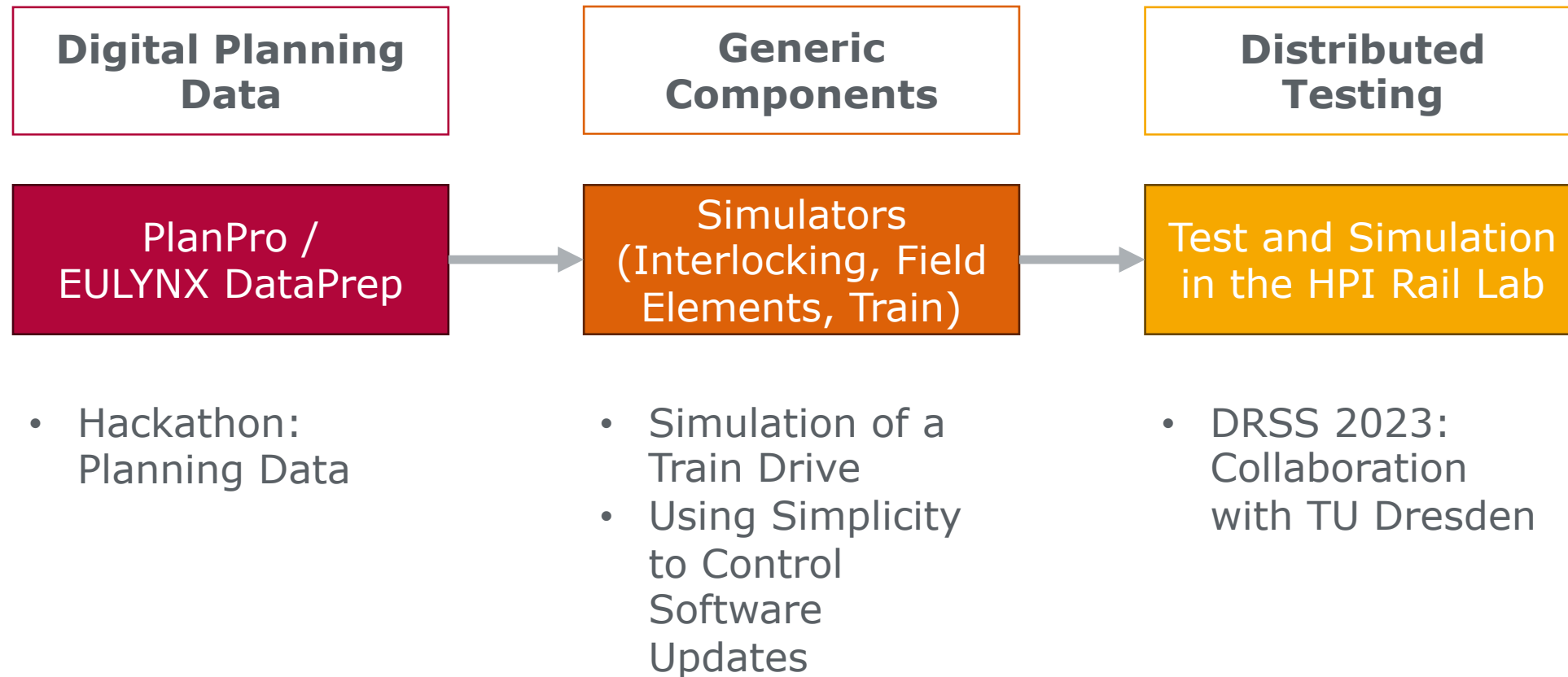
Vendor-neutral Environment

Test interoperability and dependability of digital CCS components

IT-Infrastructure for the dynamic re-configuration and network virtualization across lab sites



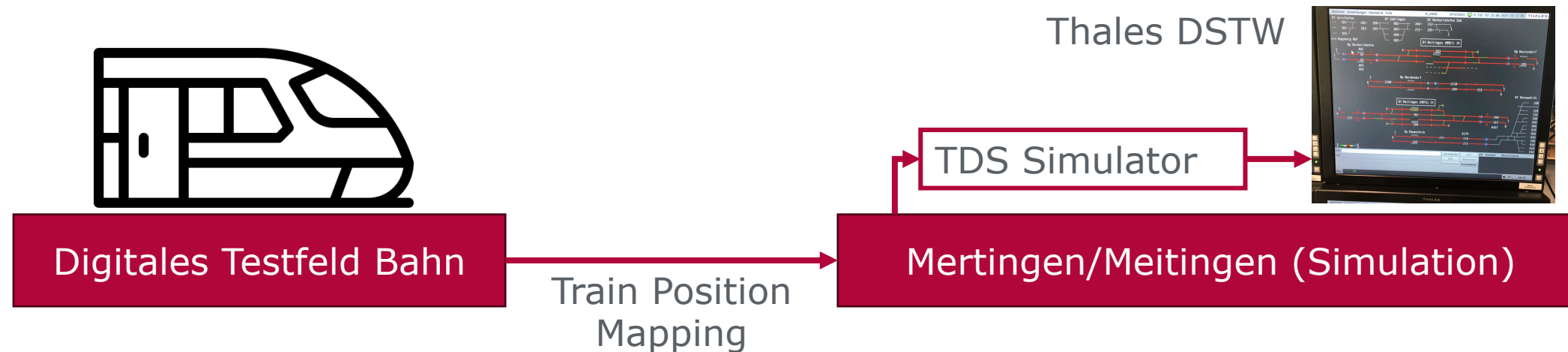
EULYNX Live: News 2023



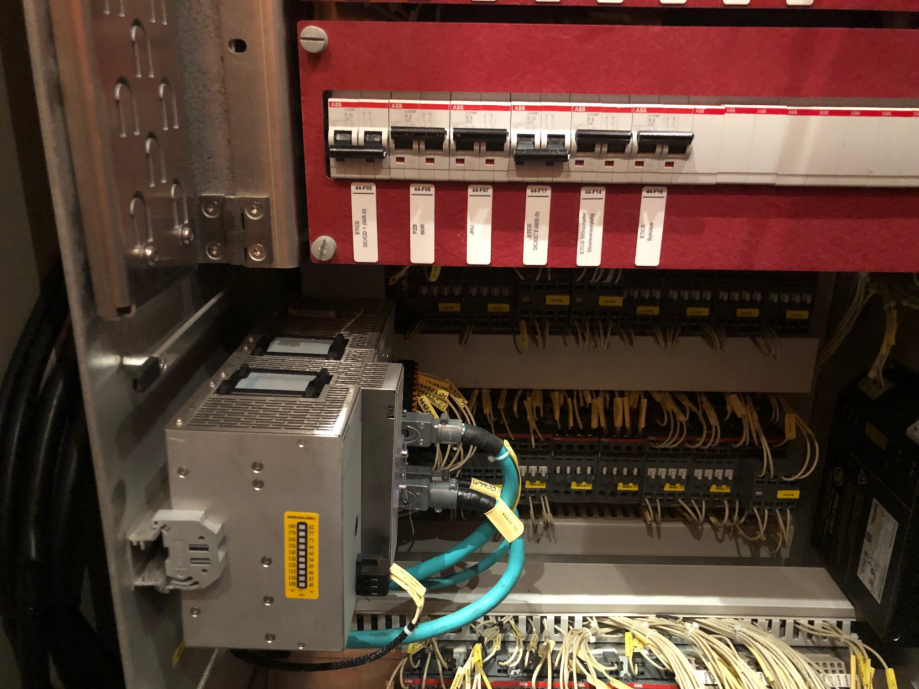


DB Netz Project System Integration Work Package: Laborvernetzung

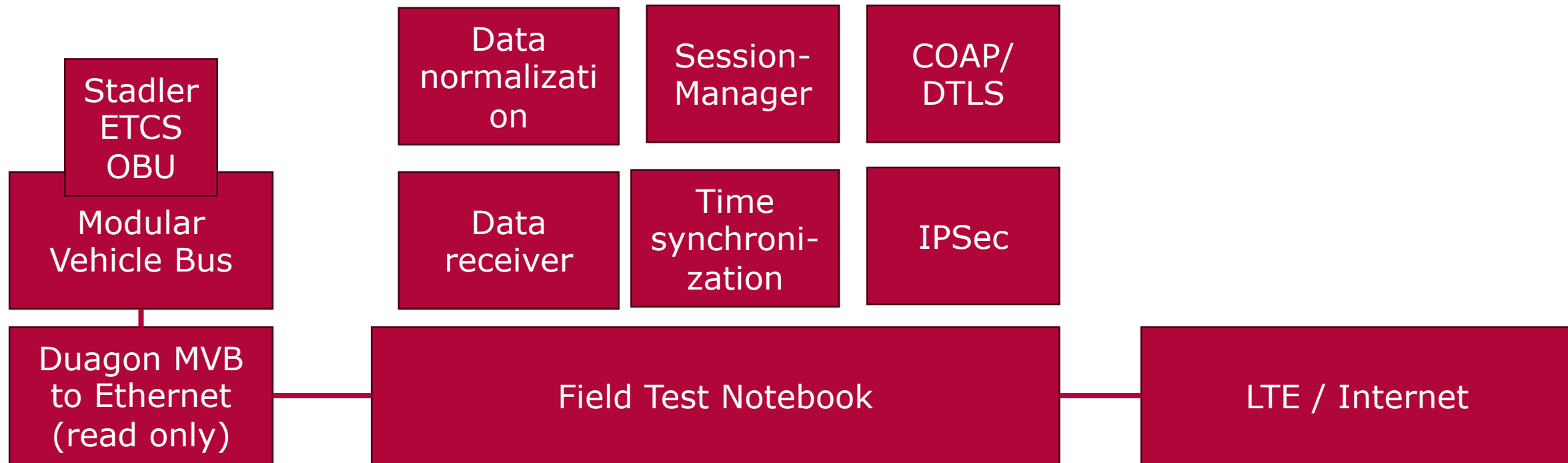
Demonstrate feasibility of conducting ETCS System Compatibility tests in a distributed lab environment, where the CCS system is decoupled from the test track.



advancedTrainLab: DB 605-5519



Implementation: Vehicle Side



Scenario Description using EULYNX DataPrep

Track Topology, Positioning of Train Detection System Sections

Soon: Balises, Light Signals

Partial manual digitization of PT 1-Planning Data of Mertingen/Meitingen:

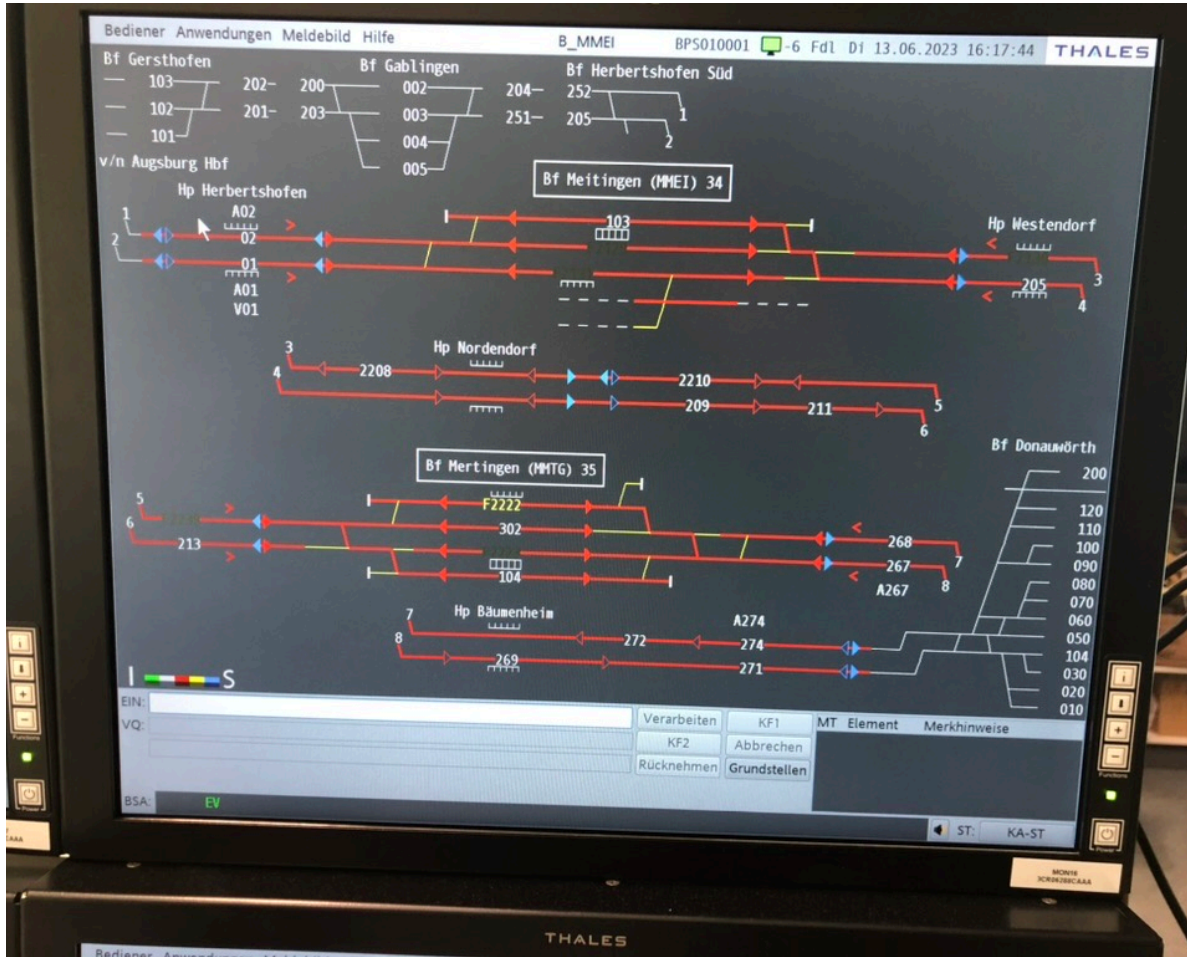
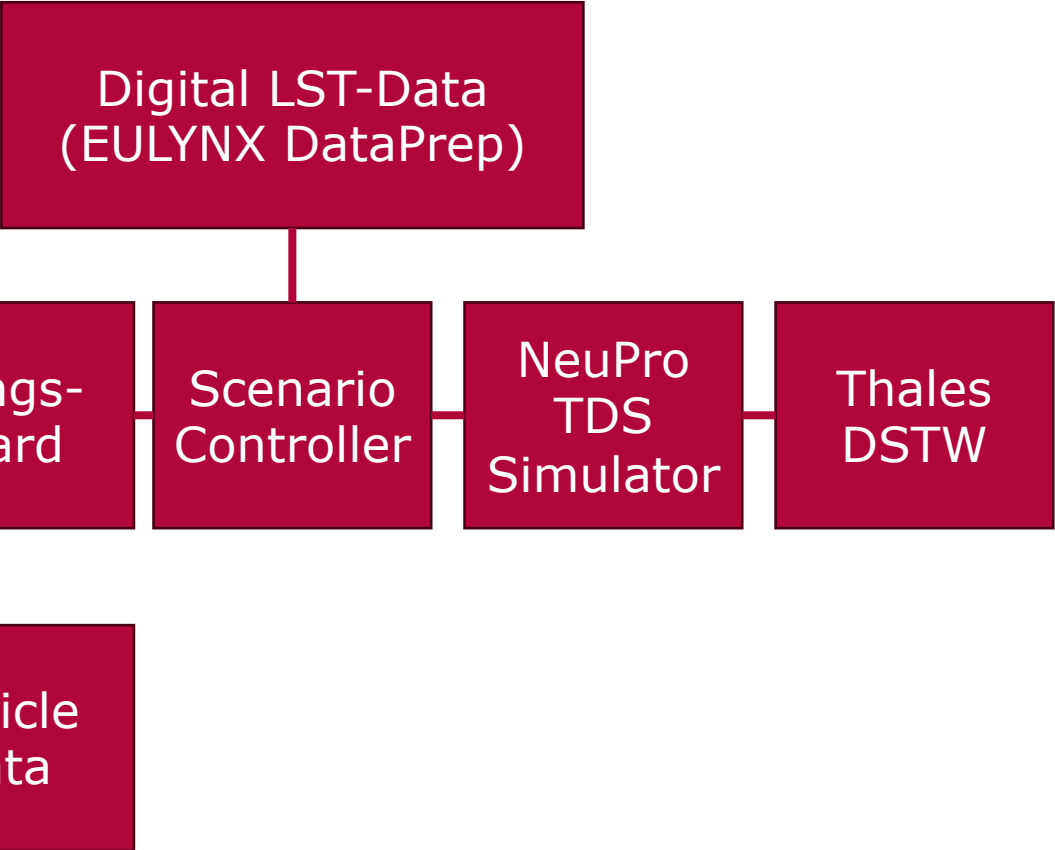
- Achszählpunkttabelle
- Achszählabschnittstabelle
- Sicherungstechnischer Lageplan

How could we do better?

Hackathon on Wednesday and Thursday

1	2				3					4		5		6		7		8		9		10	
	Zählpunkt				Stromversorgung					links2		links1		rechts		GFM-Abschnitte (Richtung der Kilometrierung)							
	Bezeichnung	Typ	Art	Stw	Schiene-profil	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.	Bezeichnung	Bem.		
1	59B112/60B114		fremd	PLKF	S54	-					59B112				60B114						60B114		
2	60B114B		eigen	PPHN	S54	-					60B114				-						-		
3	60G102B		eigen	PPHN	S54	-					-				-						60G102		
4	60G111A		eigen	PPHN	S54	-					-				-						60G111		
5	60B114/60G102/60W2		eigen	PPHN	S54	60B114					60G102				60W2						60W2		
6	59B111/60G111/60G211		eigen	PPHN	S54	59B111					60G111				60G211						60G211		
7	60G211/60W1		eigen	PPHN	UIC60	-					60G211				60W1						60W1		
8	60W1B		eigen	PPHN	UIC60	-					60W1				-						-		
9	60W2C		eigen	PPHN	UIC60	-					-				-						60W2		
10	60W51A		eigen	PPHN	S49	-					-				-						60W51		
11	60W51/60G107		eigen	PPHN	S49	-					60W51				60G107						60G107		
12	60W51/60C108		eigen	PPHN	S49	-					60W51				60C108						60C108		
13	60W1/60G101		eigen	PPHN	S54	-					60W1				60G101						60G101		
14	60W2/60W3		eigen	PPHN	UIC60	-					60W2				60W3						60W3		
15	60W3/60W4		eigen	PPHN	S54	-					60W3				60W4						60W4		
16	60G101/60G201		eigen	PPHN	S54	-					60G101				60G201						60G201		
17	60W3/60G202		eigen	PPHN	S54	-					60W3				60G202						60G202		
18	60W4/60G113		eigen	PPHN	S49	-					60W4				60G113						60G113		
19	60G113/60W5		eigen	PPHN	S49	-					60G113				60W5						60W5		
20	60G202/60G302		eigen	PPHN	S54	-					60G202				60G302						60G302		
21	60W5/60W6		eigen	PPHN	S49	-					60W5				60W6						60W6		
22	60W5/60G103		eigen	PPHN	S49	-					60W5				60G103						60G103		
23	60W6/60G104		eigen	PPHN	S49	-					60W6				60G104						60G104		
24	60W6/60G105		eigen	PPHN	S49	-					60W6				60G105						60G105		
25	60W6/60G106		eigen	PPHN	S49	-					60W6				60G106						60G106		
26	60W24F		eigen	PPHN	S49	-					-				-						60W24		
27	60G108/60W24		eigen	PPHN	S49	-					60G108				60W24						60W24		
28	60G107/60W24		eigen	PPHN	S49	-					60G107				60W24						60W24		
29	60G106/60W24		eigen	PPHN	S49	-					60G106				60W24						60W24		
30	60G105/60W24		eigen	PPHN	S49	-					60G105				60W24						60W24		
31	60G201/60G301		eigen	PPHN	S54	-					60G201				60G301						60G301		
32	60W24/60W28		eigen	PPHN	S49	-					60W24				60W28						60W28		
33	60G104/60W28		eigen	PPHN	S49	-					60G104				60W28						60W28		
34	60G103/60W29		eigen	PPHN	S54	-					60G103				60W29						60W29		
35	60G302/60G402		eigen	PPHN	S54	-					60G302				60G402						60G402		
36	60W28/60W29		eigen	PPHN	S49	-					60W28				60W29						60W29		
37	60W28/60G124		eigen	PPHN	S49	-					60W28				60G124						60G124		
38	60W29/60W30		eigen	PPHN	S49	-					60W29				60W30						60W30		
39	60G402/60W31		eigen	PPHN	S49	-					60G402				60W31						60W31		
40	60W30/60W31		eigen	PPHN	S54	-					60W30				60W31						60W31		
41	60G124/60W34		eigen	PPHN	S49	-					60G124				60W34						60W34		
42	60W30/60W34		eigen	PPHN	S49	-					60W30				60W34						60W34		
43	60G301/60W33		eigen	PPHN	S54	-					60G301				60W33						60W33		
44	60W33B		eigen	PPHN	S54	-					-				-						60W33		
45	60W31D		eigen	PPHN	S54	-					60W31				-						-		
46	60W34/60G123		eigen	PPHN	S49	-					60W34				60G123						60G123		
47	60W31/60G122		eigen	PPHN	S54	-					60W31				60G122						60G122		
48	60G120B		eigen	PPHN	S54	-					-				-						60G120		
49	60G120/60W36		eigen	PPHN	S54	-					60G120				60W36						60W36		
50	60W33D		eigen	PPHN	S54	-					60W33				-						-		

Stellwerksseite: DSTW Mertingen/Meitingen (im Labor)



Digital Rail Demo Day



The final test takes place as part of the Digital Rail Demo Day on Thursday.

How to handle Software Updates and System Evolution regarding certification and admission processes?

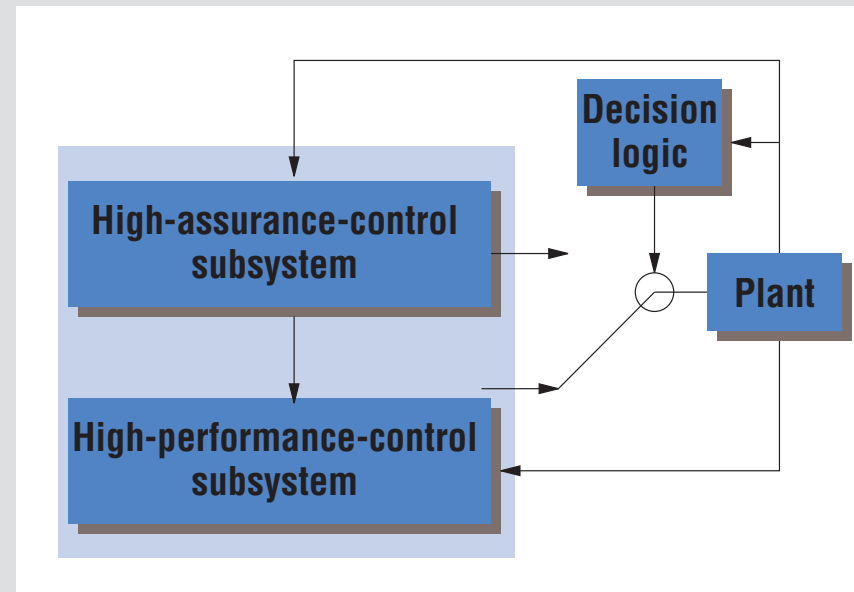
Idea: Admission property is **continuously monitored** by the system

Previously proposed in:

Using Simplicity to Control Complexity

Lui Sha, IEEE Software Juli/August 2001

We can exploit the features and **performance of complex software** even if we cannot verify them, provided we can **guarantee the critical requirements with simple software**.

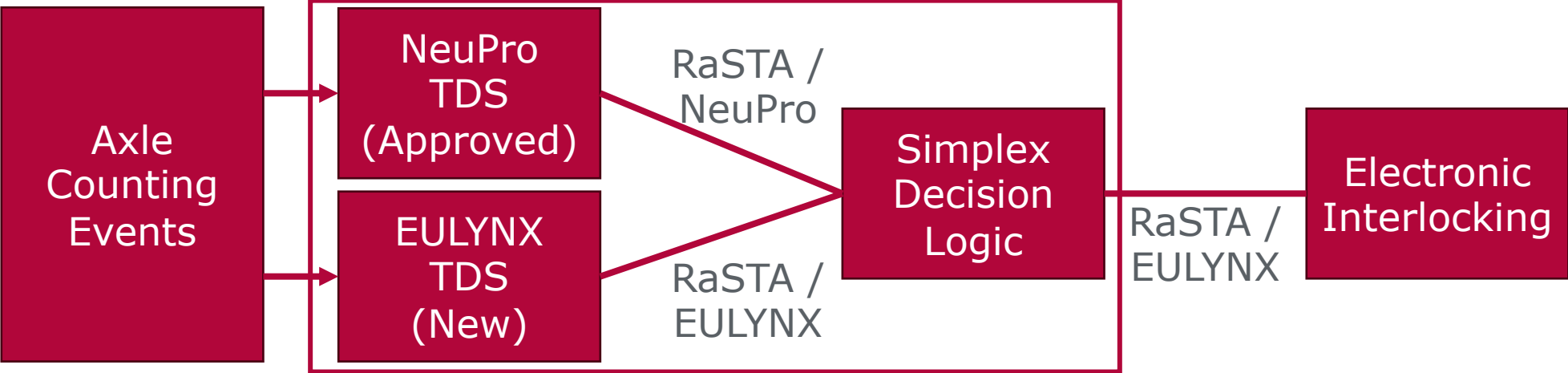


Sha, Lui. "Using simplicity to control complexity." *IEEE Software* 18.4 (2001): 20-28.

Simplex

The Simplex Architecture in Practice (Master Thesis Clemens Tiedt)

- Idea: given an approved NeuPro field element controller (TDS), can we make it EULYNX-compatible and ‚inherit‘ its approval?
- Evaluation of technical feasibility



Literature Review: Applications of Simplex Architectures in Safety-critical Domains

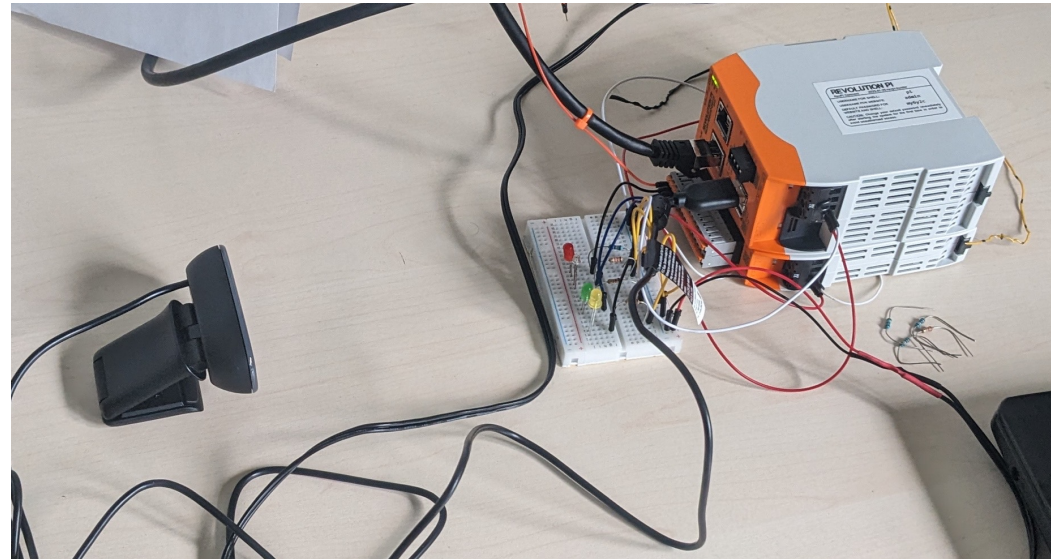
- with Katja Assaf, Frederic Reiter, Dirk Friedenberger, Clemens Tiedt

Digital Rail Summer School 2023

Build your own Object Controller

Project Tasks:

- Develop a EULYNX-compliant Light Signal Object Controller using off-the-shelf compute hardware
- Create the hardware interface and terminal box (Feldelementanschlusskasten) for controlling a Thales Ks-Vorsignal
- Project Team spanning Dresden, Chemnitz, Potsdam, Berlin



Hackathon: New Ideas for Digitizing Planning Data

Digital Planning Data is the foundation for streamlined implementation, testing and integration

Not all projects start from scratch: Thousands of Paper-based planning data sets exist

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Fahrdaten über Haltebereich	Haltebereich	diest anschließender Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Flankenschutz	Bemerkungen	
Fahrdaten über Haltebereich	Haltebereich	Weiche	Zwieschutz	Signal	Weisgabe	die Fahrt	Flankenschutz	vorvorgelichte	überwachte	grenzschutzbereich	Fahrdaten	Vorgelichte	zulässige Geschwindigkeit	Bemerkungen	
1	60W1	L	-	-	60P1	-	-	-	-	60G101	+	-	-	50	
2	60W1	R	-	-	60P2R	-	-	-	-	60G101	+	-	-	150	
3	60W2	L	-	-	60AA	-	-	-	-	60G102	+	-	-	50	
4	60W2	R	-	-	60P1R	-	-	-	-	60G102	+	-	-	150	
5	60W3	L	-	-	60P2	-	-	-	-	60G202	+	-	-	50	
6	60W3	R	-	-	60P1R	-	-	-	-	60G202	+	-	-	150	
7	60W4	L	-	-	60P3	-	-	-	-	60G301	+	-	-	50	
8	60W4	R	-	-	60P2R	-	-	-	-	60G301	+	-	-	150	
9	60W5	L	-	-	60P3	-	-	-	-	60G401	+	-	-	40	
10	60W5	R	-	-	60P4	-	-	-	-	60G401	+	-	-	120	
11	60W6	L	-	-	60P4	-	-	-	-	60G401	+	-	-	120	
12	60W6	R	-	-	60P7	-	-	-	-	60G401	+	-	-	40	
13	60W7	L	-	-	60P8R	-	-	-	-	60G501	+	-	-	120, Ra	
14	60W7	R	-	-	60P8	-	-	-	-	60G501	+	-	-	40, Ra	
15	60W8	L	-	-	60L107Y	-	-	-	-	60G601	+	-	-	40, Ra	
16	60W8	R	-	-	60L107Y	-	-	-	-	60G601	+	-	-	120, Ra	
17	60W9	L	-	-	60W32L	-	-	-	-	60G701	+	-	-	40, Ra	3)
18	60W9	R	-	-	60W32L	-	-	-	-	60G701	+	-	-	120, Ra	
19	60W53	L	-	-	60W32L	-	-	-	-	60G801	+	-	-	50	
20	60W53	R	-	-	60L108X	-	-	-	-	60G801	+	-	-	120, Ra	
21	60W54	L	-	-	60W33	-	-	-	-	60G901	+	-	-	40	
22	60W54	R	-	-	60L107X	-	-	-	-	60G901	+	-	-	50	
23	60W24	L	-	-	60W54	-	-	-	-	60G1001	+	-	-	40, Ra	
24	60W24	R	-	-	60W55R	-	-	-	-	60G1001	+	-	-	120	
25	60W25	L	-	-	60W27R	-	-	-	-	60G1101	+	-	-	40, Ra	
26	60W25	R	-	-	60W27R	-	-	-	-	60G1101	+	-	-	120	
27	60W24B	L	60W24B	60W25L	-	-	-	-	-	60G1201	+	-	-	120 (1)	
28	60W24B	R	-	-	60L124Y	-	-	-	-	60G1201	+	-	-	11, 120	
29	60W25C	L	-	-	60W26	-	-	-	-	60G1301	+	-	-	109 (1)	
30	60W25C	R	-	-	60W26	-	-	-	-	60G1301	+	-	-	11, 120	
31	60W29	L	60W29	60W29L	-	-	-	-	-	60G1401	+	-	-	120	
32	60W29	R	-	-	60W29	-	-	-	-	60G1401	+	-	-	40	
33	60W30	L	-	-	60W31L	-	-	-	-	60G1501	+	-	-	120	
34	60W30	R	60W30R	60W30R	-	-	-	-	-	60G1501	+	-	-	50	
35	60W31	L	-	-	60W32L	-	-	-	-	60G1601	+	-	-	50	
36	60W31	R	-	-	60W32R	-	-	-	-	60G1601	+	-	-	50	
37	60W32	L	-	-	60W33L	-	-	-	-	60G1701	+	-	-	150	
38	60W32	R	-	-	60L122	-	-	-	-	60G1701	+	-	-	50	
39	60W33	L	-	-	60W32L	-	-	-	-	60G1801	+	-	-	150	
40	60W33	R	-	-	60W32R	-	-	-	-	60G1801	+	-	-	50	
41	60W34	L	-	-	60W34	-	-	-	-	60G1901	+	-	-	150	
42	60W34	R	60W34R	60W34R	-	-	-	-	-	60G1901	+	-	-	40	
43	60W35	L	-	-	60W35L	-	-	-	-	60G2001	+	-	-	150	
44	60W35	R	-	-	60L121	-	-	-	-	60G2001	+	-	-	50	
45	60W36	L	-	-	60W36L	-	-	-	-	60G2101	+	-	-	150	
46	60W36	R	-	-	60B	-	-	-	-	60G2101	+	-	-	50	
47	60W37	L	60L126	60W37L	-	-	-	-	-	60G2201	+	-	-	50	Gloss 8
48	60W37	R	60L126	60W37R	-	-	-	-	-	60G2201	+	-	-	150	Gloss 7
49	60W38	L	60L127	60W38L	-	-	-	-	-	60G2301	+	-	-	50	Gloss 4
50	60W38	R	60L127	60W38R	-	-	-	-	-	60G2301	+	-	-	150	Gloss 5
51	60W39	L	60L128	60W39L	-	-	-	-	-	60G2401	+	-	-	50	Gloss 6
52	60W39	R	60L128	60W39R	-	-	-	-	-	60G2401	+	-	-	150	Gloss 6
53	60W40	L	60L129	60W40L	-	-	-	-	-	60G2501	+	-	-	50	Gloss 9
54	60W40	R	60L129	60W40R	-	-	-	-	-	60G2501	+	-	-	150	Gloss 9

1) in Höhe 40 km/h
2) Zwieschutzweiche wird zum Flankenschutz für den Haltebereich in R beantragt
Ra nur Rangierstraßen über dessen Weichenstrang
+ Verbindung von Zug- und Rangierstraßen

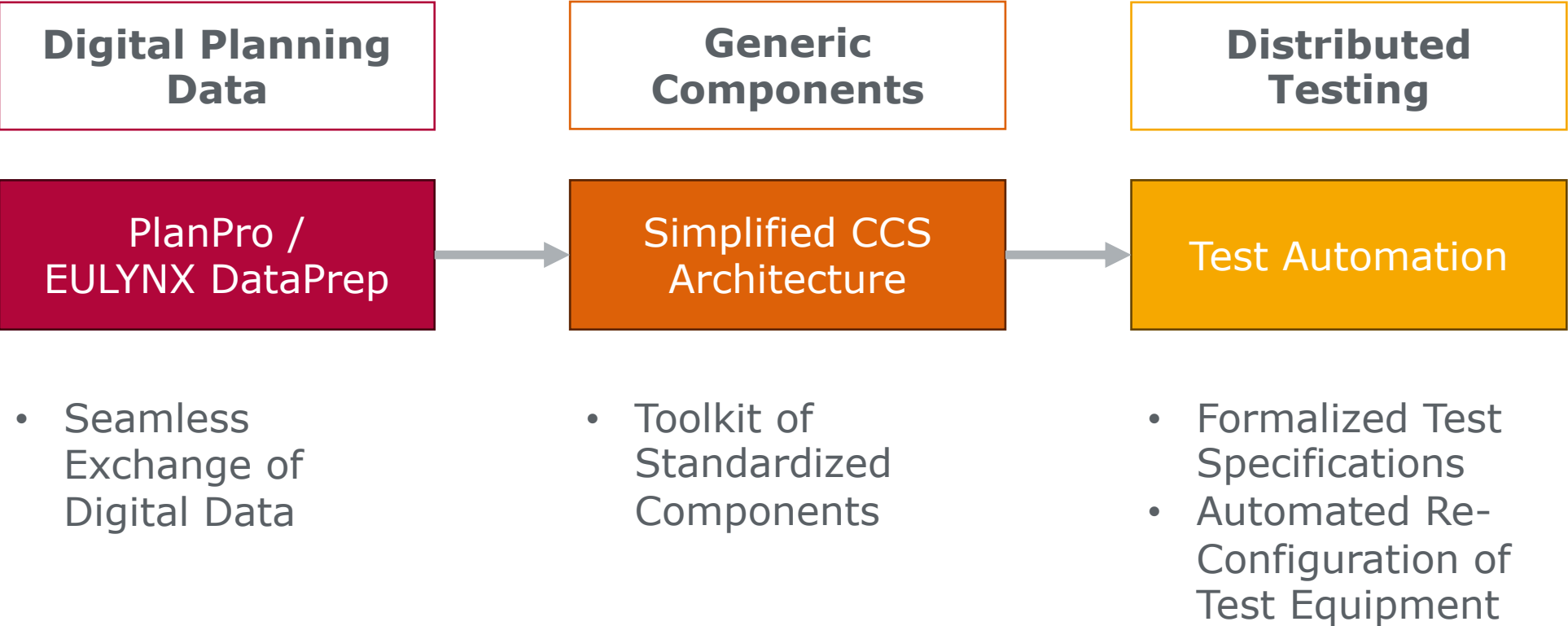
2. ÄM

Bestand auf		Erstellt für		Erstellt durch	
DB NETZE		27.11.15		27.11.15	
PPHN_1024					
ESTW-UZ N-Stadt					
ESTW-A-Hausen					
Flankenschutztafel					
01.02					

- Achszähltabelle
- Durchrutschwegtabelle
- Flankenschutztafel
- Gleismagnettabelle
- Gefahrpunkttafel
- Rangierstraßentabelle
- Streckenblocktafel
- Signaltabelle
- Weichentabelle
- Zugstraßentabelle
- Zwieschutzweichentabelle

How can state-of-the-art OCR technologies and Machine Learning help?

How can we increase the testing capacity for the upcoming DLST projects?



Thank you!

Robert Schmid

Operating Systems and Middleware

Prof. Dr. Andreas Polze

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**Design IT.
Create Knowledge.**

www.hpi.de

