how2SE
Systems Engineering

25th anniversary
annual INCOSE
international symposium
Seattle, WA
July 13 - 16, 2015

An application of System Architecture in (Rail) Infrastucture

Paul Schreinemakers, How2SE, co-Owner / Consultant

Topics

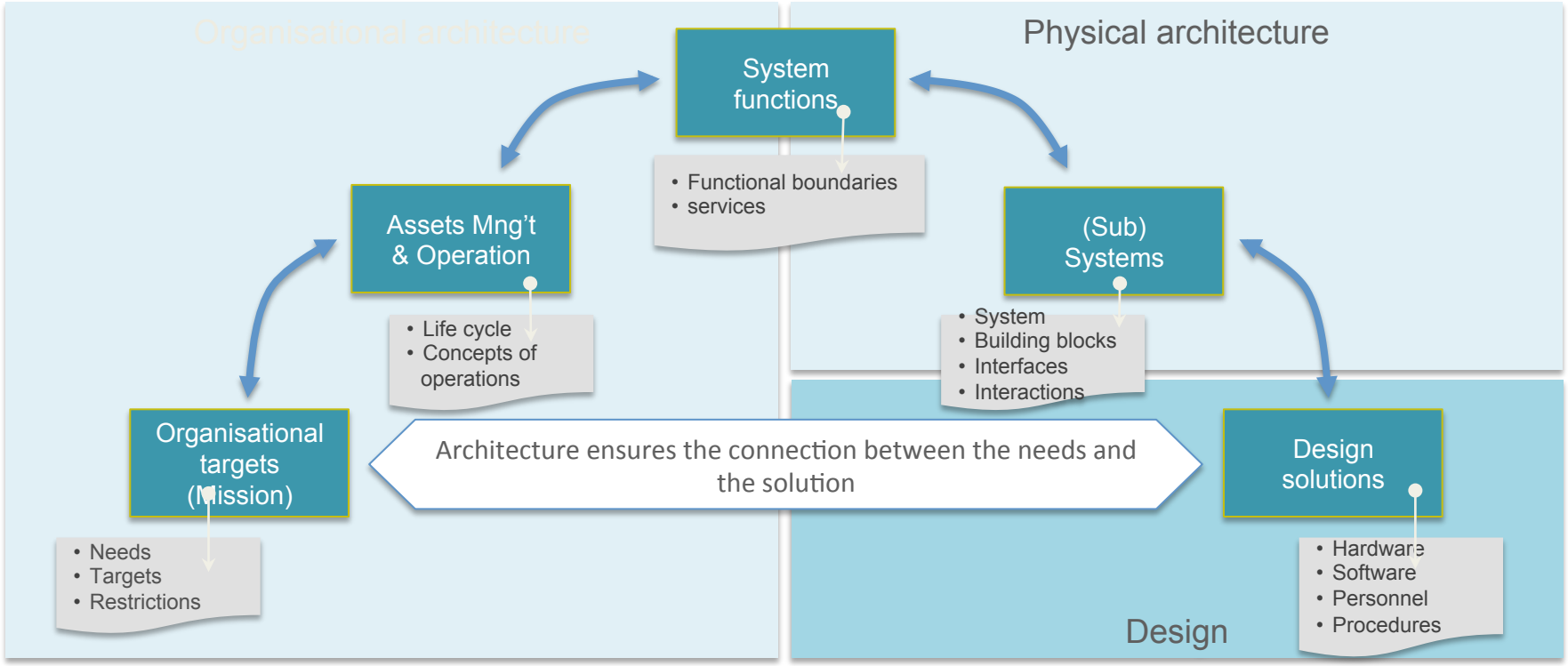
- Architecture
  - The arch to success
  - Architectural frameworks
- Rail example of System Architecture

SYSTEM ARCHITECTURE

Architecture is the arch to success

(James Martin)

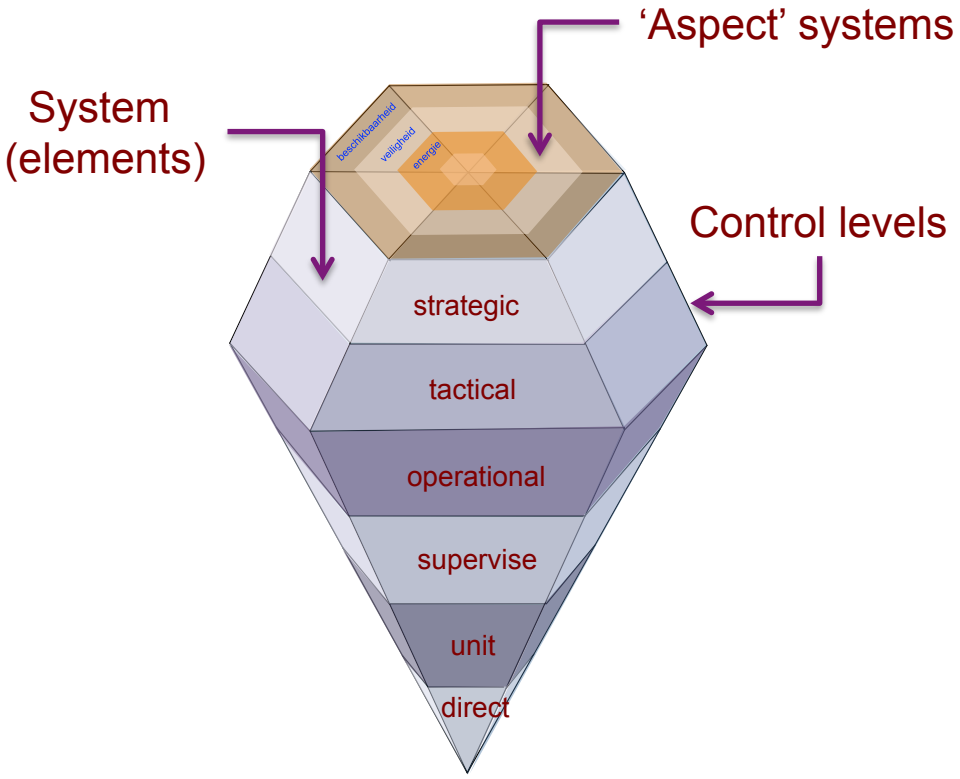
Provides insight in the underlying design choices and consistency – or architecture- is required to achieve a unambiguous and consistent scope and set of requirements



The architecture also the optimisation of the system regarding fulfilling the customer needs, reliability and costs.

Golden rules

In a system architecture we optimise systems (elements), aspect-systems and control levels in connection.

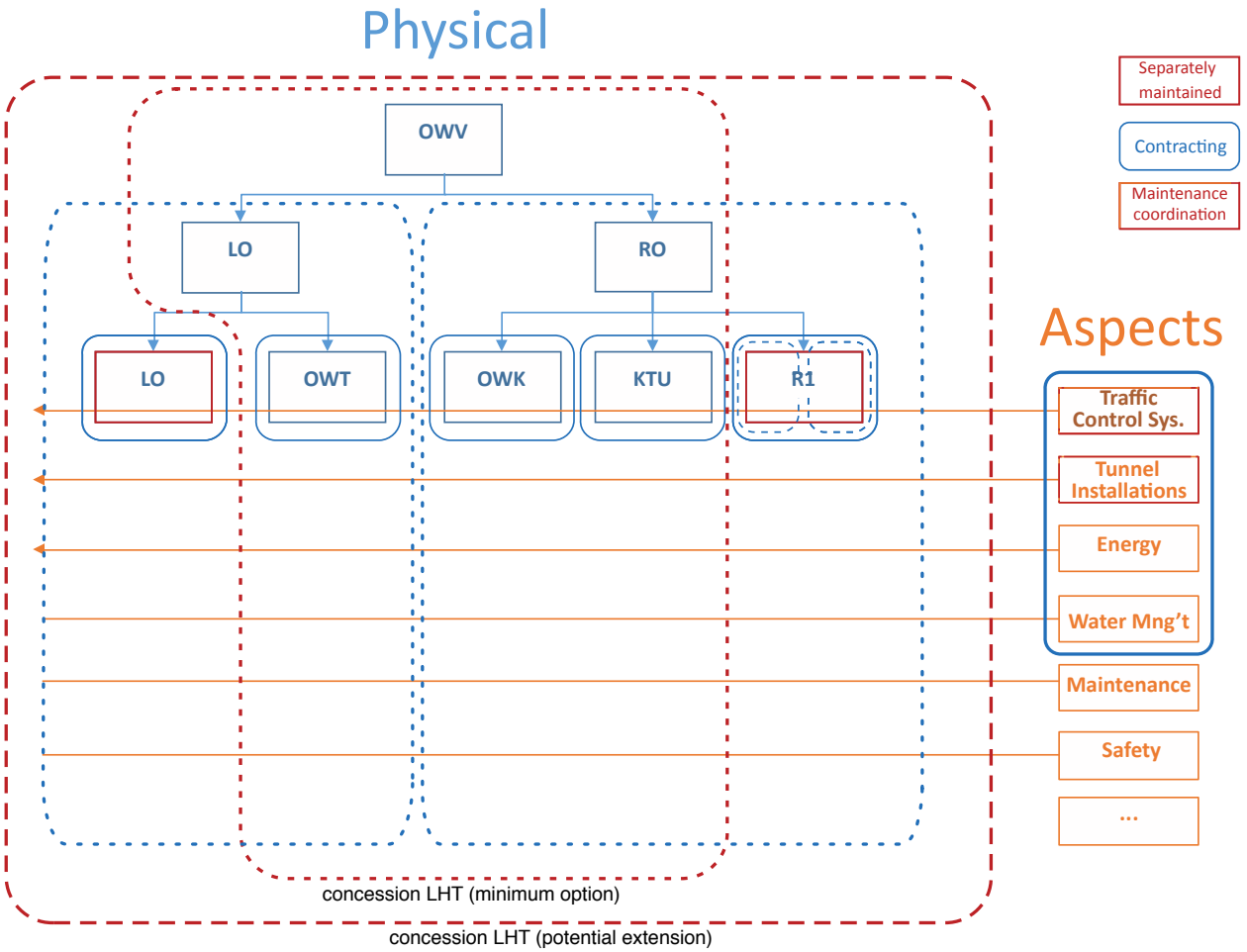


Golden architecture rules:

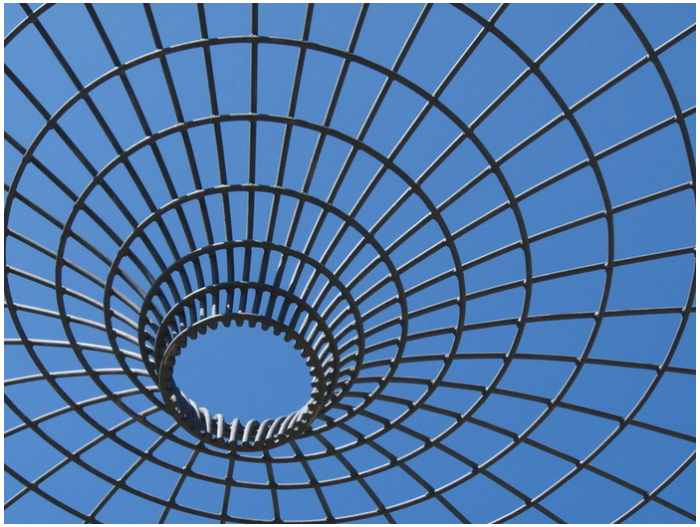
- Optimise the **performance** of (aspect) systems
- Minimise **interfaces** between systems (elements)
- Maximise **decoupling** of control levels

Aspect systems

Aspect systems are types of relations between Systems and system elements (Prof. in ‘t Veld, 1975)



sub-systeem / aspect-systeem		deelverzameling van elementen A	B	C
deelverzameling van relaties	sociaal			
	technisch			
	informatie			
	X			
	Y			



ARCHITECTURE FRAMEWORKS

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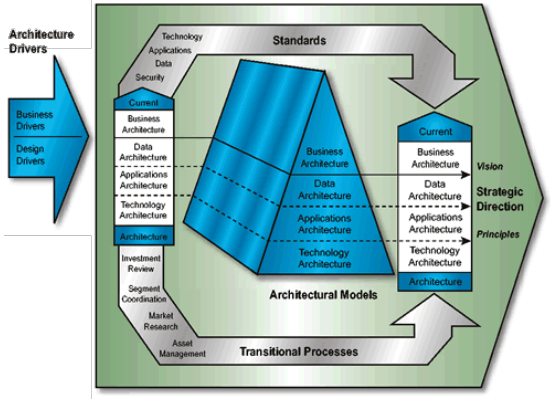
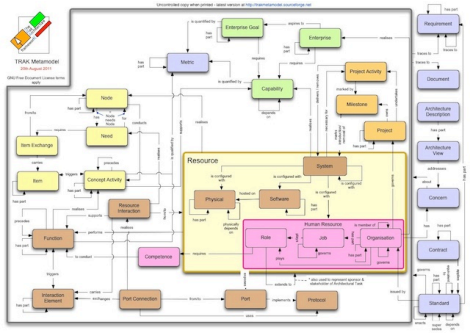
Architecture Frameworks

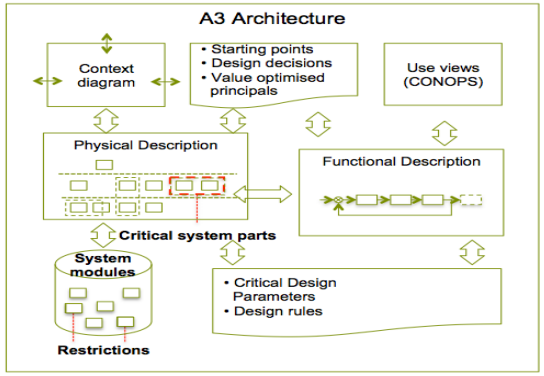
Federal Enterprise Architecture Framework (FEAF)



TRACK



A3 Architecture



Source: Maarten Bonnema, (Twente University)

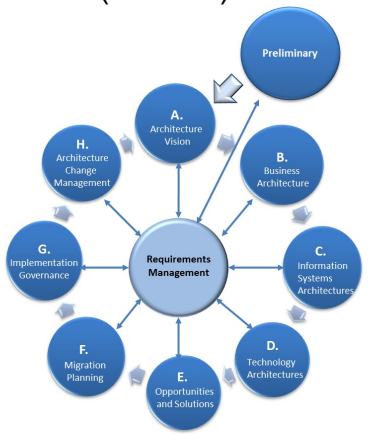
Zachman Enterprise Architecture Framework

abstractions / perspectives	DATA *What*	FUNCTION *How*	NETWORK *Where*	PEOPLE *Who*	TIME *When*	MOTIVATION *Why*
SCOPE *Planner* contextual	List of Things - *Important to the Business*	List of Processes - *the Business Performs*	List of Locations - *in which the Business Operates*	List of Organizations - *Important to the Busine*	List of Events - *Significant to the Business*	List of Business Goals and Stra
ENTERPRISE MODEL *Owner* conceptual	e.g., Semantic Model	e.g., Business Process Model	e.g., Logistics Network	e.g., Work Flow Model	e.g., Master Schedule	e.g., Business Plan
SYSTEM MODEL *Designer* logical	e.g., Logical Data Model	e.g., Application Architecture	e.g., Distributed System Architecture	e.g., Human Interface Architecture	e.g., Processing Structure	e.g., Business Rule Model
TECHNOLOGY CONSTRAINED MODEL *Builder* physical	e.g., Physical Data Model	e.g., System Design	e.g., Technical Architecture	e.g., Presentation Architecture	e.g., Control Structure	e.g., Rule Design
DETAILED REPRESEN-TATIONS *Subcontractor* out-of-context	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Specification
FUNCTIONING ENTERPRISE	DATA Implementation	FUNCTION Implementation	NETWORK Implementation	ORGANIZATION Implementation	SCHEDULE Implementation	STRATEGY Implementation

DODAF v1.0

View Type	Framework Product	Framework Product Name
All Views	AV-1	Overview and Summary Information
	AV-2	Integrated Dictionary
Operational	OV-1	High-Level Operational Concept Graphic
	OV-2	Operational Node Connectivity Description
	OV-3	Operational Information Exchange Matrix
	OV-4	Organizational Relationships Chart
	OV-5	Operational Activity Model
	OV-6a	Operational Rules Model
	OV-6b	Operational State Transition Description
	OV-6c	Operational Event-Trace Description
	OV-7	Logical Data Model
Systems	SV-1	Systems Interface Description
	SV-2	Systems Communications Description
	SV-3	Systems-Systems Matrix
	SV-4	Systems Functionality Description
	SV-5	Operational Activity to Systems Function Traceability Matrix
	SV-6	Systems Data Exchange Matrix
	SV-7	Systems Performance Parameters Matrix
	SV-8	Systems Evolution Description
	SV-9	Systems Technology Forecast
	SV-10a	Systems Rules Model
	SV-10b	Systems State Transition Description
	SV-10c	Systems Event-Trace Description
	SV-11	Physical Schema
Tech-nical	TV-1	Technical Standards Profile
	TV-2	Technical Standards Forecast

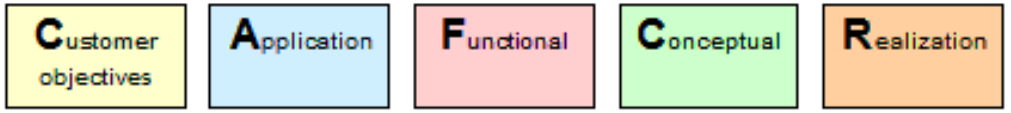
The Open Group Architecture Framework (TOGAF)



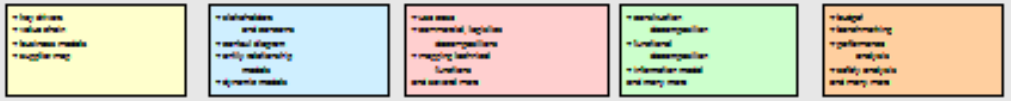
CAFCR Architecture Framework

method outline *method visualization*

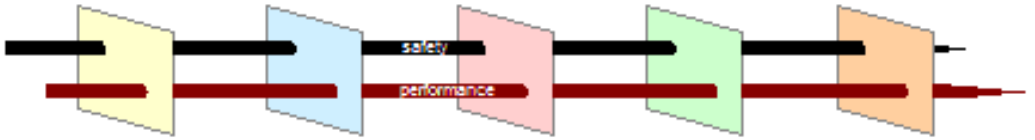
framework



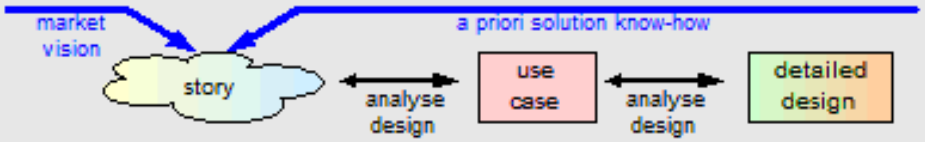
submethods



integration via qualities



explore specific details



reasoning

Customer Application Function Concept Realization (CAFCR): Gerrit Muller, (www.gaudisite.nl)

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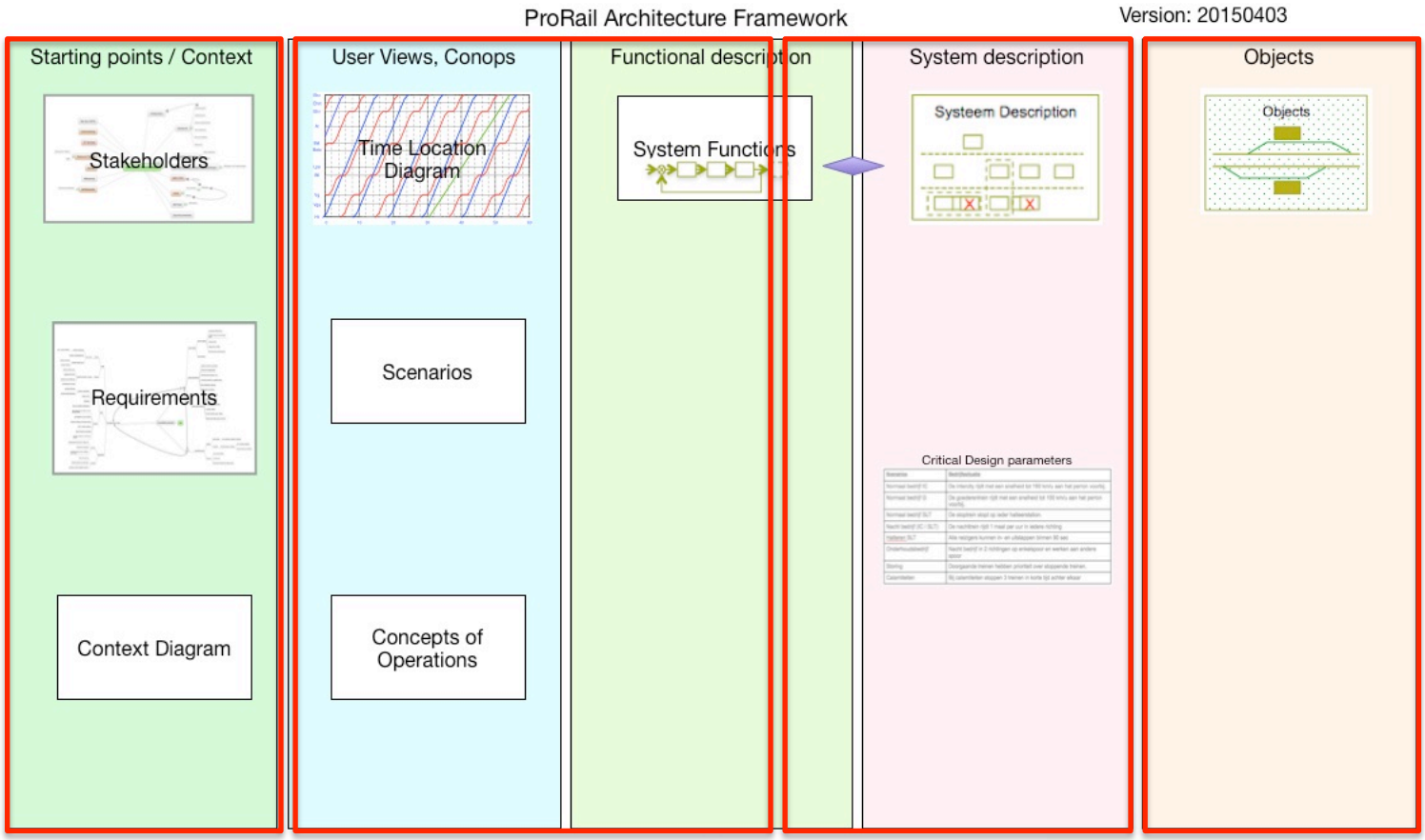
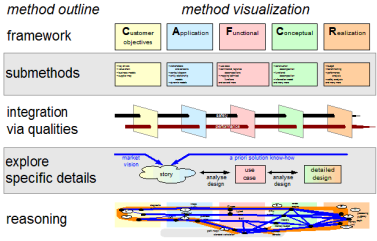
ProRail System Architectuur HRP

Consistency and standardisation of Systems

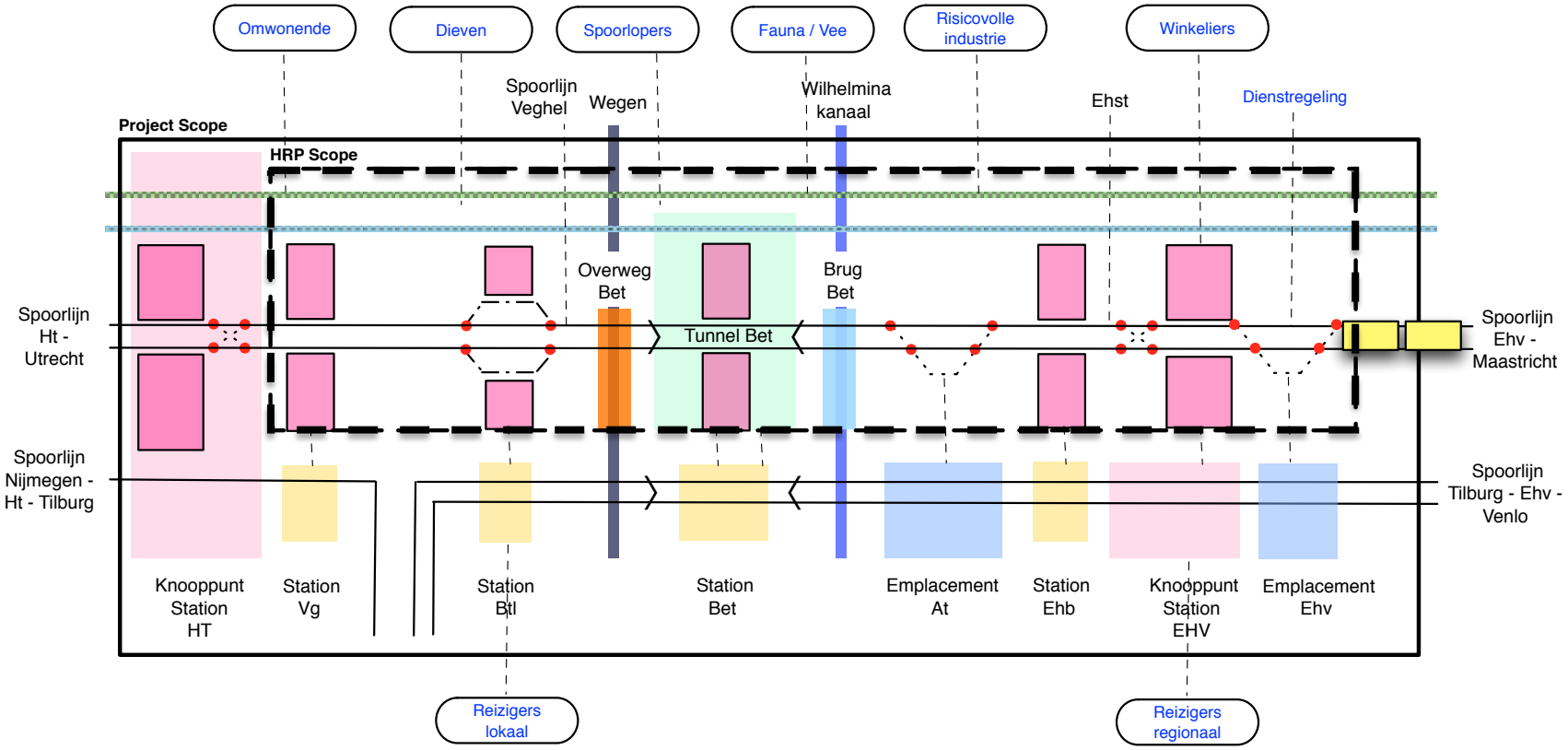
ProRail Architecture framework

The following ProRail architecture framework was developed and used as an outline for 4 workshop sessions.





HRP Scope and Context

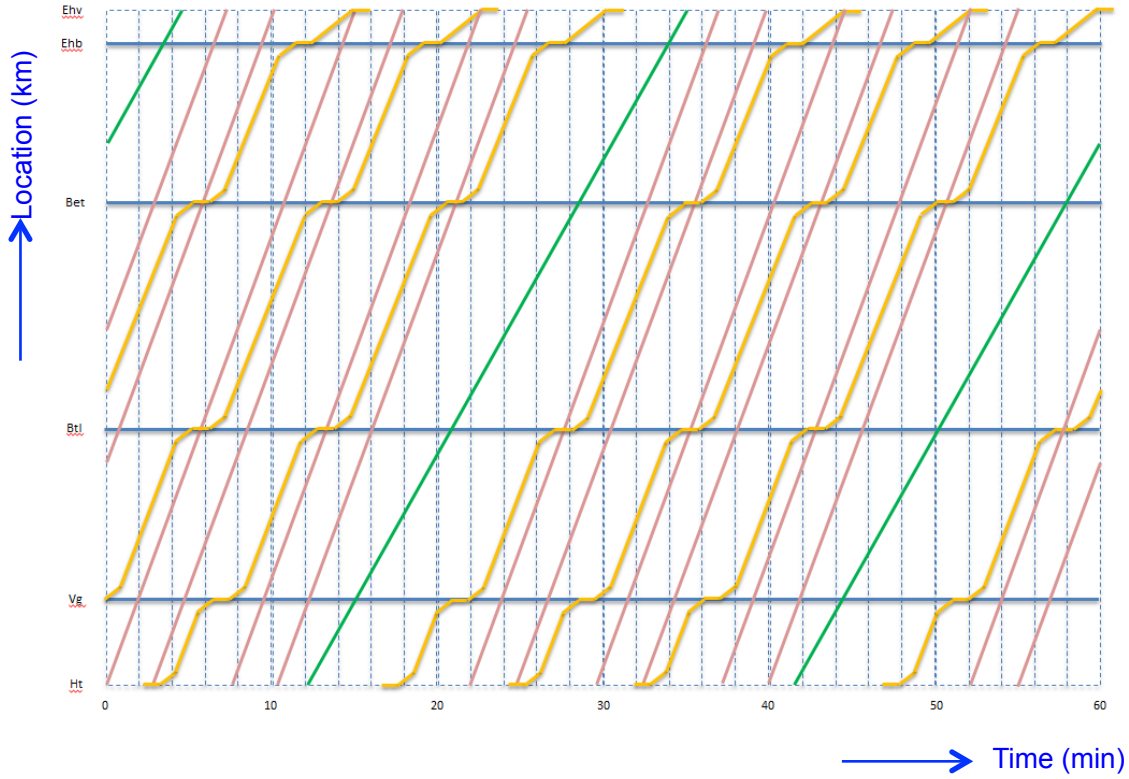


HRP Conops

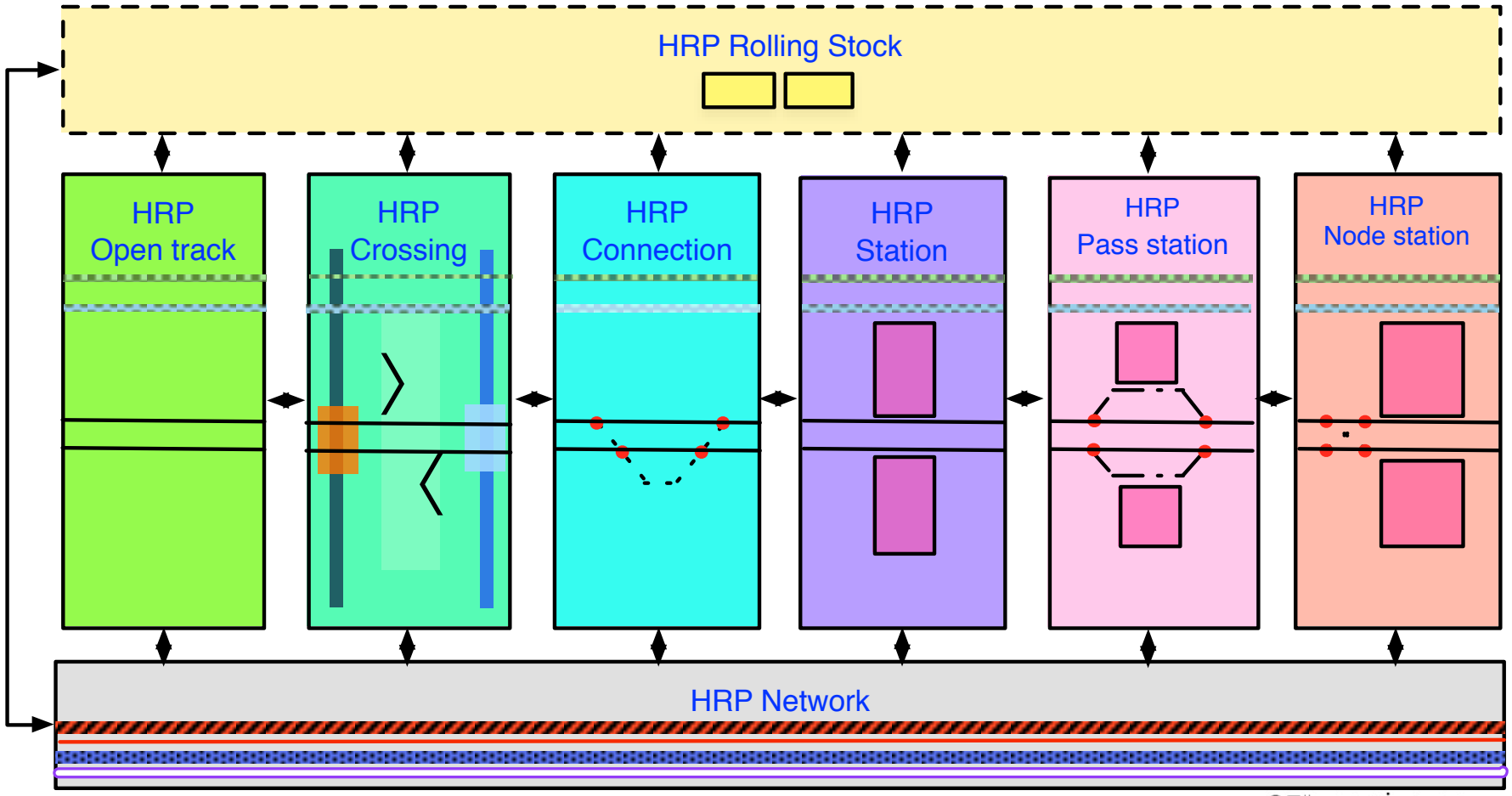
Density of rolling stock: 10 (IC) + 6 (Local) + 2 (Fr).

This implies consequences for the activities that the system supports, incl. it's performance.

Scenarios	Bedrijfssituatie
Normaal bedrijf IC	De intercity rijdt met een snelheid tot 160 km/u aan het perron voorbij.
Normaal bedrijf G	De goederentrein rijdt met een snelheid tot 100 km/u aan het perron voorbij.
Normaal bedrijf SLT	De stoptrein stopt op ieder halteerstation.
Nacht bedrijf (IC / SLT)	De nachttrein rijdt 1 maal per uur in iedere richting
Halteren SLT	Alle reizigers kunnen in- en uitstappen binnen 90 sec
Onderhoudsbedrijf	Nacht bedrijf in 2 richtingen op enkelspoor en werken aan andere spoor
Storing	Doorgaande treinen hebben prioriteit over stoppende treinen.
	Bij calamiteiten stoppen 3 treinen in korte tijd achter elkaar



HRP physical building blocks



System Architecture

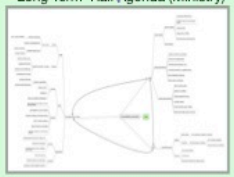
Reference Architecture Heavy Rail Premium

Version: 20150113

Starting points / Context

Stakeholder diagram

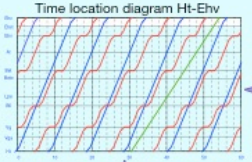
Long Term Rail Agenda (Ministry)



Context diagram

User Views, Conops

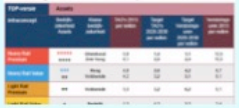
Time location diagram Ht-Ehv



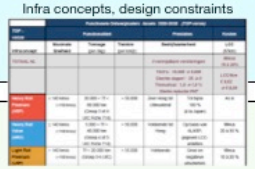
Scenarios

TAO on section Ht-Ehv

Infra concepts, conops

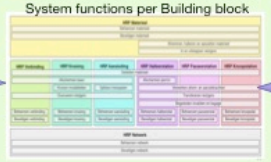


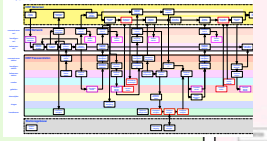
Infra concepts, design constraints



Functional description

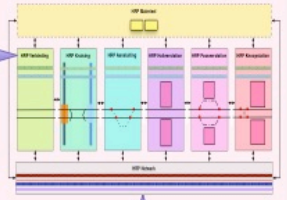
System functions per Building block



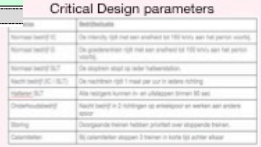


System description

Block diagram Rail infra + Roling stock

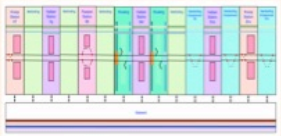


Critical Design parameters



Objects

Traject HT-Ehv



Functional Design Context

Technical Design Context

Relevante OVS'en:

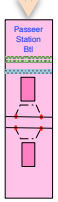
Layers in Architecture

National Network

Starting points / Context | User Views | Functional description | System Description / Design decisions | Objects

Heavy Rail Premium

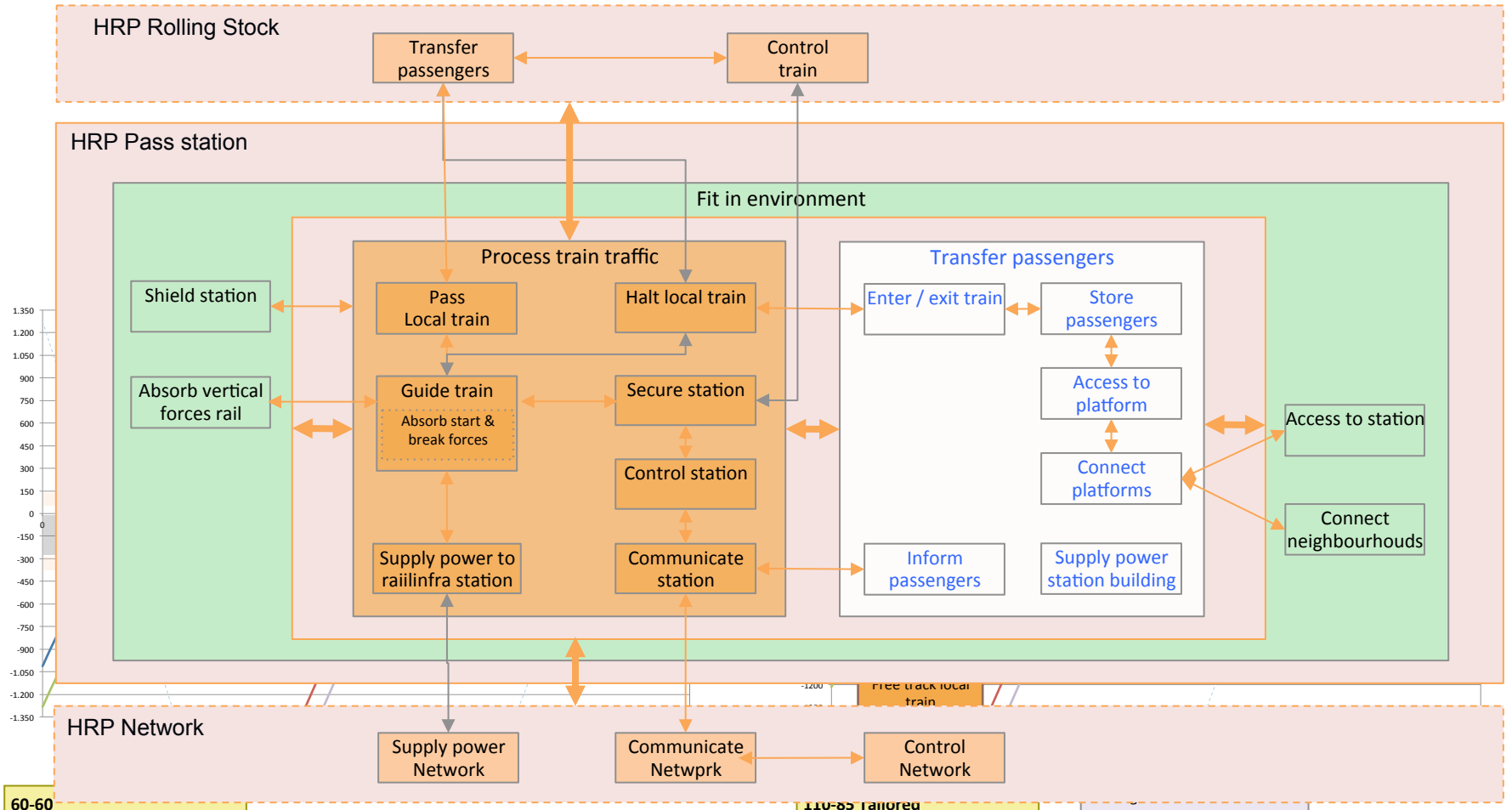
Starting points / Context | User Views | Functional description | System Description / Design decisions | Objects



Pass Station

Starting points / Context | User Views | Functional description | System Description / Design decisions | Objects

Pass station Architecture



60-60
- Halteertijd: 131 sec
- Passeerspoor: 345 m
- Rembeperking: 10 sec
- Aanzetbeperking: 10 sec

Klik hier voor meer info

110-85 Tailored
- Halteertijd: 112 sec
- Passeerspoor: 529 m
- Rembeperking: 0 sec
- Aanzetbeperking: 0 sec

Klik hier voor meer info

Thank you very much?

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