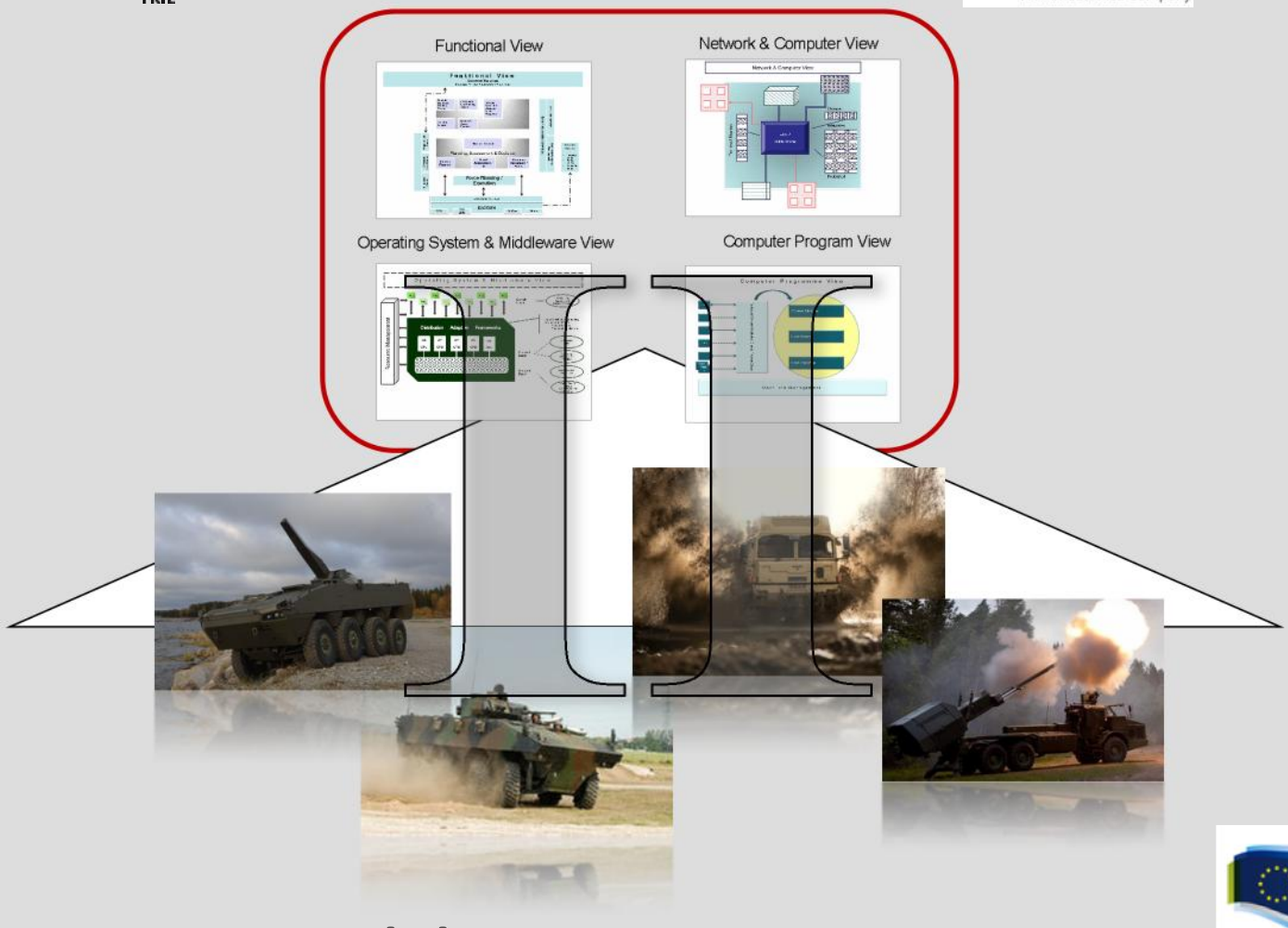


EDA LAVOSAR II Workshop #2

"Industry Workshop" (Brussels, 9th July 2015)

Dr. Norbert Härle

Rheinmetall Defence Electronics

phone: +49 421 457-1503 fax: +49 421 457- 2239 mobile: +49 151 14805589 e-mail: Norbert.Haerle@Rheinmetall.com

European Reference Open Architecture Standard for a modern Integrated Electronic Mission System in Military Land Vehicles" (LAVOSAR II)

- Agenda -

Time	Topic
10:30 – 10:45	Introduction by EDA
10:45 – 11:15	LAVOSAR II Study presentation
11:15 – 11:45	Architectural Domain Analysis and Requirements
11:45 – 12:45	Workflow and Procedure Update
12:45 – 13:30	**Lunch Break**
13:30 – 14:00	Open Reference Architecture Standards Update
14:00 – 15:00	Through Life Capability
15:00 – 15:15	**Coffee Break**
15:15 – 16:00	Architecture Contribution to EDA Repository
16:00 – 16:45	Alignment with NGVA
16:45 – 17:15	Concluding Remarks and Way Ahead

Workshop #2 "Industry Workshop"

Involvement of stakeholders

- **Workshop #1 with government officials at the 5 March 2015 (feedback from procurement and maintenance side)**
- **Workshop #2 with Industry (feedback about state of the art and potential future technology)**

APPROACH

- **Information to industrial stakeholders about the current status and results.**
- **Feedback and refinement to the intermediate project results**
  - Study Presentation
  - Architectural Domain Analysis and Requirements (WP1)
  - Open Reference Architecture Standards Update (WP2)
  - Workflow and Procedure Update (WP3)
  - Through Life Capability (WP4)
  - Alignment with NGVA (WP5)
  - Architecture Contribution to EDA Repository (WP6)

BRIEF SUMMARY OF LAVOSAR I RESULTS

General
- Motivation

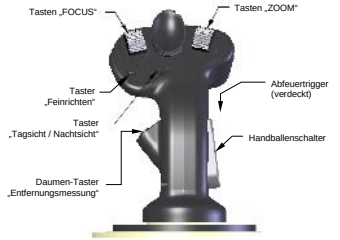
- **permanent and increasing need for networked information technology in military land vehicles**
  - enable better situational awareness and
  - faster, more efficient and precise effects
- **number of national projects underway that aim to standardise certain information technology features in order**
  - to manage complexity and
  - to provide a coordinated approach at European level
    - to future procurement and
    - to whole life equipment support.
- **previous land vehicle studies at EDA**

- **LAVOSAR I is focussing on the mission systems of typical vehicles to be used by participating member countries.**

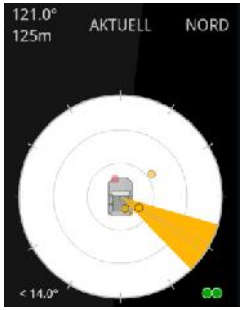
General
- Mission System Examples

System 1: E/O Panoramic Sensor System
System 2: E/O Sector Sighting System

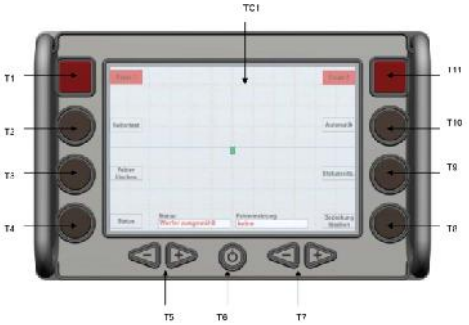
System 4: Remote Controlled Weapon Station



System 3: Acoustic Sniper Detection



System 5: Obscuring Systems



Terminology

Open Reference Architecture

- **Comprehensive best practice architecture with all necessary views from which a target architecture for a specific system can be derived *and which is maintained by an open, public consensus process of an open forum*.**

  There are no barriers to implementation by a third party:

  - **No Secrets:** MUST include all details necessary for implementation.
  - **Availability:** MUST be freely and publicly available (e.g., from a stable web site) under royalty-free terms.
  - **Patents:** All patents essential to implementation MUST:
    - be licensed under royalty-free terms for unrestricted use, or
    - be covered by a promise of non-assertion when practiced
  - **No Agreements:** There MUST NOT be any requirement for execution of a license agreement, NDA, grant, click-through, or any other form of paperwork, to deploy conforming implementations.
  - **No Incompatible Dependencies:** Implementation MUST NOT require any other technology that fails to meet the criteria above.

Terminology from EG20 System Architecture

Open architecture - An architecture is open when the external interfaces of its core architecture are publically defined (physically and functionally).

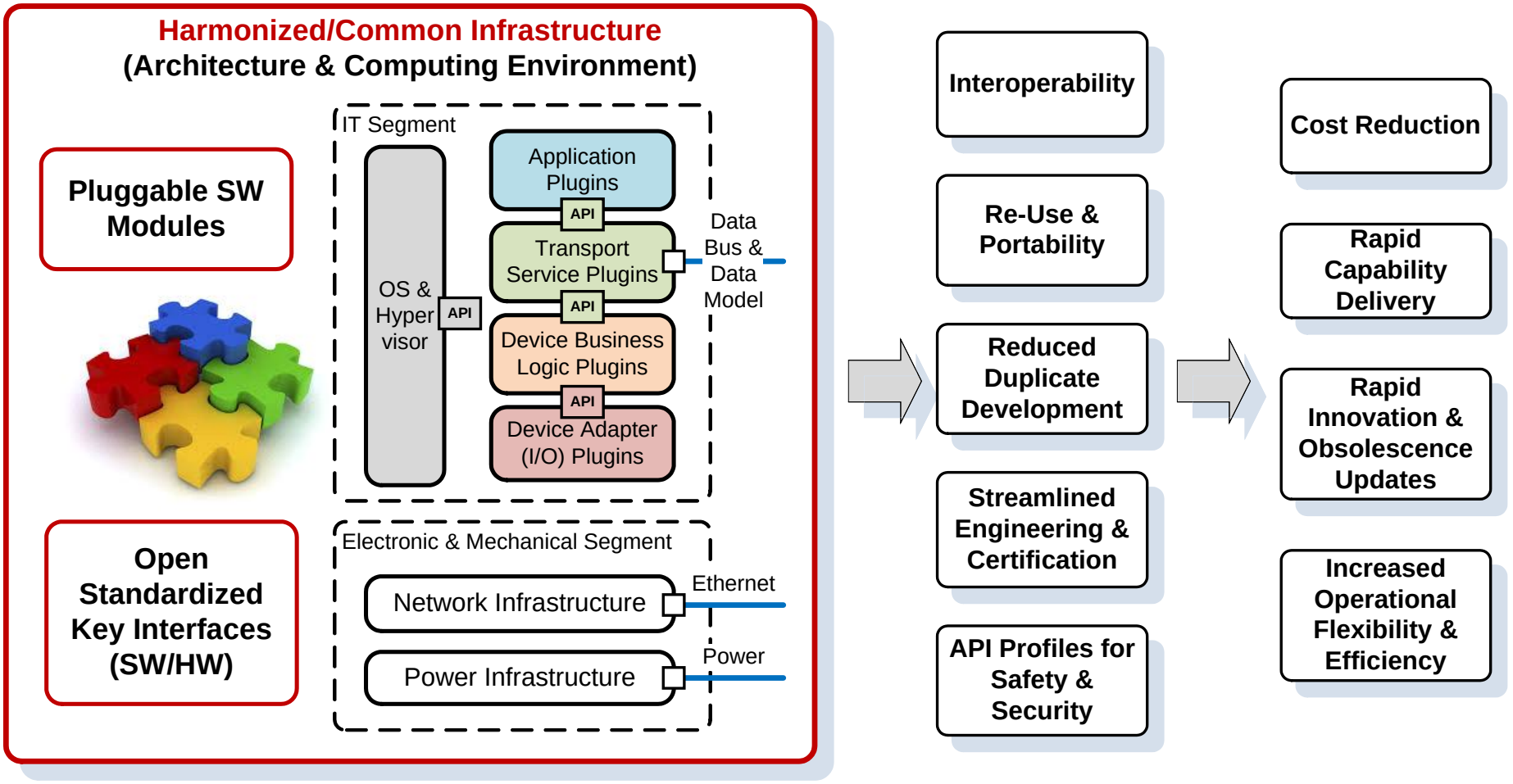
- **NOTE 1: a good open architecture allows adding, upgrading and swapping of additional architectural items without compromising the main integrity of the core part. But –of course- the performance can be significantly altered (positively or negatively).**
- **NOTE 2: Knowledge of the external interface is sufficient for a third party to develop and add architectural parts to the core architecture.**
- **NOTE 3: From LAVOSAR (working process – to be published):**
  - Comprehensive best practice architecture with all necessary views from which a target architecture for a specific system can be derived and which is maintained by an open, public consensus process of an open forum.

General
- Benefits of an Open Reference Architecture

By standardizing the architecture across Europe, a number of benefits will be provided:

- **integration of sub-systems into a single integrated Mission System**
- **reduced vendor lock in,**
- **greater competition,**
- **improved ability to re-role vehicles,**
- **improved insertion of new technology,**
- **reduced technical risk,**
- **reduced operator and maintenainer training,**
- **facilitated sharing of equipment during international common missions,**
- **decreased cost of system engineering and integration, verification and validation costs, and**
- **enabled greater system innovation.**

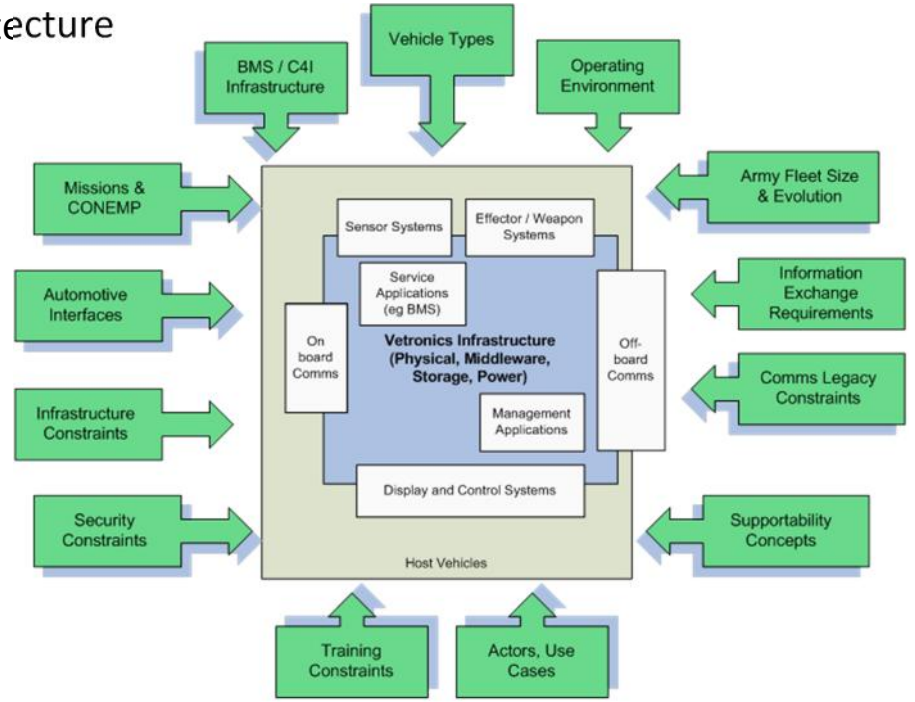
General
- Benefits of an Open Reference Architecture



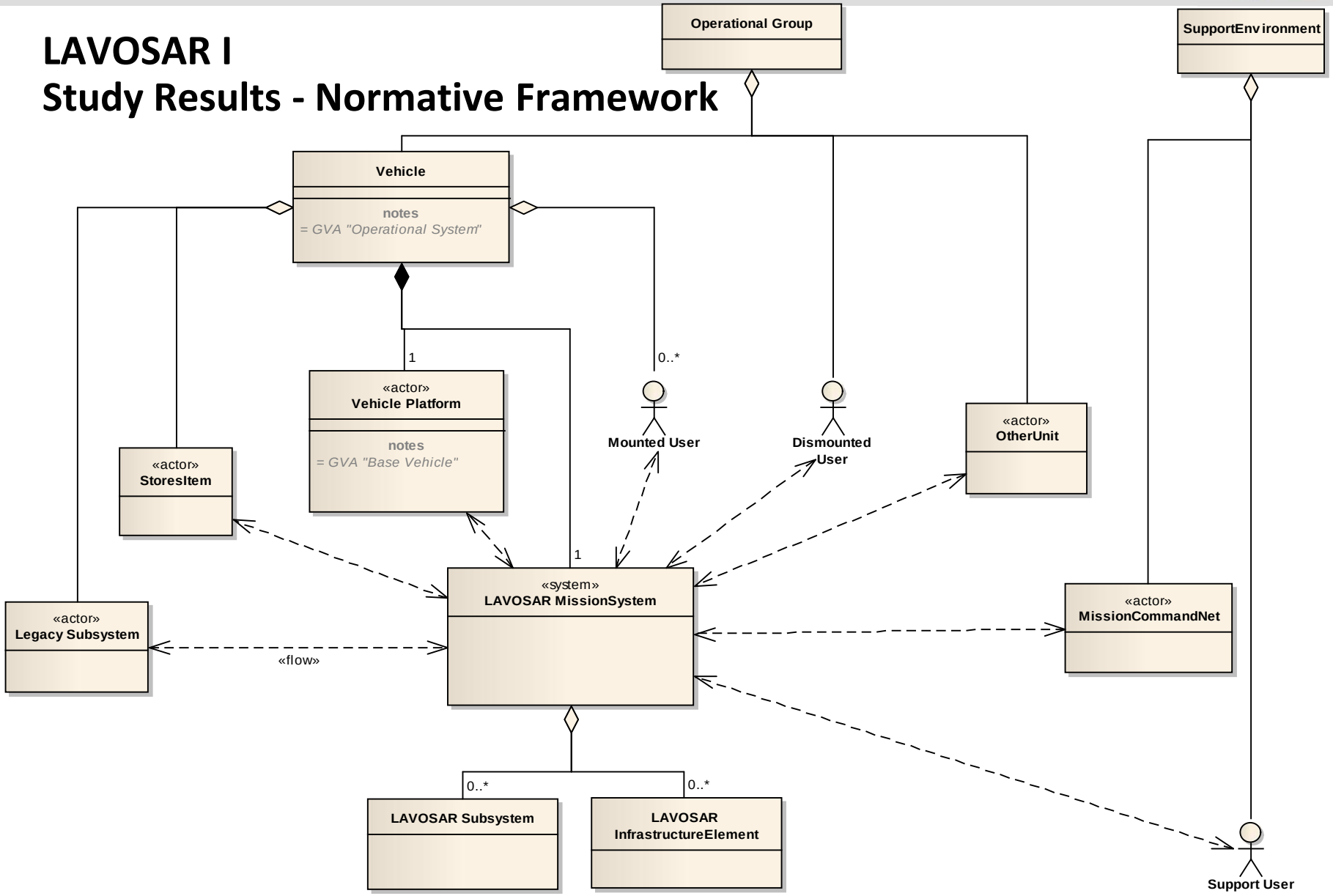
some parts are derived from Fig. 17 Ed2.1 FACE Technical Standards, Copyright 2014 Open Group

LOVOSAR I
- Study Results

- **Study Results**
  - Analysis of Background Material
  - Information Collection from Stakeholders
  - Normative Framework
  - Business Case for an Open Reference Architecture
  - Operational Aspects
  - Integrated Mission System
  - Standards
  - Technologies
  - Specifications and Design Guidelines
  - System Acceptance Framework



LAVOSAR I
Study Results - Normative Framework



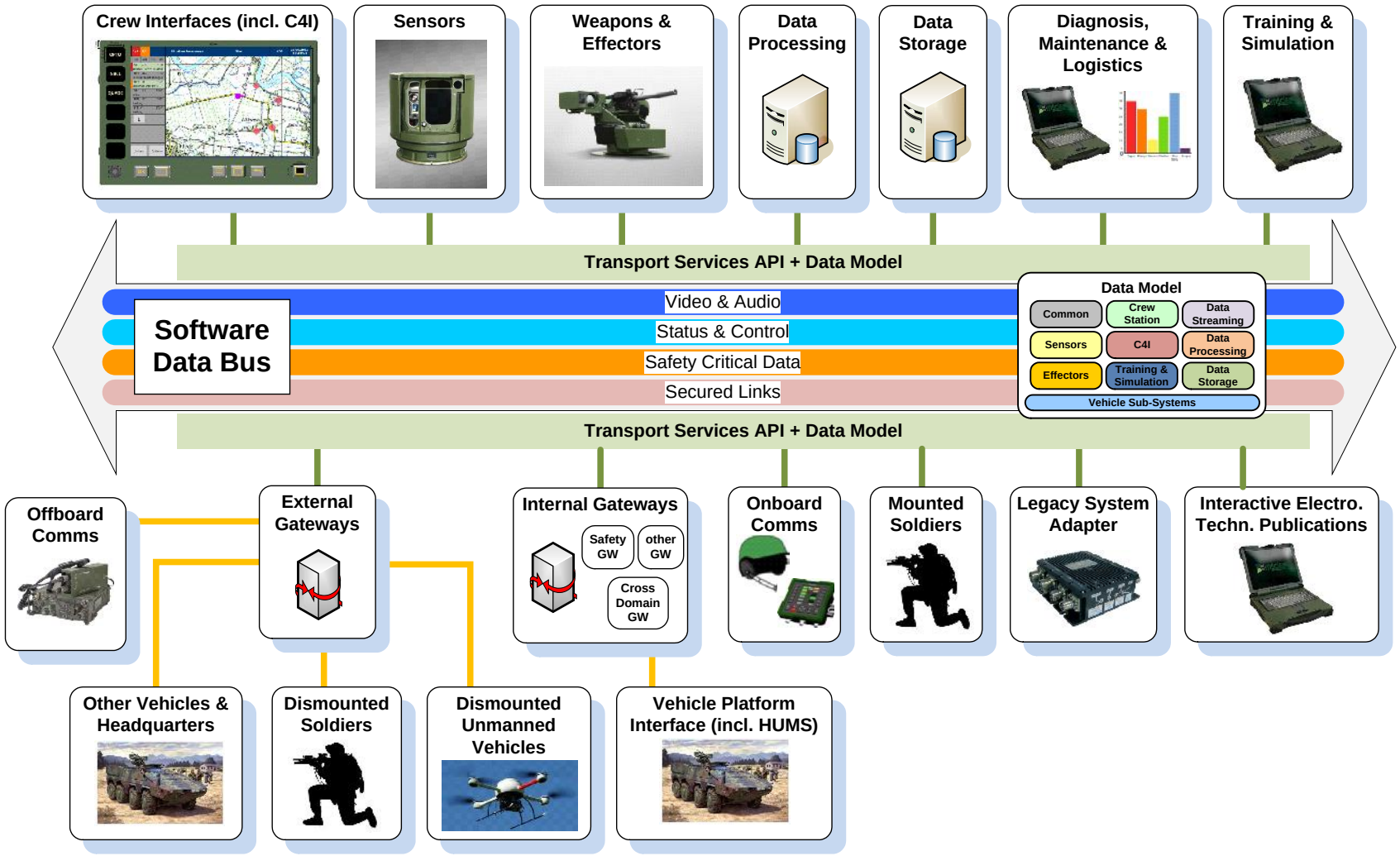
LAVOSAR I
Study Results - Whole Life Consideration

Crude assessment based upon 5000 systems across 10 member states.

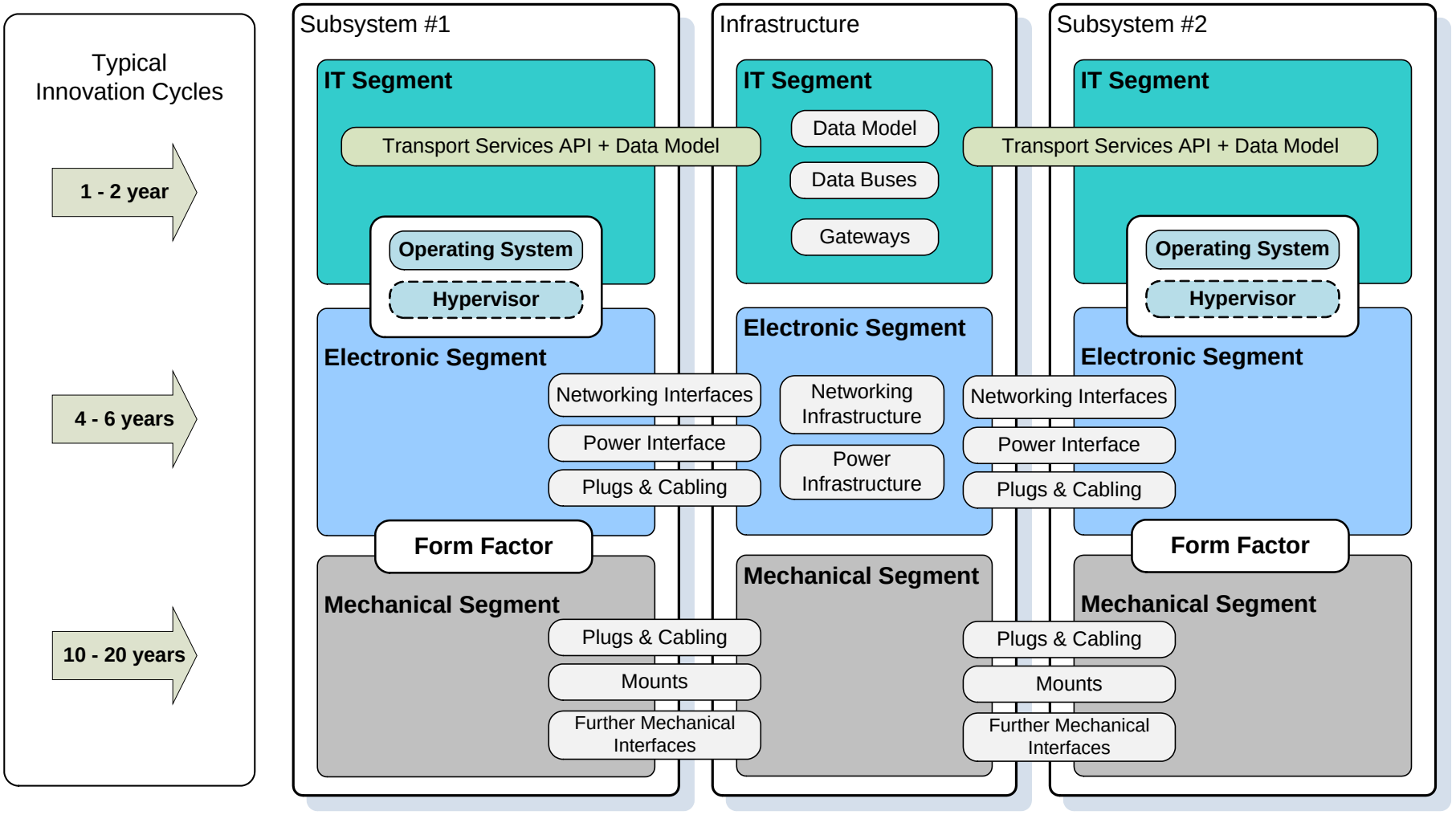
- **Baseline - each pMS continues with its own national approach procuring blocks of 500 vehicles with 10 role-specific fits**
- **European (LAVOSAR) approach - each pMS purchases the same number of vehicles (but at the reduced acquisition cost) and then support and training costs are reduced as indicated in Table 4-18.**

Total overall vehicle system sets all countries (fleet)	5000	
Countries taking part	10	
Vehicles required per country	500	
Support Period years	10	
Baseline acquisition cost per mission system (eg) (arbitrary cost units)	200,000	
Baseline Batch Size per country	500	
Baseline Batch acquisition cost	100,000,000	
Baseline Batch Support Cost (7% per annum) over support period	70,000,000	
Baseline Batch Training Cost (5% per annum) over support period	50,000,000	
Baseline Whole Life Country Cost (acq, supt, trg)	**220,000,000**	
LAVOSAR acquisition cost per mission system (10% reduced from baseline)	180,000	
LAVOSAR fleet acquisition cost	900,000,000	
Country acquisition cost LAVOSAR systems	90,000,000	
Country support cost (5% per annum) LAVOSAR systems	45,000,000	
Country training cost (3.5% per annum) LAVOSAR systems	31,500,000	
Whole life Country Cost	**166,500,000**	
Saving	**53,500,000**	**24%**

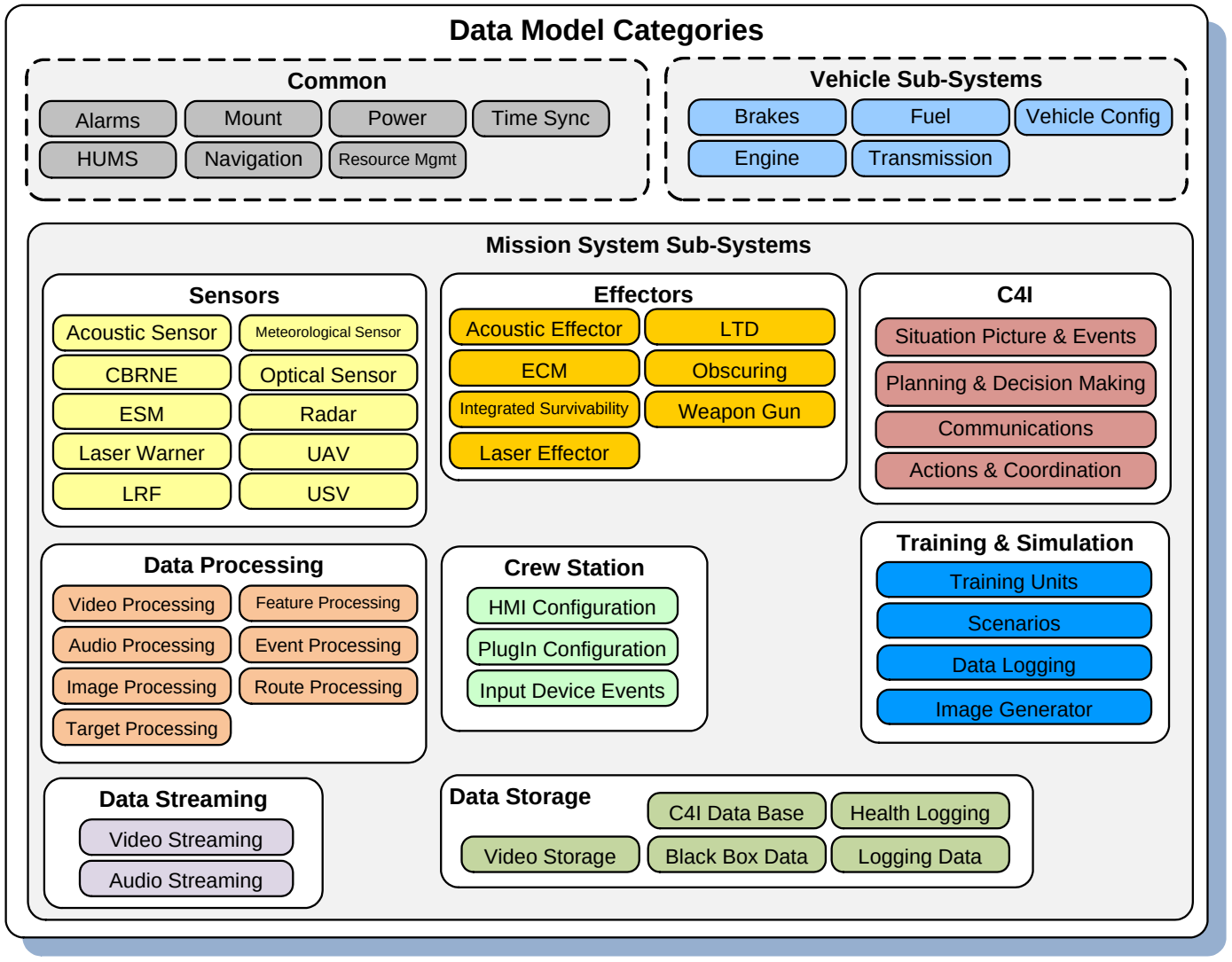
LAVOSAR I
Study Results - Integrated Mission System



LAVOSAR I
Study Results - Integrated Mission System

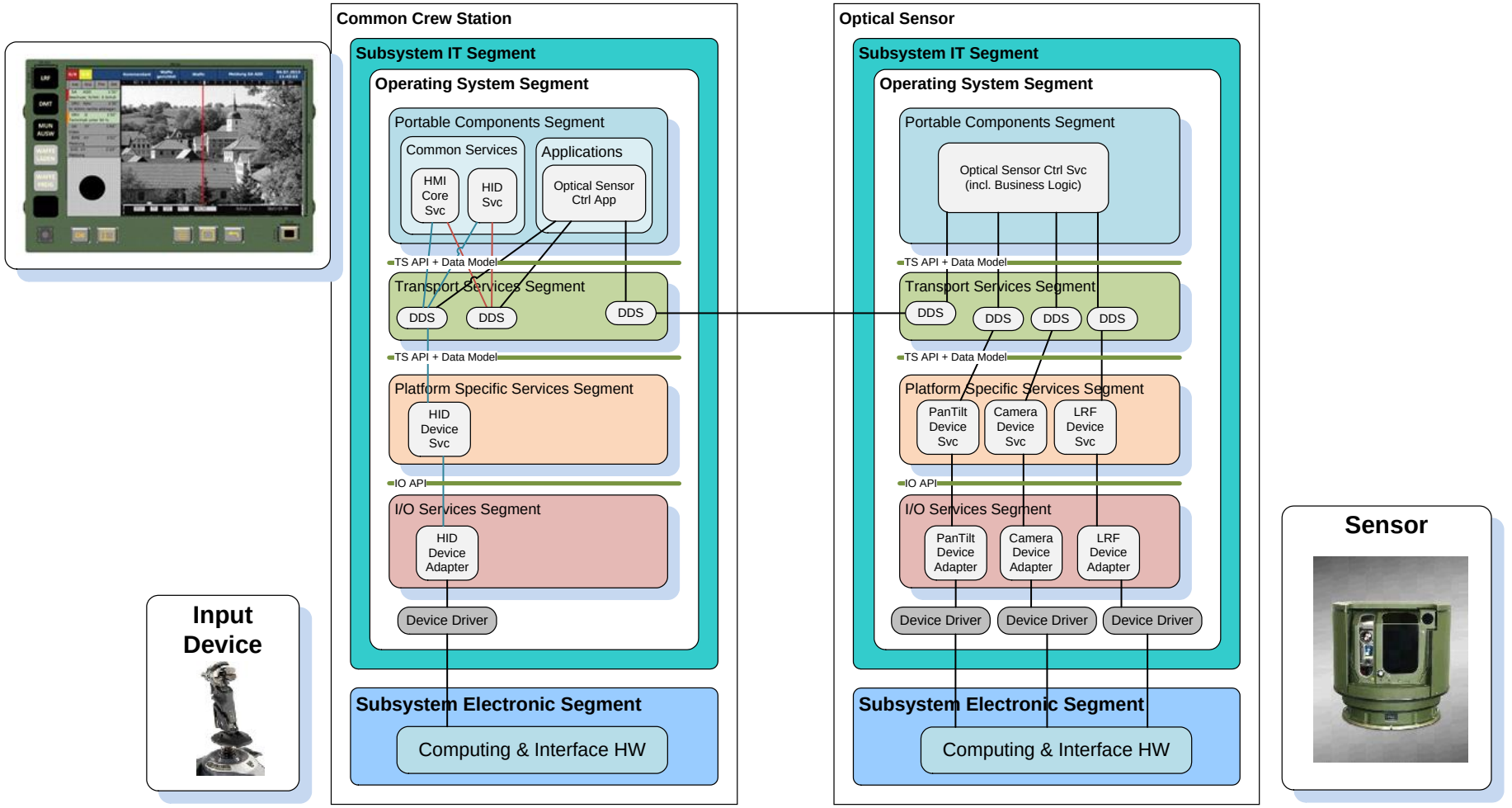


LAVOSAR I
Study Results - Integrated Mission System



LAVOSAR I
Study Results - Integrated Mission System

derived from Fig. 17 Ed2.1 FACE Technical Standards, Copyright 2014 Open Group

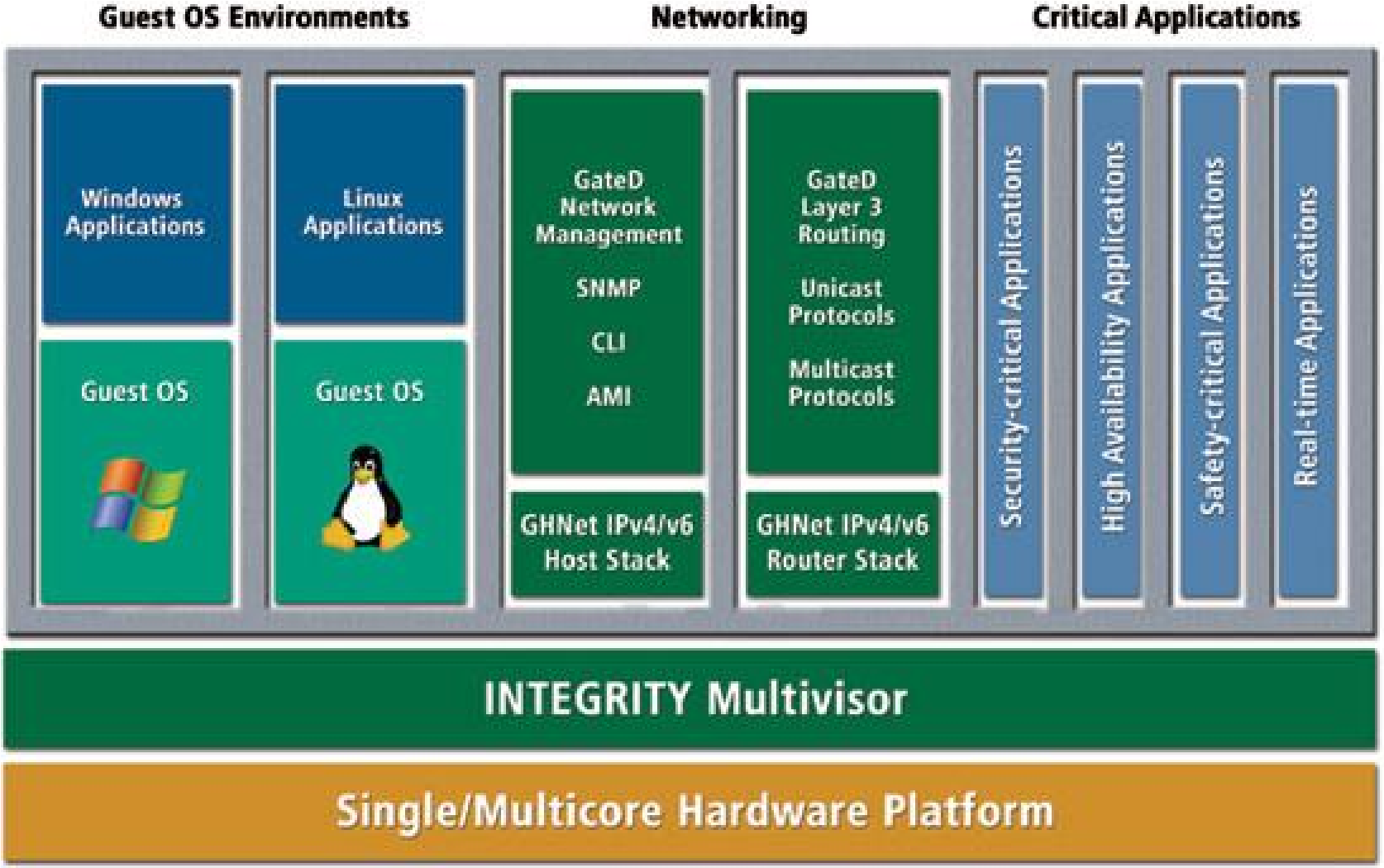


LAVOSAR I
Study Results - Standards

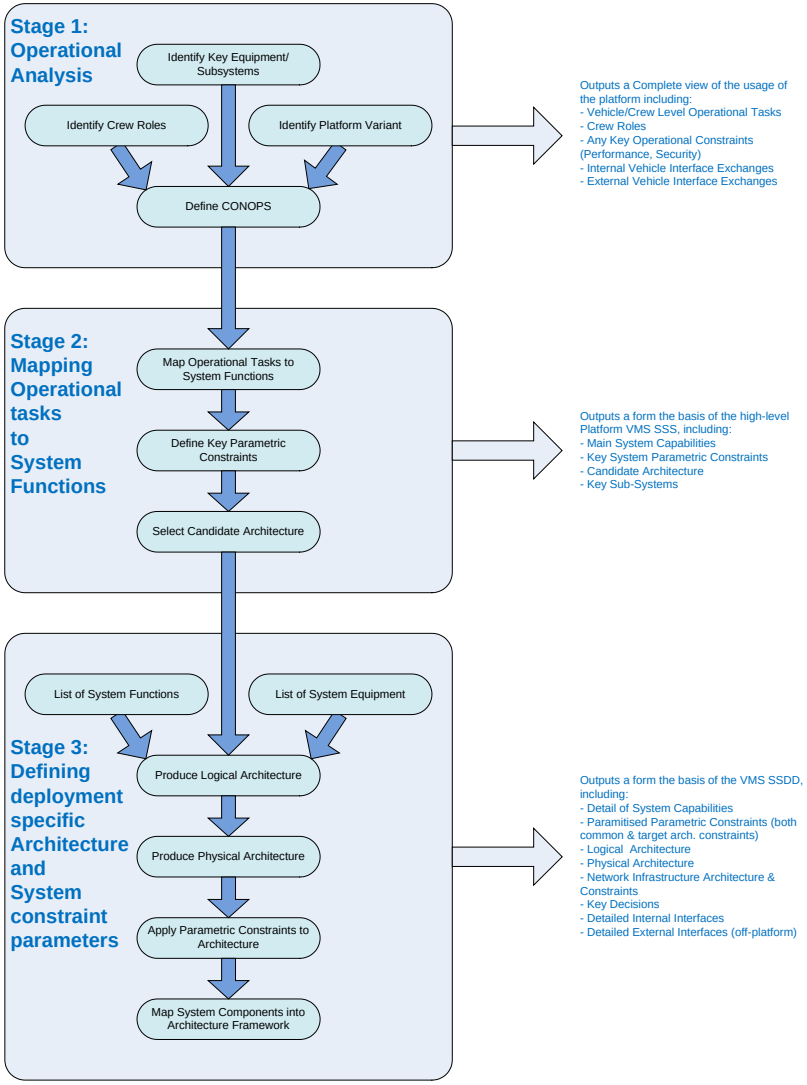
Software Infrastructure					
Subcategories	**Std Type**	**Std #**	**Part**	**Ed**	**Title**
Data Model					
	UK DEF STAN	23-09		V 2.0	GVA Data Model (in development, current baseline: v2)
Middleware					
	OMG DDS			1.2	DDS API
	OMG DDS			2.1	DDS Interoperability Wire Protocol (Real-time Publish-Subscribe Wire Protocol)
	OMG DDS Xtypes				DDS Extensible and Dynamic Topics Types for DDS (DDS-XTypes)
	OMG UML DDS Profile			1	UML Profile for Data Distribution
	OMG DDSi			2009-01-05	DDS Interoperability Wire Protocol (DDSI)
	ISO	19500		v3.1.1	Common Object Request Broker Architecture (CORBA)
	ISO	19506		v1.3	Knowledge Discovery Metamodel (KDM)
	ISO	19502		v1.4.1	Meta Object Facility Core (MOF)
	ISO	19507		v2.3.1	Object Constraint Language (OCL)
	ISO	19505		v2.4.1	Unified Modelling Language (UML)
	ISO	19503		v2.0.1	MOF 2 XML Mapping (XMI)
Operating Systems					
	IEEE	1003.1		2002	POSIX 1-2008 The Open Group Technical Standard Base Specifications, Issue 7

Video Related Standards					
Subcategories	**Std Type**	**Std #**	**Part**	**Ed**	**Title**
	UK DEF STAN	00-82		2+	Vetronics Infrastructure for Video Over Ethernet (see note 8.1)
	NATO STANAG	4697			Platform Level Extended Video Standard (under ratification)
	NATO AEP	79			Platform Level Extended Video Standard
• Formulae	VESA	GTF			Video Electronics Standards Association Generalized Timing Formula
• Timings	VESA	CVT			Video Electronics Standards Association Coordinated Video Timings (VESA-2003-9)
• Encoding	ITU-R	BT.601			Encoding Parameters of Digital Television for Studios
	ISO/IEC	14496	2		Information technology -- Coding of audio-visual objects (MPEG-4)
	ISO/IEC	15444			Information technology — JPEG 2000 image coding system
	ISO/IEC	10918			Information technology – Digital compression and coding of continuous-tone still images (JPEG)
	H.264				Video compression standard (same as MPEG-4 Part 10)
• 4:2:2 Video	ITU-R	BT.656			Interfaces for Digital Component Video Signals in 525 line and 625 line Television Systems operating at the 4:2:2 level of Recommendation ITU-R BT.601 (Part A)
• HDTV	ITU-R	BT.709			Parameter values for the HDTV standards for production and international programme exchange
	ITU-R	BT.1120			Digital interfaces for HDTV studio signals
• Analogue TV	ITU-R	BT.1700			Characteristics of composite video signals for conventional analogue television systems
• Picture Data	SMPTE	274			Television - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates
	SMPTE	296			Television - 1280 x 720 Progressive Image Sample
• RTSP	RFC	2326			Real Time Streaming Protocol
• RTCP	RFC	3550			Transport Protocol for real-time applications
	ISO	22311	annex A		Societal security -- Video-surveillance -- Export interoperability
• CCIR	NATO STANAG	3350	B and C		Analogue Video Standard for Aircraft System Applications
• SDI	SMPTE	259			Serial Digital Interface (SDI)
• HD SDI	SMPTE	292			Bit-Serial Digital Interface for High Definition Television

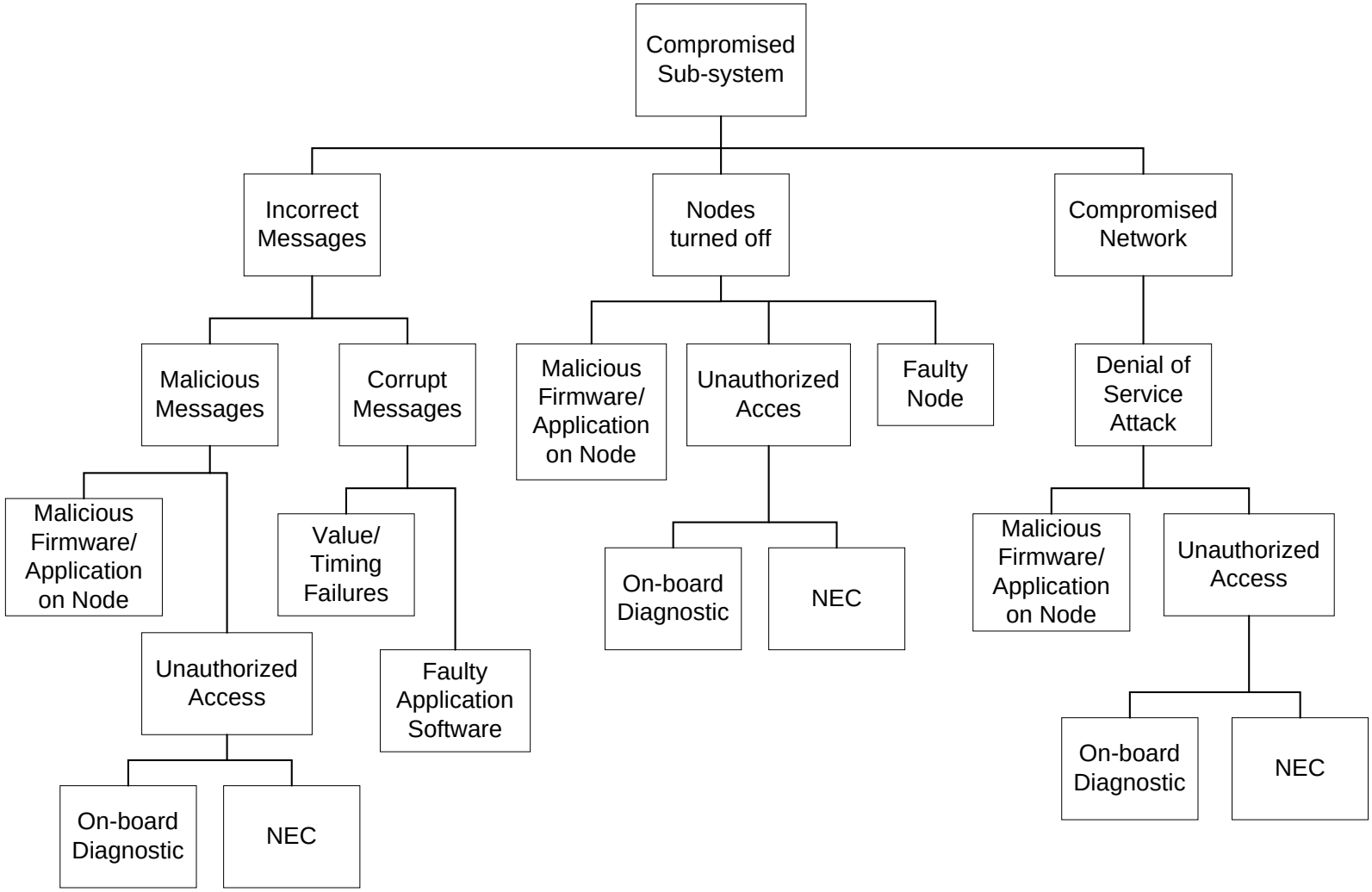
LAVOSAR I - Study Results - 8. Technologies - Hypervisors



LAVOSAR I
Study Results - Specification and Design Guidelines



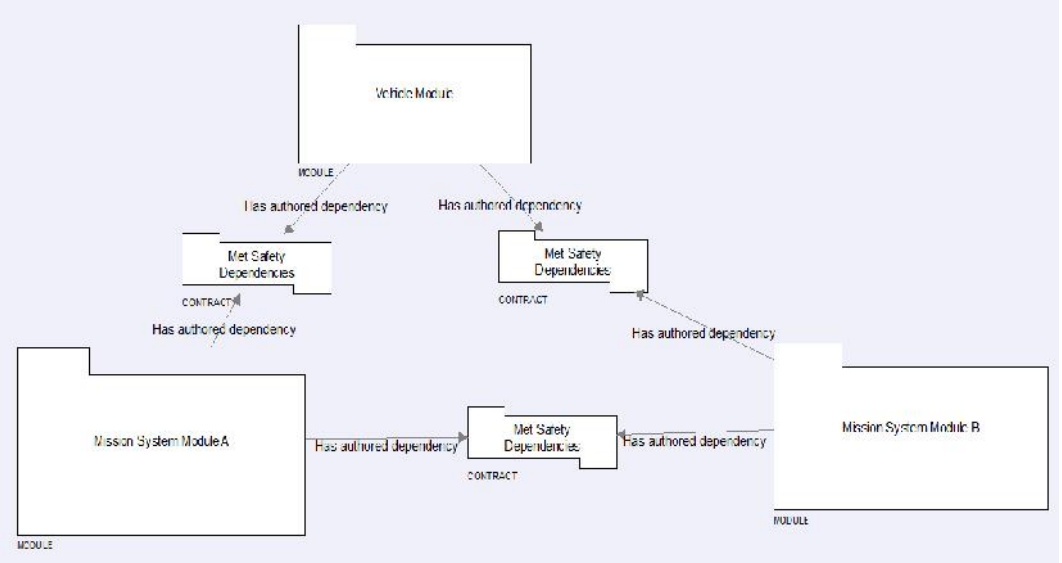
LAVOSAR I
Study Results - Specification and Design Guidelines - Security



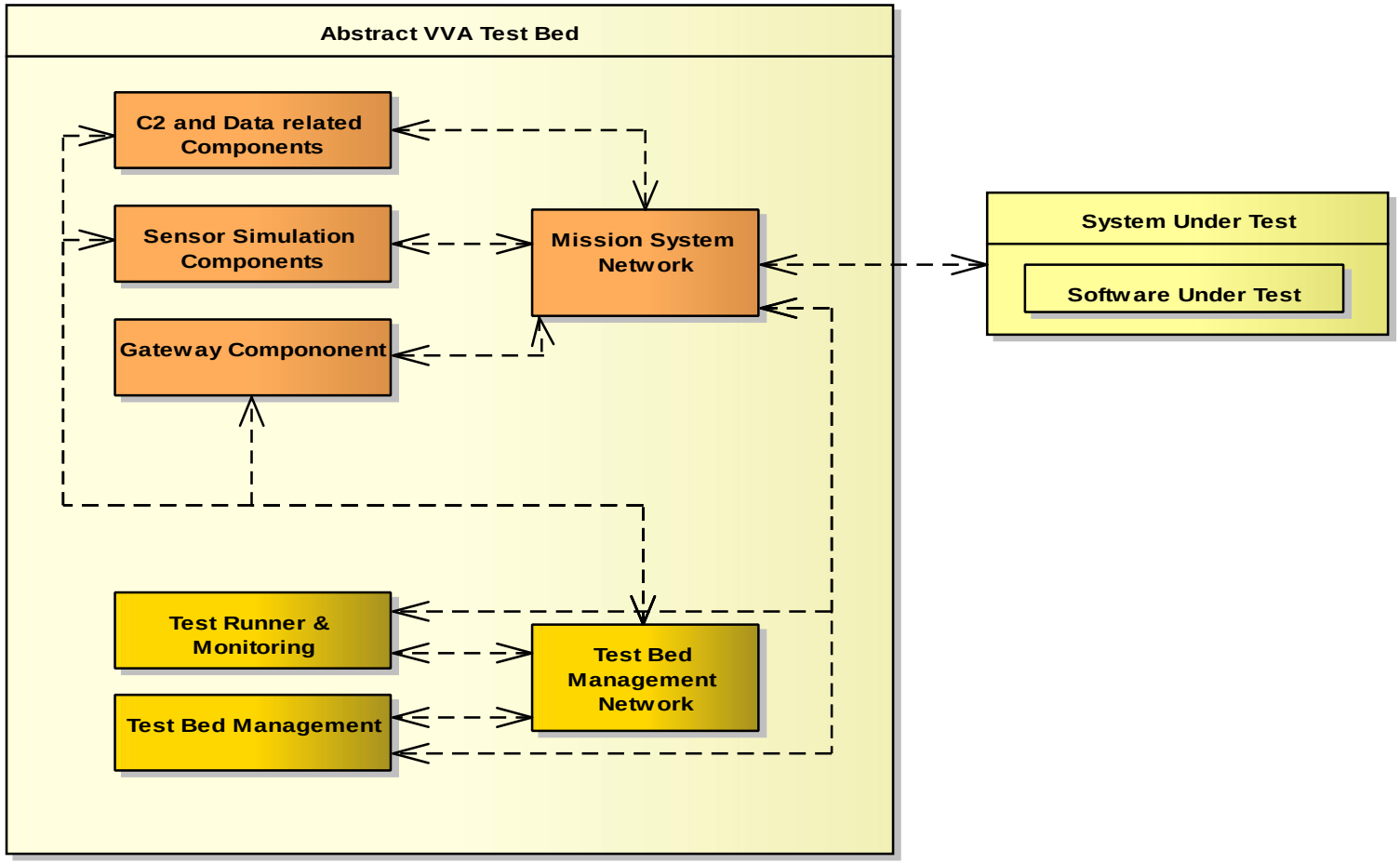
LAVOSAR I
Study Results - Specification and Design Guidelines

Modular Safety Cases

- **breaking down safety cases in smaller chunks**
- **advantages**
  - reduction of complexity
  - reuse
  - maintainability
  - cost efficient qualification when changing or adding parts



LAVOSAR I
Study Results - System Acceptance Framework



LAVOSAR I
Summary and Recommendations

- Comprehensive Open Reference Architecture for Military Land Vehicle Mission Systems as a European Standard is key for the European Member States
- From the Reference Architecture, Target Architectures for the vehicles to be procured would be derived using compatible MOTS Mission Sub-Systems or Components
- A vehicle which is built according to this standard can sustain the respective state of technology by simply adding, replacing or upgrading sub-systems
- In the same way, a specific or a changing mission need can be satisfied by adapting the set of sub-systems
- Logistics are simplified and exchange of spare subsystems across various types of vehicles and even European nations is possible.
- Software concepts from FACE™ are very promising
- Data Models are key to interoperability.
- The business case is important for deciding on the economical importance and should cover at least the next 10 years.
- Raising the new Mission System approaches from national to EU level would increase numbers and competition.
- Security was identified as a difficult unsolved issue
- The major results of LAVOSAR could be standardized as a comprehensive and abstract, higher level concept in order to enable improved standard development on the lower level (c.f. DefStan 23-09 or NGVA).
- Most of the current developments are national, except NGVA

INTRODUCTION OF LAVOSAR II

LAVOSAR II Project Facts

Contracting

- **Contracting Agency**
  - European Defence Agency (EDA)
- **Contract Number**
  - 14-cat-op-053
- **Project Duration**
  - 1 Jan. 2015 - 31 Dec. 2015
- **Budget**
  - Total: 345K€
- **EDA Project Officer**
  - Marek Kalbarczyk
- **Contactor Contact**
  - Dr. Norbert Härle

Partners and Experts Involved:

- **Fraunhofer Institute for Communications, Information Processing and Ergonomy (Germany)**
  - Daniel Ota, Thomas Kudla
- **BAE Systems Bofors (Sweden)**
  - Dan Carlson, Kristoffer Biel
- **Nexter Systems (France)**
  - Carine Nesi, Tariq Khoutaif
- **Patria Land Systems (Finland)**
  - Teemu Alakoski, Pasi Niemela
- **Rheinmetall Defence Electronics (Germany)**
  - Dr. Norbert Härle, Dr. Oliver Prenzel
- **Rheinmetall Land Systems (Germany)**
  - Gerd Wollmann
  - Sönke Felsing
- **Selex ES (United Kingdom)**
  - Guy Davies, Edouard Mouchel
- **Vectronics Research Centre (United Kingdom)**
  - Prof. Elias Stipidis, Dr. George Valsamakis, Dr. Aditya Deshpande

LAVOSAR II
- Background (see Request for Tender)

General

- **Motivation is to enable European member states to**
  - increase mission efficiency and, at the same time,
  - save cost when procuring or upgrading military land vehicles
- **Progress in IT is substantial for**
  - better situational awareness and
  - faster, more efficient and precise military effects.
- **Complexity of IT to be managed through the architecture standardisation**

EDA LAVOSAR II

- **address the gaps identified in LAVOSAR I**
- **establish suite of architectural standardisation materials complementary to NGVA.**

EDA LAVOSAR I

- **stated**
  - comprehensive standardised Open Reference Architecture for missions systems of military land vehicles will be key to:
    - cost-efficient acquisition and through-life management and
    - more efficient and flexible use of equipment, including provision for future innovative improvements to mission capabilities.
  - Open Reference Architecture to derive the Target Achitecture for specific vehicle
  - LAVOSAR and NGVA need to be aligned (NGVA is endorsed)
- **provided**
  - relatively high-level operational views and identified concepts and technologies
  - without specifying a full and precise set of standards.
- **recommended further work on**
  - Interfaces with different innovation speeds,
  - tactical ad-hoc local area network communications
  - logistics and maintenance aspects

Background
- LAVOSAR II Objectives (see Request for Tender)

- **LAVOSAR II shall follow up on LAVOSAR I results**
- **Definition and Positioning of architectural domain**
  - European approach covers a current gap
  - complements or contributes to other current activities in the area
- **Background Material Analysis**
  - LAVOSAR I, NATO Generic Vehicle Architecture (NGVA), UK DefStan 23-09, Victory, Scorpion, FACE and other national programmes
- **Additional architectural layers to LAVOSAR I architecture to be identified and defined**
- **Benefits to be gained and the cost of implementing**
- **Roadmap for LAVOSAR II contribution to future development of NGVA**
- **Formalized architecture to contribute to the EDA Architectural Repository**

- **Investigate Updates to LAVOSAR I Architecture (specific European requirements), especially:**
  - Open Interface requirements that exist between disciplines of different innovation speeds
  - Extensions of the NGVA Data model for data exchange to cover European standards,
  - Gateways for external communications,
  - Generic Data exchange between vehicles, typically of different type,
  - Suggestion of further international open standards needed.
- **Update of the LAVOSAR I defined**
  - operational workflows and
  - logistic procedures
- **Roadmap**
  - to harmonise data exchange procedures
  - on Modification, Maintenance, Repair and Overhaul
  - with military and civilian facilities
  - along different vehicle types in the European Countries

RHEINMETALL DEFENCE

WP0: Project Management

- Administrative Management
- Technical Management (WPs Coherence)
- Quality Assurance and Configuration Management
- Coordination and Consultation with Relevant Stakeholders

Stakeholder Engagement

- Workshop 1 Government Officials EU Standardization
- Workshop 2 Manufacturers, Integrators, Suppliers
- Briefing 1
- Briefing 2
- Briefing 3
- Briefing 4

VRC Vetronics Research Centre

BAE SYSTEMS

WP1: Architectural Domain Analysis and Requirements

- Analysis of Relevant Programs and Activities
- Characterization of Required Architectural Domain
- Definition of Any Needed Additional Architectural Layers
- Evaluation of Benefits to be Gained
- Estimation of Cost of Implementing

Selex ES A Finmeccanica Company

WP2 Open Reference Architecture Standards Update

- Investigation and Update On Specific European Requirements
- Proposal for ORA Standards Update

nexter

WP3 Worksflow and Procedure Update

- Update of Operational Workflows
- Update of Logistics Procedures

Patria

WP4 Through Life Capability

- Harmonized Data Exchange Procedures
- Development of Roadmap

WP5 Alignment with NGVA

- Concepts for LAVOSAR Contrib. to Future Developm. of NGVA
- Identification of Potential Contributions
- Development of Roadmap

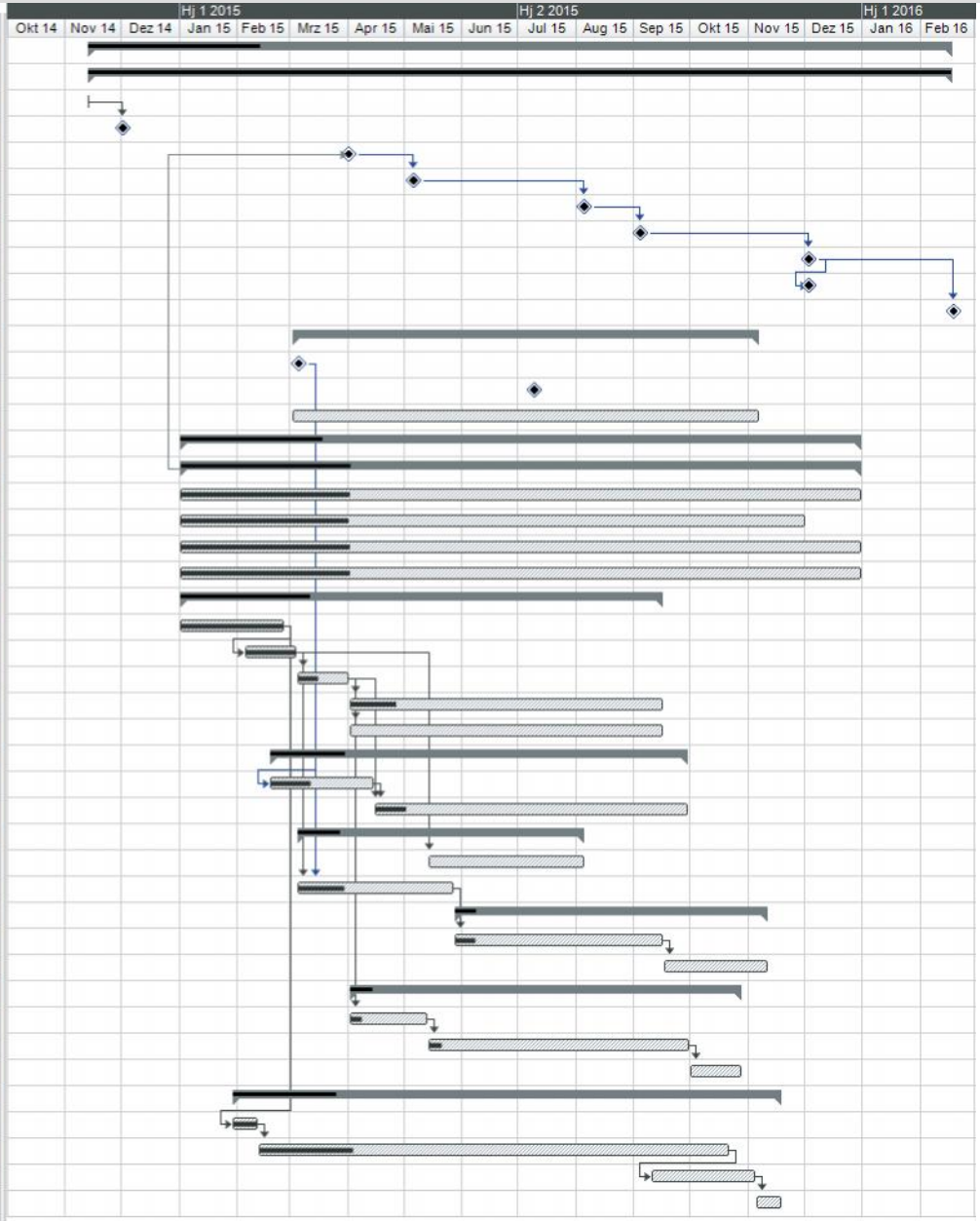
Fraunhofer FKIE

WP6 Architecture Contributions to EDA Repository

- Gathering EDA requirements for formal Architecture
- Modelling of required Architecture Views
- Generating Model Documentation
- Transferring Architectural Views to EDA

Project Gantt Chart (dated 31 March 2015)

	Name der Aufgabe	Dauer	Start	Ende
1	LAVOSAR II Project	330 Tage?	13.11.2014	18.02.2016
2	⊟ Deliverables (excl. Stakeholder Engagement)	330 Tage	13.11.2014	18.02.2016
3	Kick Off Meeting	1 Tag	13.11.2014	13.11.2014
4	Inception Report	0 Tage	01.12.2014	01.12.2014
5	Progress Report 1	0 Tage	31.03.2015	31.03.2015
6	Progress Meeting 1 (Milestone 1)	0 Tage	05.05.2015	05.05.2015
7	Progress Report 2	0 Tage	04.08.2015	04.08.2015
8	Progress Meeting 2 (Milestone 2)	0 Tage	03.09.2015	03.09.2015
9	Final Report	0 Tage	02.12.2015	02.12.2015
10	Public Executive Summary and PPT Presentation	0 Tage	02.12.2015	02.12.2015
11	Final Meeting (Milestone 3)	0 Tage	18.02.2016	18.02.2016
12	⊟ Stakeholder Engagement	180 Tage	02.03.2015	06.11.2015
13	Workshop 1: Government Officials	0 Tage	05.03.2015	05.03.2015
14	Workshop 2: Industry	0 Tage	09.07.2015	09.07.2015
15	Briefing 1, 2, 3 and 4	180 Tage	02.03.2015	06.11.2015
16	⊟ LAVOSAR Work Packages	261 Tage?	01.01.2015	31.12.2015
17	⊟ WP0 - Project Management (RDE)	261 Tage?	01.01.2015	31.12.2015
18	0.1 - Administrative Management	261 Tage?	01.01.2015	31.12.2015
19	0.2 - Technical Management	239 Tage?	01.01.2015	01.12.2015
20	0.3 - Quality Assurance and Configuration Management	261 Tage?	01.01.2015	31.12.2015
21	0.4 - Coordination and Consultation with relevant Stakeholders	261 Tage	01.01.2015	31.12.2015
22	⊟ WP 1 - Architectural Domain Analysis and Requirements (BAE)	185 Tage	01.01.2015	16.09.2015
23	1.1 Analysis of Relevant Programs and Activities	40 Tage	01.01.2015	25.02.2015
24	1.2 Characterization of Required Architectural Domain	20 Tage	05.02.2015	04.03.2015
25	1.3 Definition of Any Needed Additional Architectural Layers	20 Tage	05.03.2015	01.04.2015
26	1.4 Evaluation of Benefits to be Gained	120 Tage	02.04.2015	16.09.2015
27	1.5 Estimation of Cost of Implementing	120 Tage	02.04.2015	16.09.2015
28	⊟ WP 2 - Open Reference Architecture Standards Update (SELEX)	160 Tage	18.02.2015	29.09.2015
29	2.1 Investigation and Update On Specific European Requirements	40 Tage	18.02.2015	14.04.2015
30	2.2 Proposal for ORA Standards Update	120 Tage	15.04.2015	29.09.2015
31	⊟ WP 3 - Workflow and Procedure Update (Nexter)	110 Tage	05.03.2015	05.08.2015
32	3.1 Update of Operational Workflows	60 Tage	14.05.2015	05.08.2015
33	3.2 Update of Logistics Procedures	60 Tage	05.03.2015	27.05.2015
34	⊟ WP 4 - Through Life Capability (Patria)	120 Tage	28.05.2015	11.11.2015
35	4.1 Harmonized Data Exchange Procedures	80 Tage	28.05.2015	16.09.2015
36	4.2 Development of Roadmap	40 Tage	17.09.2015	11.11.2015
37	⊟ WP 5 - Alignment with NGVA (VRC)	150 Tage	02.04.2015	28.10.2015
38	5.1 Concepts for LAVOSAR Contributions to Future Development of NGVA	30 Tage	02.04.2015	13.05.2015
39	5.2 Identification of Potential Contributions	100 Tage	14.05.2015	30.09.2015
40	5.3 Development of Roadmap	20 Tage	01.10.2015	28.10.2015
41	⊟ WP 6 - Architecture Contribution to EDA Repository (FKIE)	210 Tage	29.01.2015	18.11.2015
42	6.1 Gathering EDA requirements for formal LAVOSAR II Architecture	10 Tage	29.01.2015	11.02.2015
43	6.2 Modelling of required Architecture Views	180 Tage	12.02.2015	21.10.2015
44	6.3 Generating Model Documentation	40 Tage	10.09.2015	04.11.2015
45	6.4 Transferring Architectural Views to EDA	10 Tage	05.11.2015	18.11.2015



Workshops & Briefings

Deliverable	Date	Description
Workshop 1	05 March 2015	A workshop will be organized to which government officials from the procurement and maintenance departments of the Ministries of Defence of all EDA participating Member States and also EDA standardization and other standardization organizations will be invited. The main aim is to collect specific European requirements and also general requirements for the project which is the basis for the following work.
Workshop 2	09 July 2015	A second workshop will be organized in order to inform stakeholders about intermediate results and to receive feedback which will feed into the study work carried out in all relevant work packages. The invitation will address all relevant stakeholders such as government representatives, EDA representatives (e.g. Material Handling and Standardization), other standardization bodies (e.g. ASD), platform manufacturers, system integrators, and equipment suppliers.
Briefing 1 - 4	T0+x month	Briefing to specific bodies will be arranged in close consultation with the EDA Project Officer: • Interoperable Open Architecture Conference (London, 29 April 2015) • the Military Vetronics Association (MILVA; Versailles, 30 Sept. 2015) • NATO LCG LE (Oct. 2015) • EDA Capability Technology group "CapTech" Ground Systems or EDA LAVOSAR Experts Working Group

European Reference Open Architecture Standard for a modern Integrated Electronic Mission System in Military Land Vehicles" (LAVOSAR II)

- Agenda -

Time	Topic
10:30 – 10:45	Introduction by EDA
10:45 – 11:15	LAVOSAR II Study presentation
11:15 – 11:45	Architectural Domain Analysis and Requirements
11:45 – 12:45	Workflow and Procedure Update
12:45 – 13:30	**Lunch Break**
13:30 – 14:00	Open Reference Architecture Standards Update
14:00 – 15:00	Through Life Capability
15:00 – 15:15	**Coffee Break**
15:15 – 16:00	Architecture Contribution to EDA Repository
16:00 – 16:45	Alignment with NGVA
16:45 – 17:15	Concluding Remarks and Way Ahead

Contact

Dr. Norbert Härle

Rheinmetall Defence Electronics GmbH

Defence Electronics - Mission Systems, Vice President Technology Strategies

phone: +49 421 457-1503 fax: -2239 mobile: +49 151 14805589

e-mail: Norbert.Haerle@Rheinmetall.com