

Architectures and Foundations for the Swedish Armed Forces' C4ISR Systems 2010

Johan H Bendz

Swedish Defense Materiel Administration

Joint Materiel Command

Systems Architecture Group

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- *Background*
 - *A New Defence*
 - *A Need for Architecture*
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We live in interesting times...

*From now on, the only thing
that's constant is change!*

*So, our #1 capability must
be change management!*

A New Set of Objectives

SwAF politically assigned objectives are

- *International Peace-keeping Operations (UN, EU, NATO/PfP)*
- *Supporting Society*
- *Territorial Integrity*
- *Armed Aggression*

SwAF Capabilities - 102 defined so far

An Epoch Shift

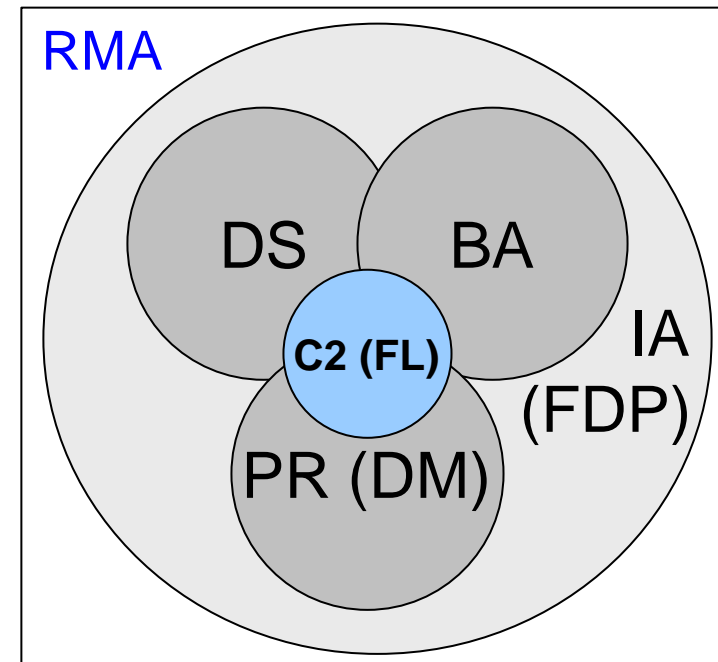
- *A shift from one to four objectives*
- *A shift from predictable business to great uncertainty*
- *A shift of focus from quantity to quality*
- *A shift of from Invasion Preparedness to Preparedness for Change*

- *A Swedish adaptation of RMA - the "Revolution in Military Affairs" concept*

Revolution in Military Affairs

RMA identifies 5 + 3 key capabilities

- *BA - Battlespace Awareness*
- *DS - Decision Support*
- *C2 - Command & Control*
- *PR - Precision Response*
- *IA - Information Assurance*
- *FL - Focused Logistics*
- *DM - Dominant Manouver*
- *FDP - Full-Dimensional Protection*

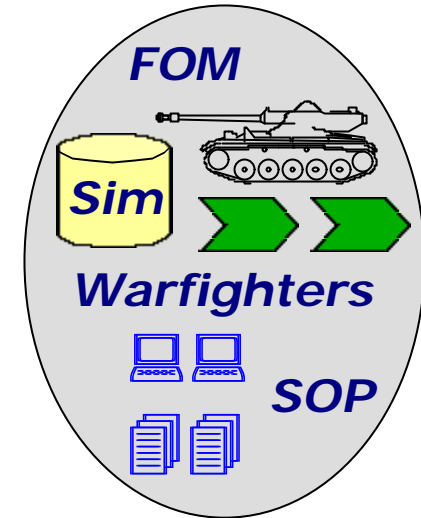
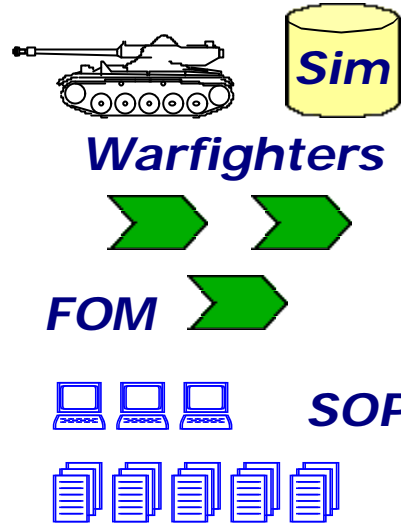
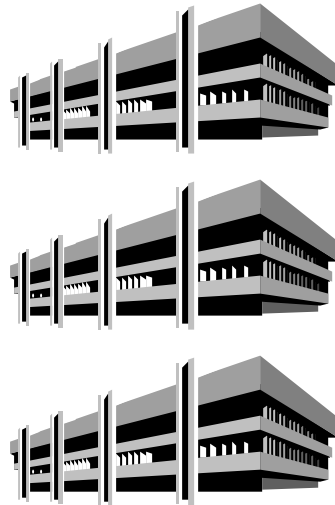


"Just-in-time" becomes critical

***We must field rapidly
assembled task forces***

***This requires a component
based approach!***

Rapid deployment



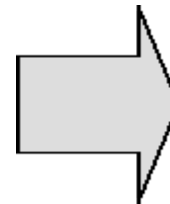
Component factories

Lead times:

weeks - months - year

Component life-cycles:

months - years



Force factories

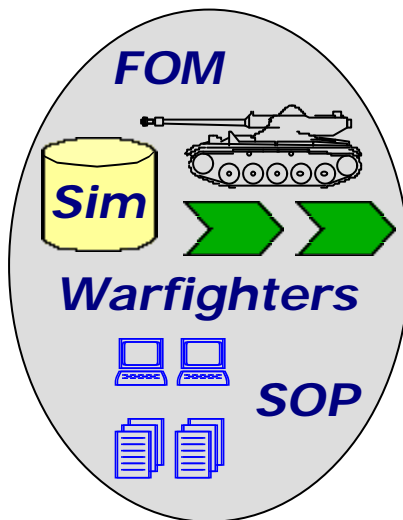
Lead times:

days - weeks

Force life-cycles:

*days - weeks -
months - years*

Tailored Task Forces



- *Rapidly composed from std components - inherently Joint*
- *Components from different services (cultures), organizations and countries*
- *Always deployed in "partially validated" state*
- *Tuned to adequate performance "in the field"*
- *Requires the warfighters to develop a new mindset (attitudes, culture)*

As everything goes "joint"...

*Multiple aspects are fused
to achieve superiority...*

*Increasing the apparent
complexity of operations!*

Complexity drivers

- ***Policy***
 - ***Ever changing objectives and priorities***
- ***Time***
 - ***Rapid response - rapid deployment***
- ***Technology***
 - ***Opportunities of rapid commercial developments***
- ***Politics***
 - ***Multi-lateral interoperoperation***
- ***Economics***
 - ***Standards, COTS, reuse***

Coping with complexity

Requires an Architecture approach

- *Structured products*
 - *Functional domains*
- *Structured processes*
 - *Modelling and Simulation*
- *Structured information assets*
 - *Smart Product Models*

Architecture definitions

- ***The study of, or concrete examples of, the interplay of technical and aesthetic factors. (Sw Nat'l Encyclopedia Dictionary 1995)***
- ***Art and science of building; design or style of buildings. (Oxford ALDoCE 1974)***
- ***The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time. (IEEE STD 610.12)***

Useful findings

Architecture

- *US DoD C4ISR Architecture Framework*
- *Norwegian Defence MACCIS, v1*

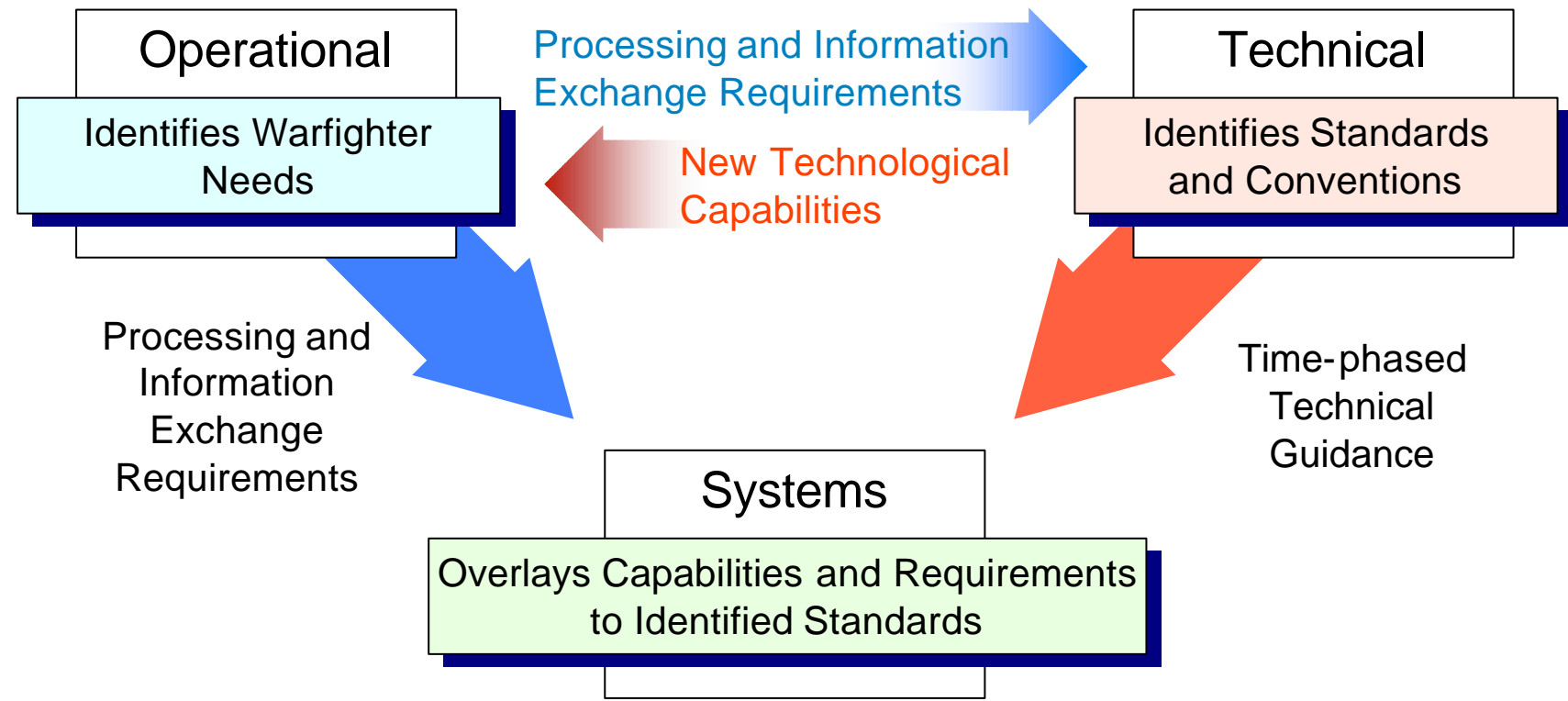
Systems Engineering

- *UK MoD DERA SE Reference Model*
- *World Class Systems Engineering, J Lake*

Systems Life-Cycles, SLC

- *ISO/IEC 15288 (CD2) SLC Processes*

US DoD C4ISR Architecture Framework



ISO/IEC 15288 System Life-Cycle Processes

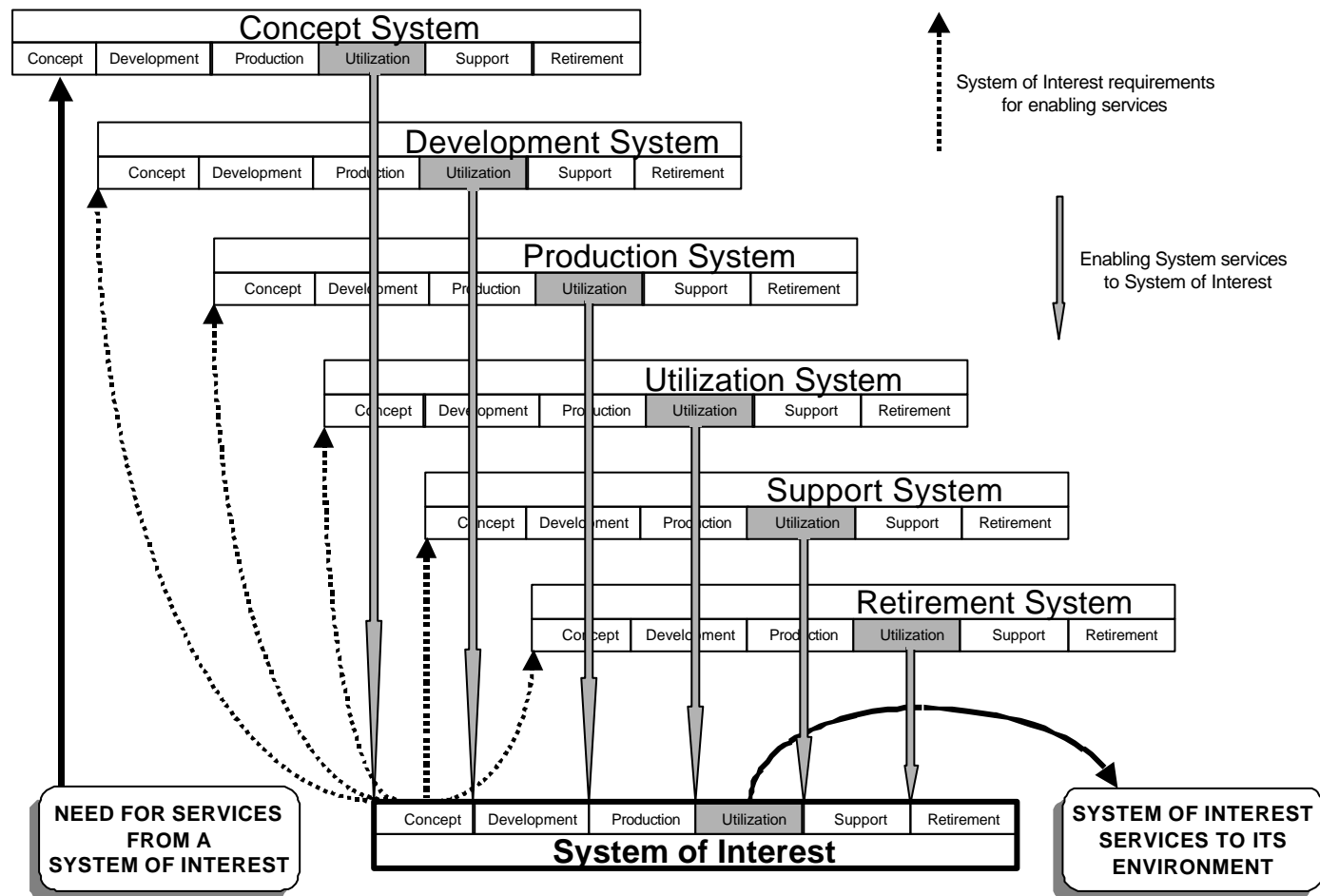
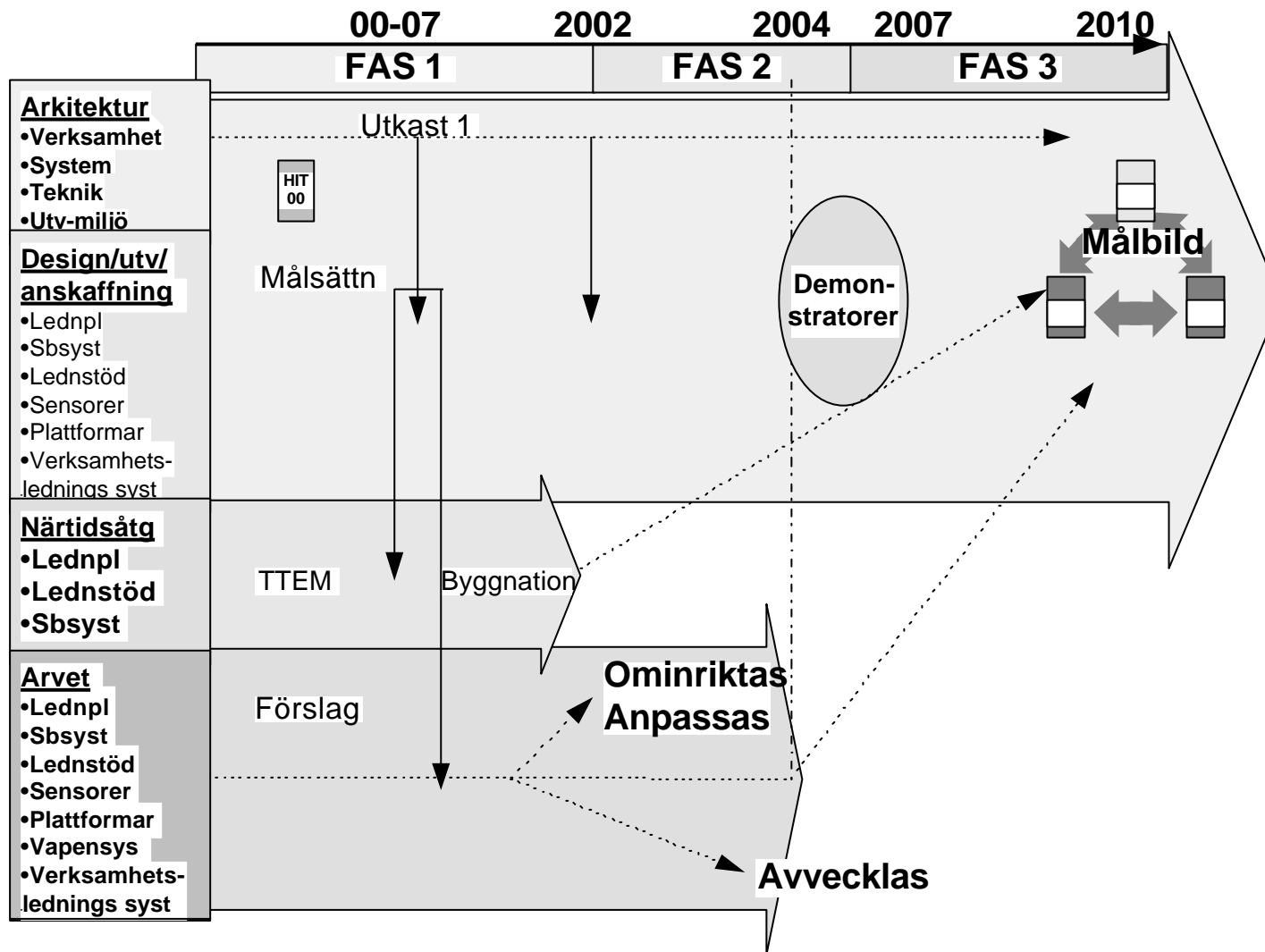


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- *Background*
- *The Architecture Project*
 - *Project Focus*
 - *Levels of Abstraction*
 - *Current reasoning*
- *Challenges*

Project Context



5P-model



Competences
Training
Experience

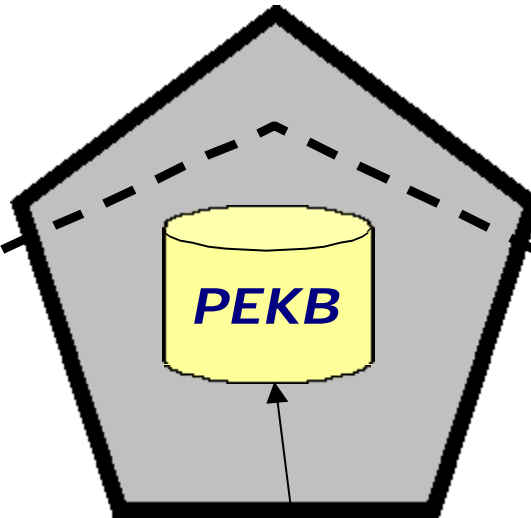
Assignments
Doctrines
Objectives

Organisation
Teams
Task Forces

Policies

People

Projects



PEKB

Architectures
Components
Constr./rules

Products

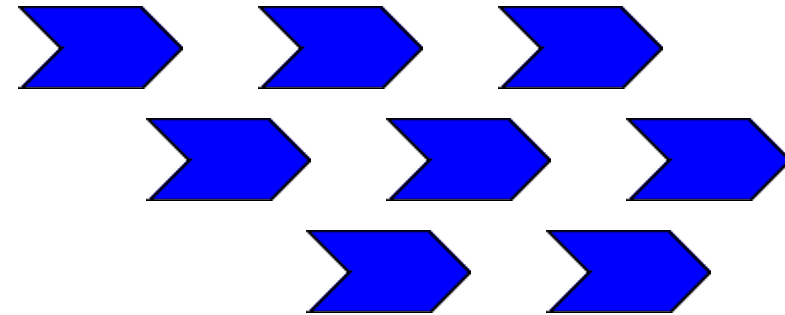
Processes

Rôles & resp.
Models,
Methods &
Tools

Architecture Project Basis 1



**SwAF C4ISR
(Operational
products)**



**Product
evolution
processes**



Product Information

Levels of Abstraction

The project produces results on three levels of abstraction

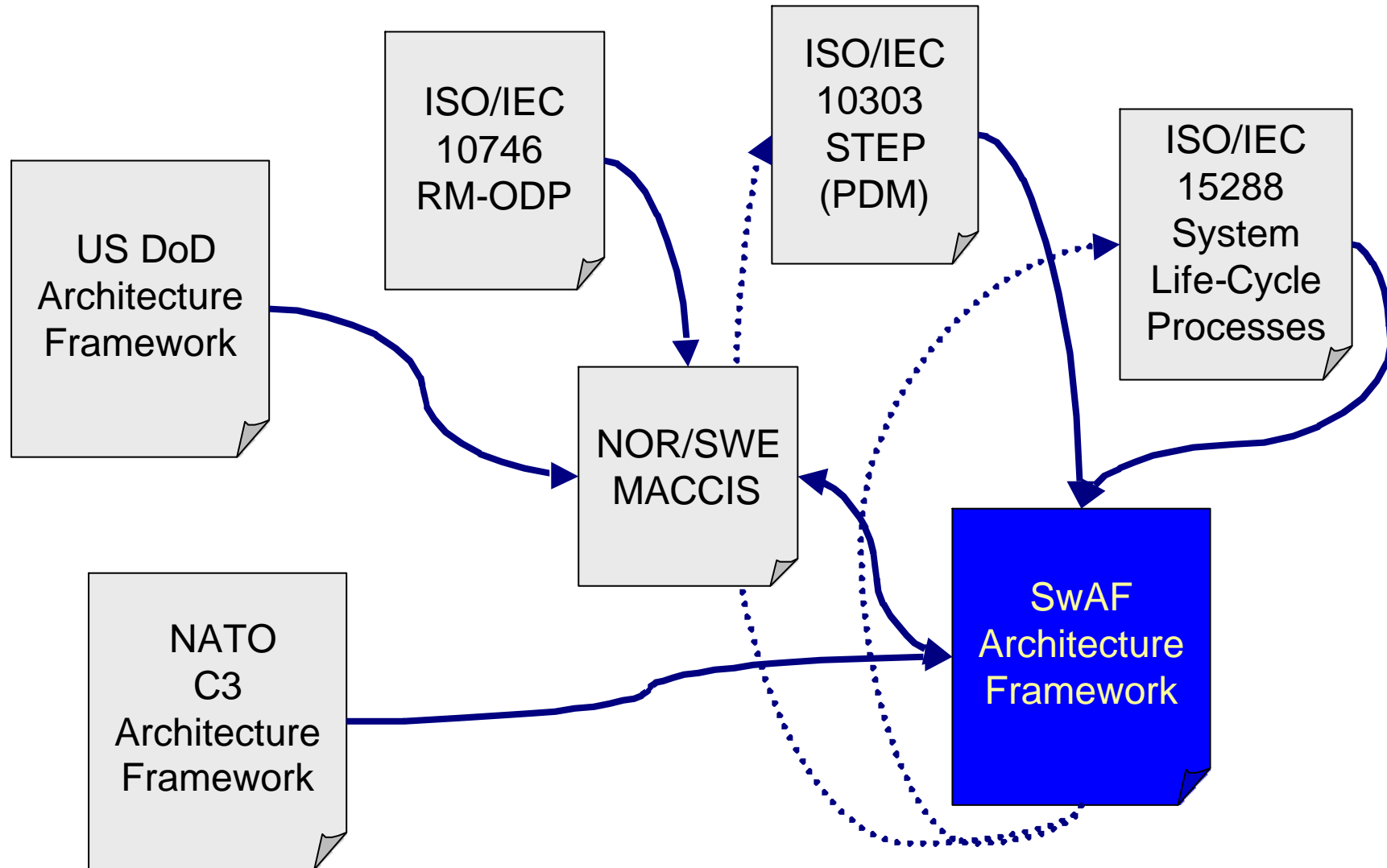
- ***Meta-Architecture***
- ***Reference Architecture for C4ISR - a System-of-Systems approach***
- ***Target Architectures for yr 2005 SwAF C4ISR demonstrators:***
 - ***"Air & Sea"***
 - ***"Ground Combat (Int'l Operations)"***

Meta-Architecture

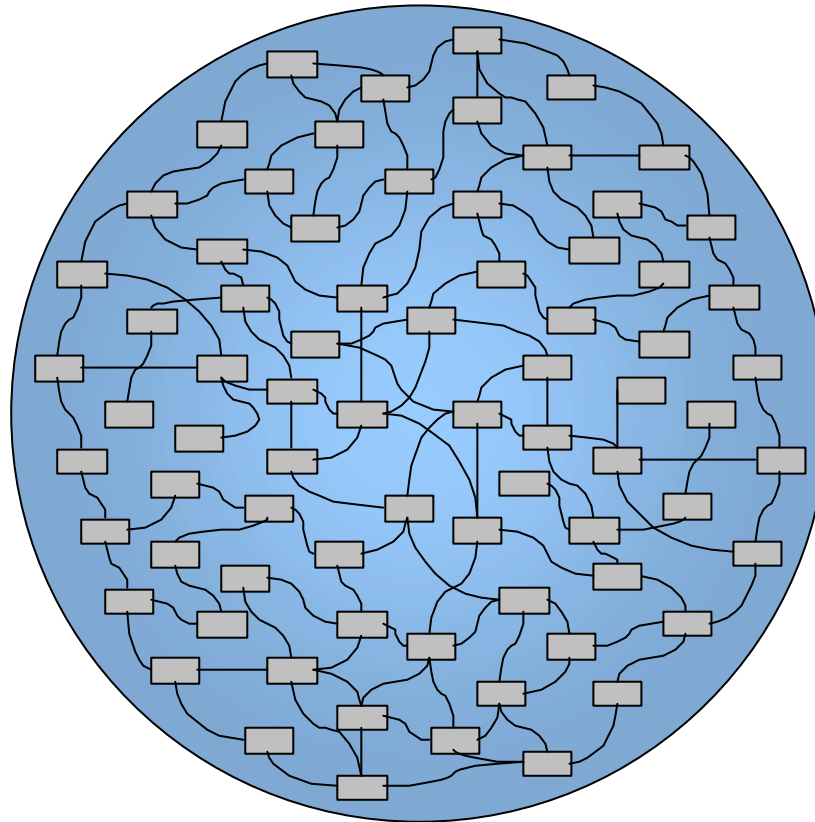
The Architecture Framework

- *Architecture principles & philosophy*
- *Product Evolution Knowledge Base*
- *Product structures & -models*
- *Standards*
- *Process structures & -models*
- *Criteria for selecting methods & tools*
- *Infrastructure issues*

Influences

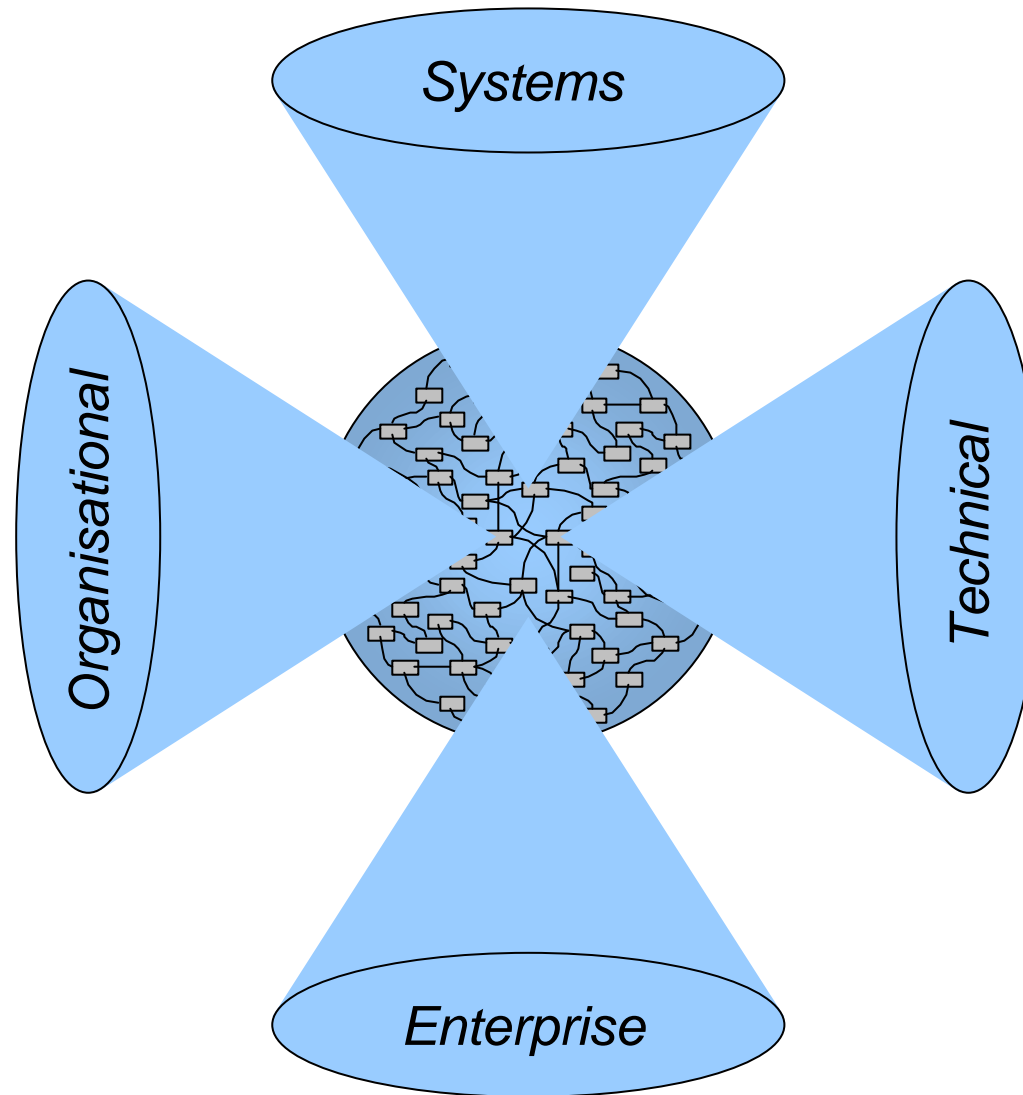


The Knowledge Base



*Our ability to master the complexity of future SwAF C4ISR systems requires the use of a **Smart Product Data Model** approach to Life-Cycle Information Management. The SPDM is capable of providing multiple views to satisfy the needs of various stakeholders.*

Principal viewpoints

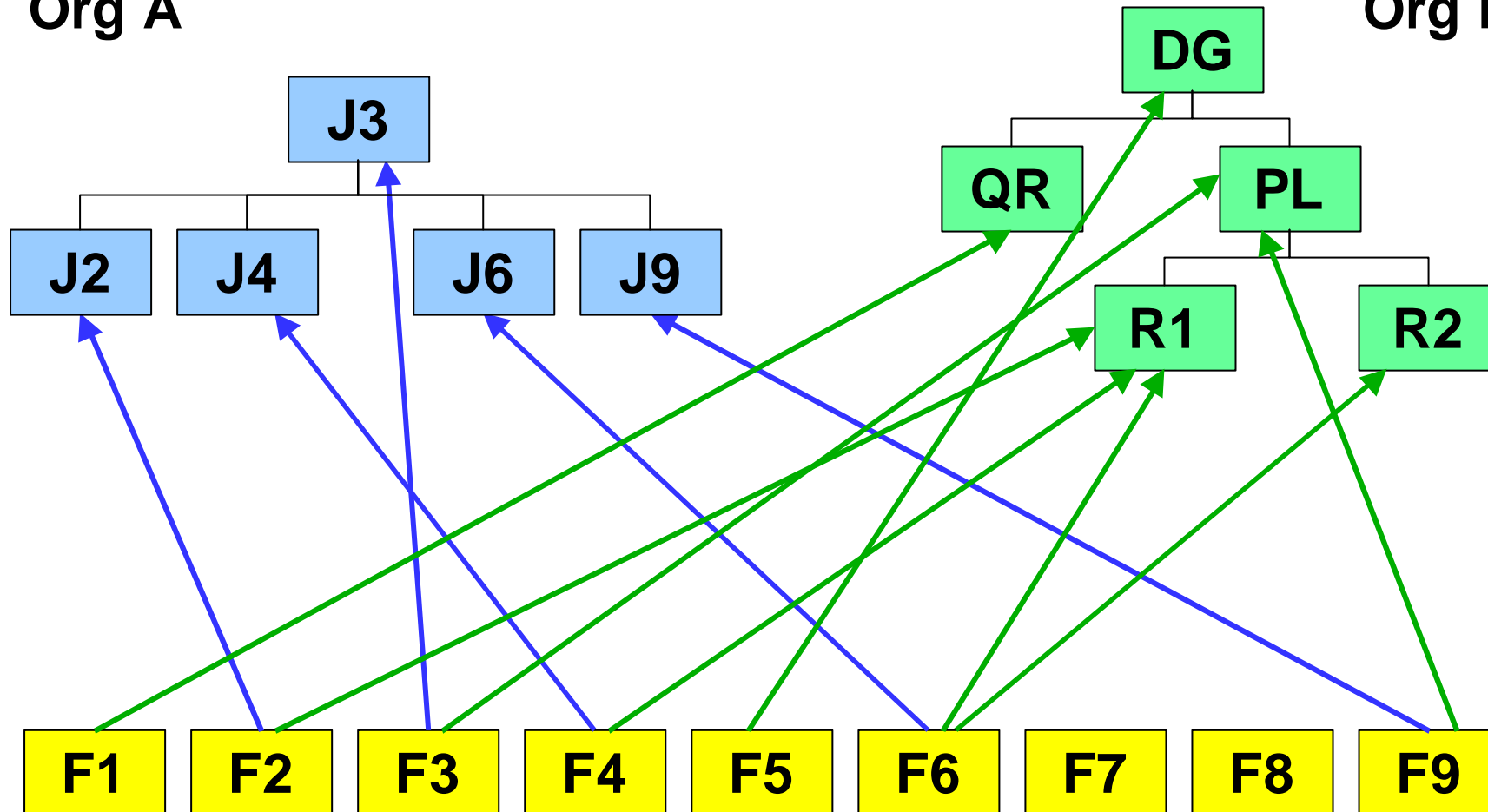


Organizational independence



Org A

Org B

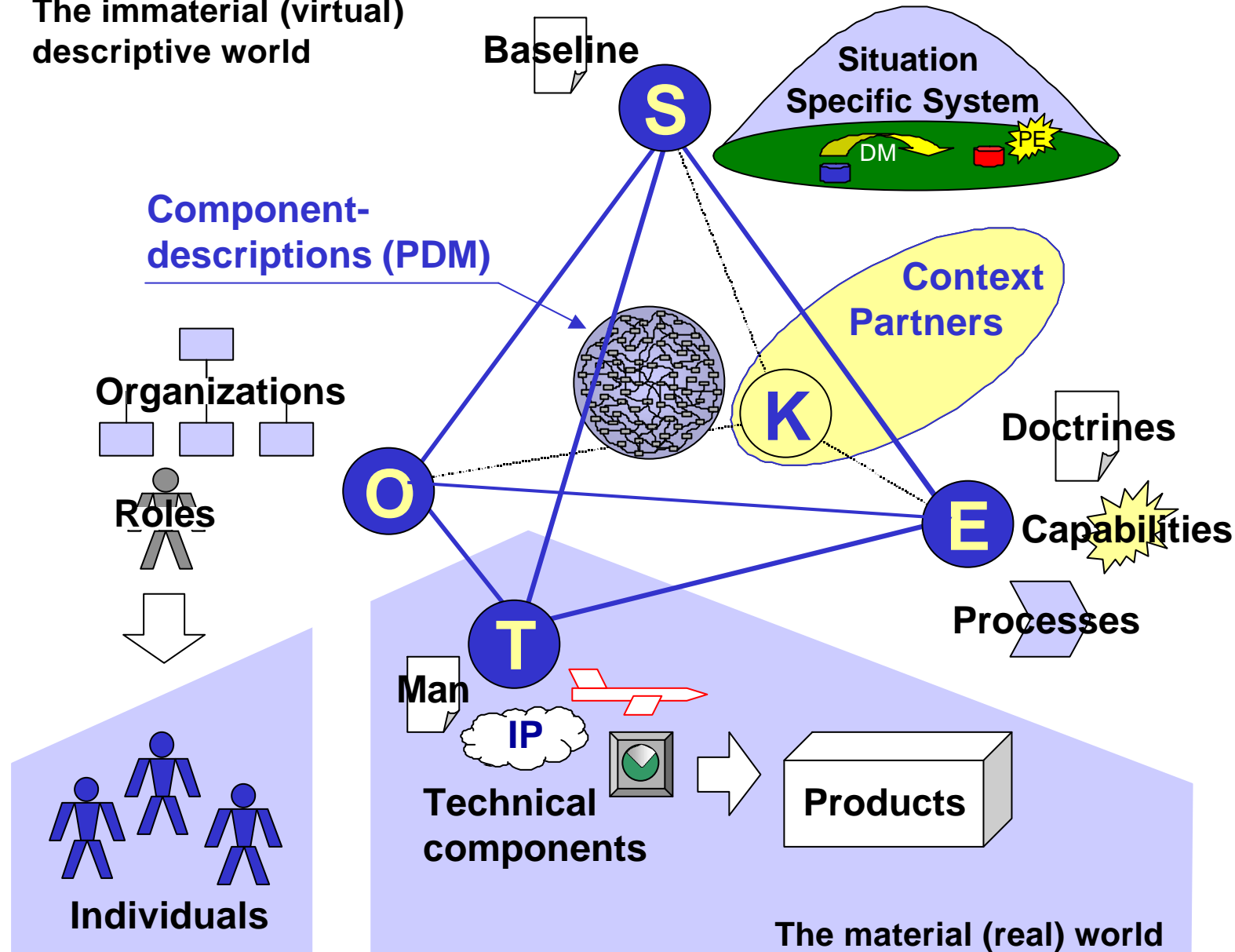


Functions

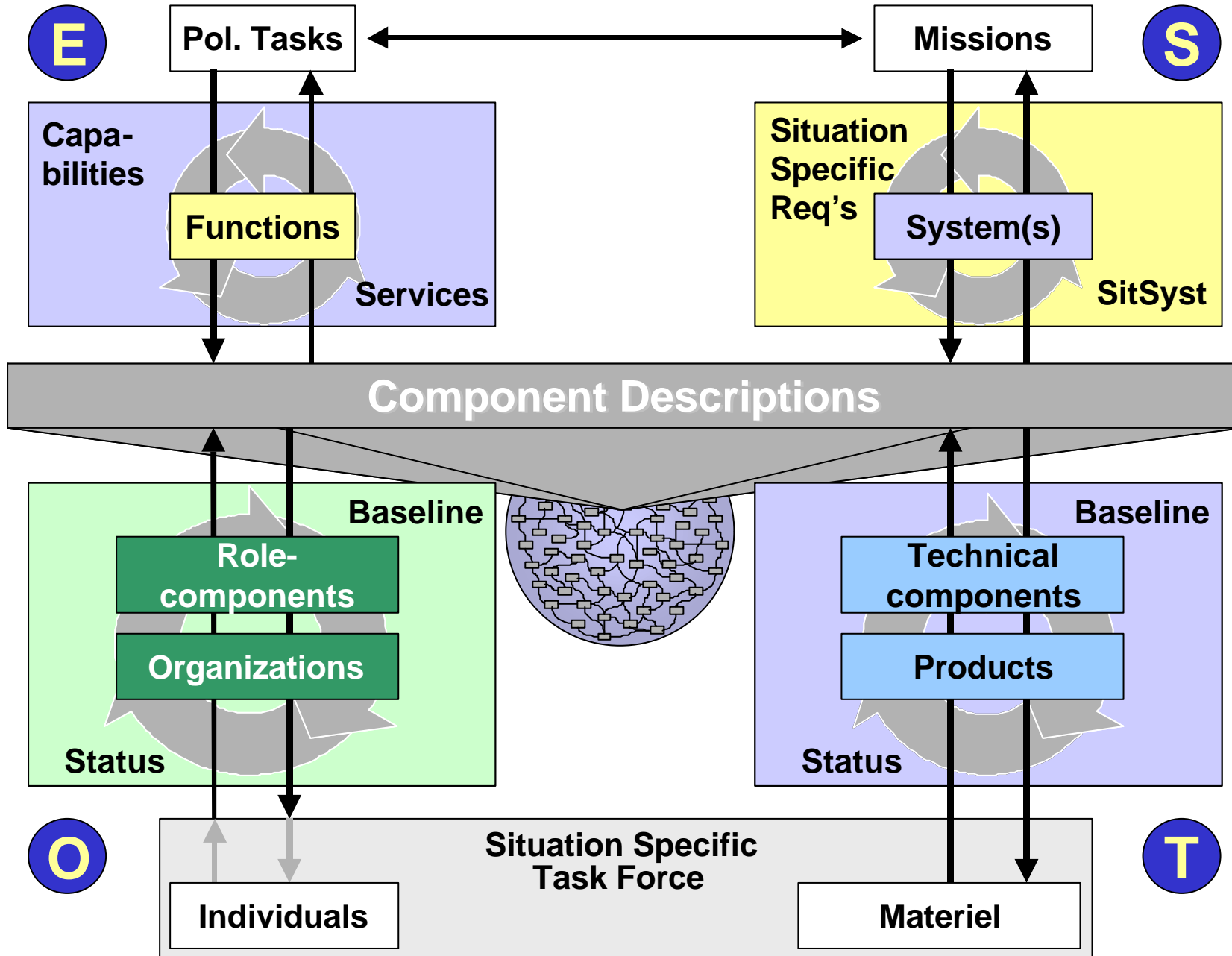
Architecture Models 1



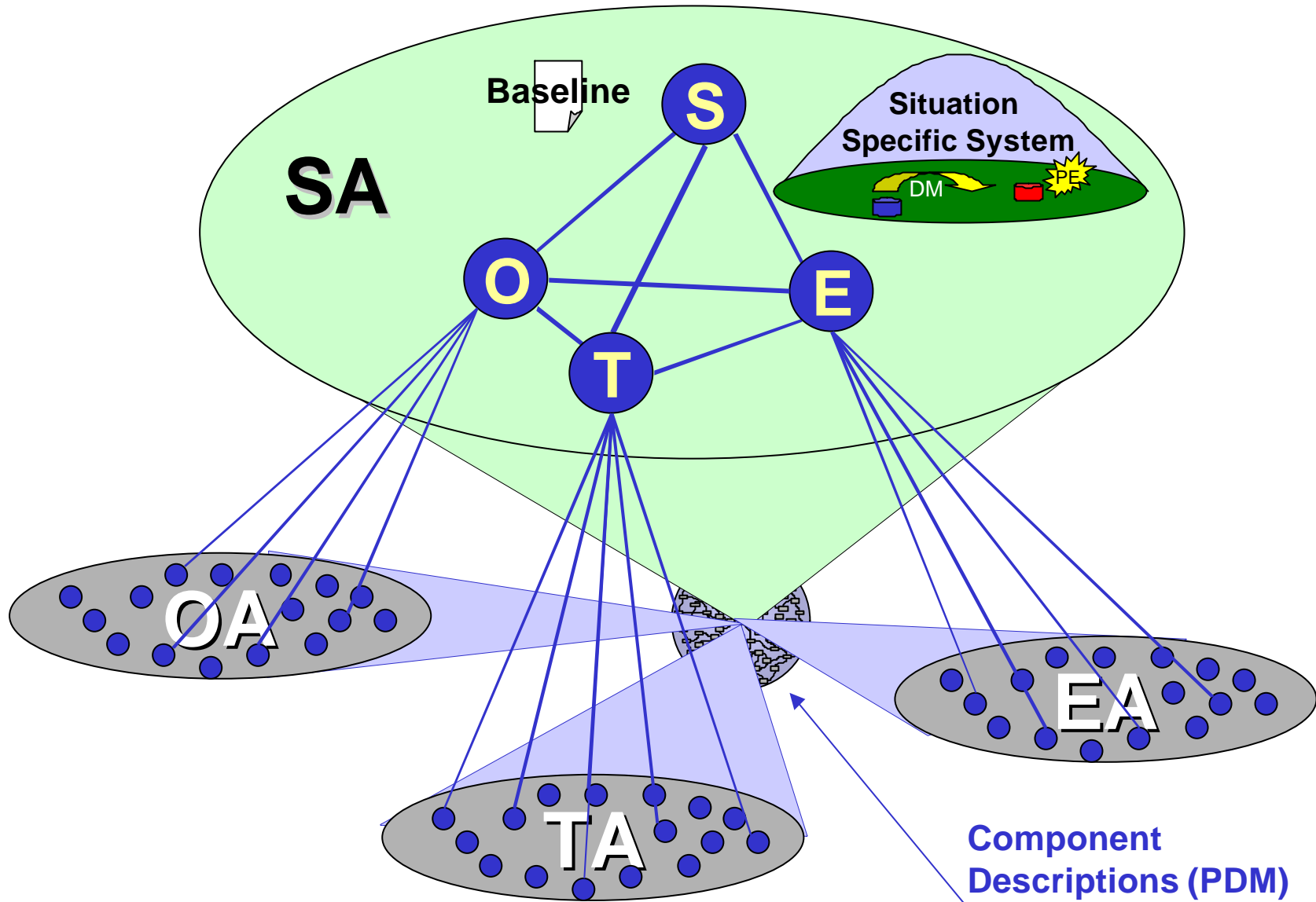
The immaterial (virtual) descriptive world



Architecture Models 2



Use of Architectures



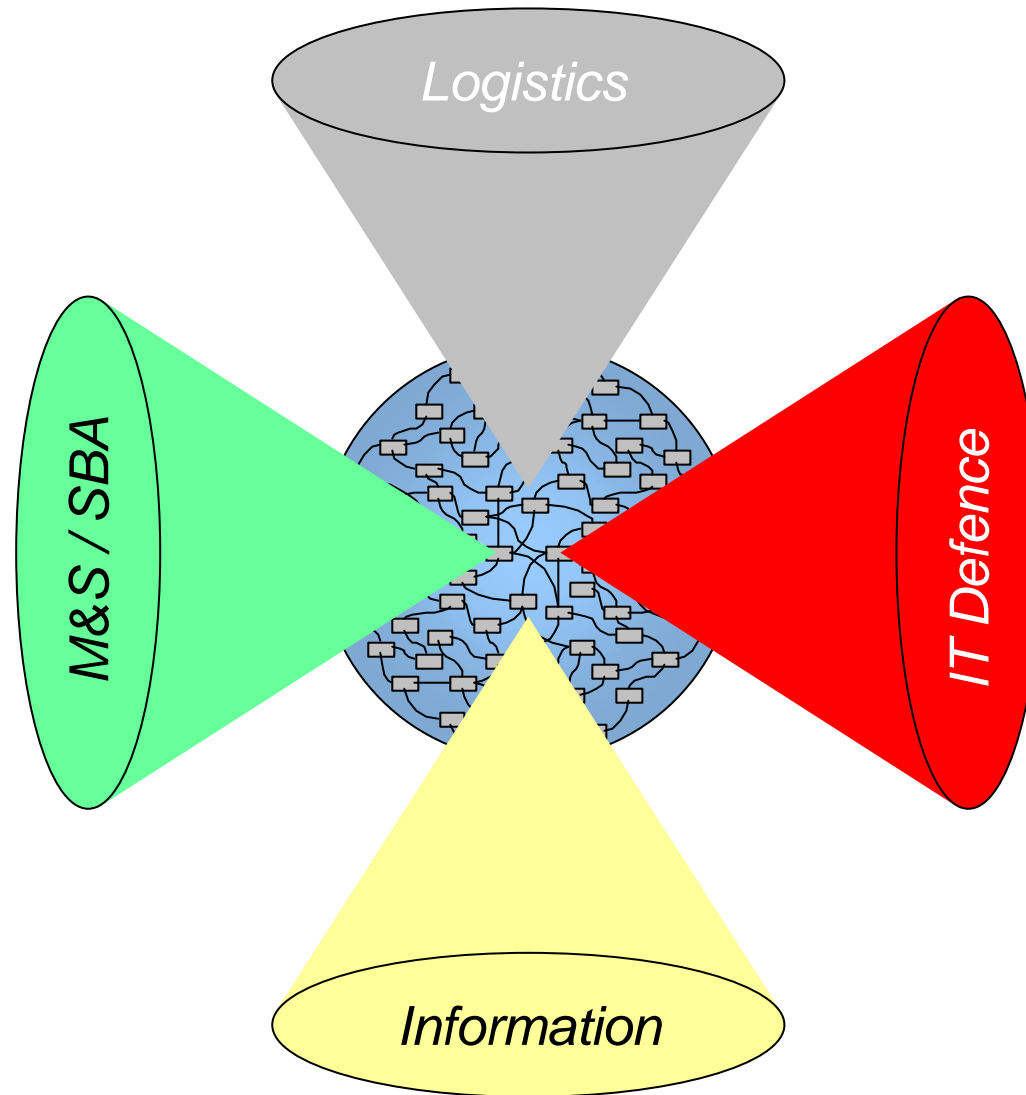
Baseline



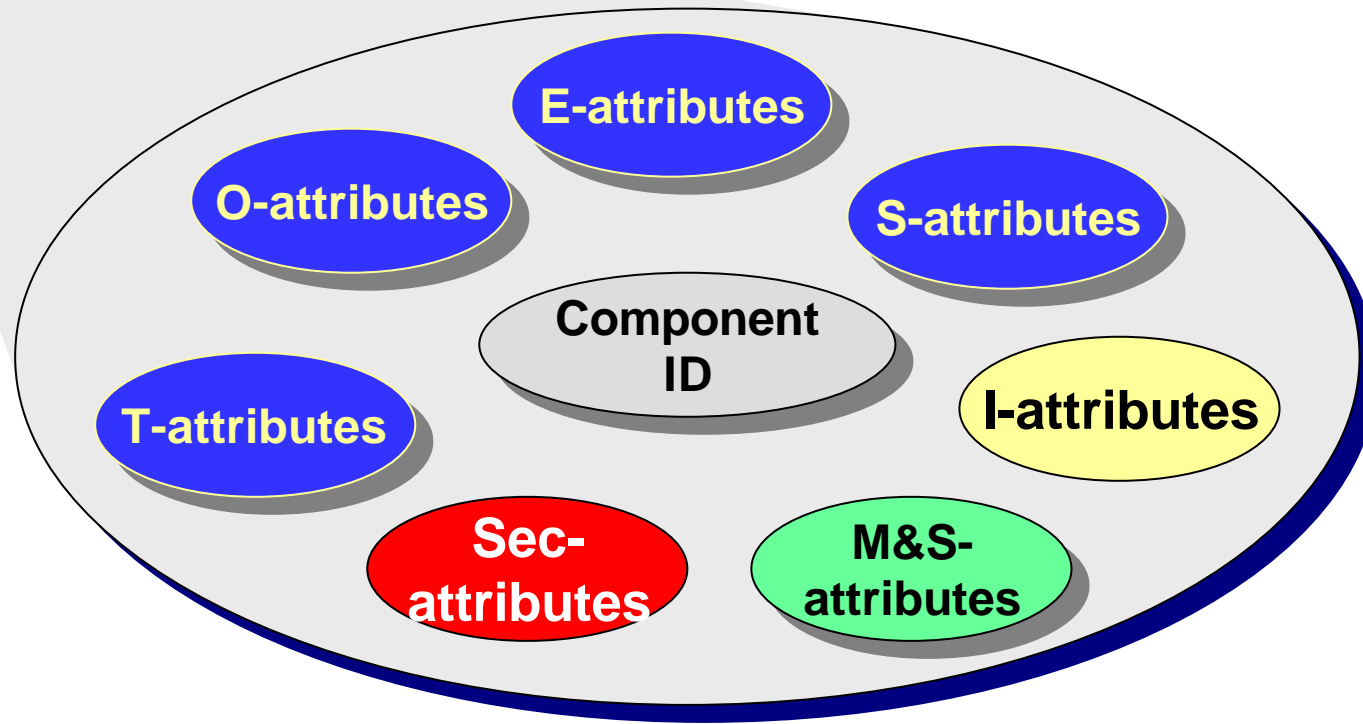
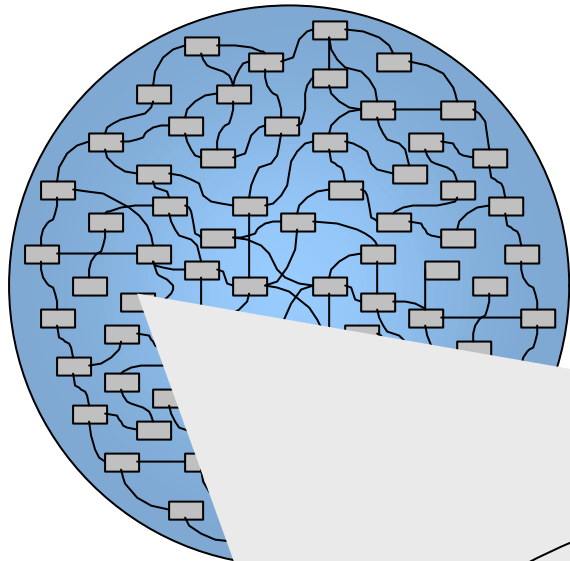
Baseline of SitSyst for Operation E43

Comp	Ver	BL	Role	Prod	Func	Serv
427	4	-	-	JJW	3.1.4	3019
118	7B	3	FXT	KLW	4.2.1	4123
763	3	1	-	AXX	2.1.7	2078
764	3	1	-	AXX	2.1.7	2078
765	3	1	-	AXX	2.1.7	2079
18	23	-	QRT	-	6.1	6202
330	1	-	-	BTT	4.5	4009
331	1	-	-	BTT	4.5	4009
280	12B	10	-	GTR	6.2	6344
281	12B	10	-	GTR	6.2	6345
198	2	29	KRV	KPR	1	1004
23	7	-	RTT	-	9.1	9533
....

Other Perspectives



Component Descriptions



Reference Model



	Enterprise VP	Systems VP	Technical VP	Process VP
Meta-architecture	<p>IEEE 1516 (HLA)</p> <p>ISO 10303 (STEP)</p> <p>UML</p>	<p>IEEE 1516 (HLA)</p> <p>ISO 10303 (STEP)</p> <p>ISO RM-ODP</p> <p>UML</p>	<p>IEEE 1516 (HLA)</p> <p>ISO 10303 (STEP)</p> <p>ISO RM-ODP</p> <p>UML</p> <p>ASN-1</p>	<p>IEEE 1516 (HLA)</p> <p>ISO 15288</p> <p>UML</p>
C4ISR Reference Architecture	<p>DoD/NATO UJTL</p> <p>OODA</p>			
Demonstrator Architecture 2005	<p>ATCCIS</p>		<p>SE COE</p> <p>Jini</p> <p>AQUA</p> <p>CORBA</p>	<p>ISO 12207</p> <p>IEEE 1220</p>

Reference Architecture for C4ISR

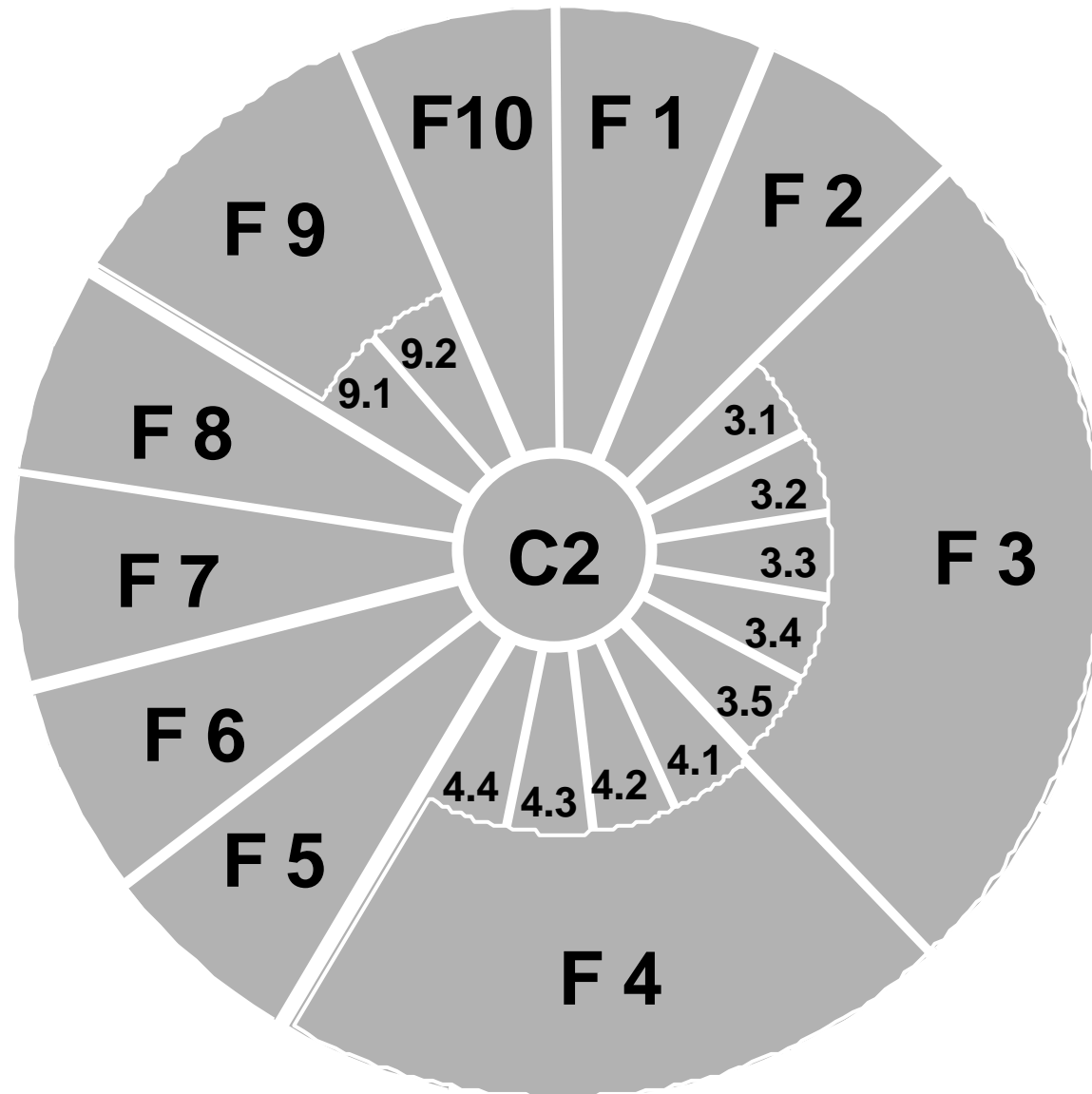
- *A System-of-Systems approach*
- *A macro-level template for C4ISR systems*
- *Provides general principles for breakdown and aggregation of systems*
- *Identifies domain-specific products and infrastructure components*

- *Preparing for other domains*

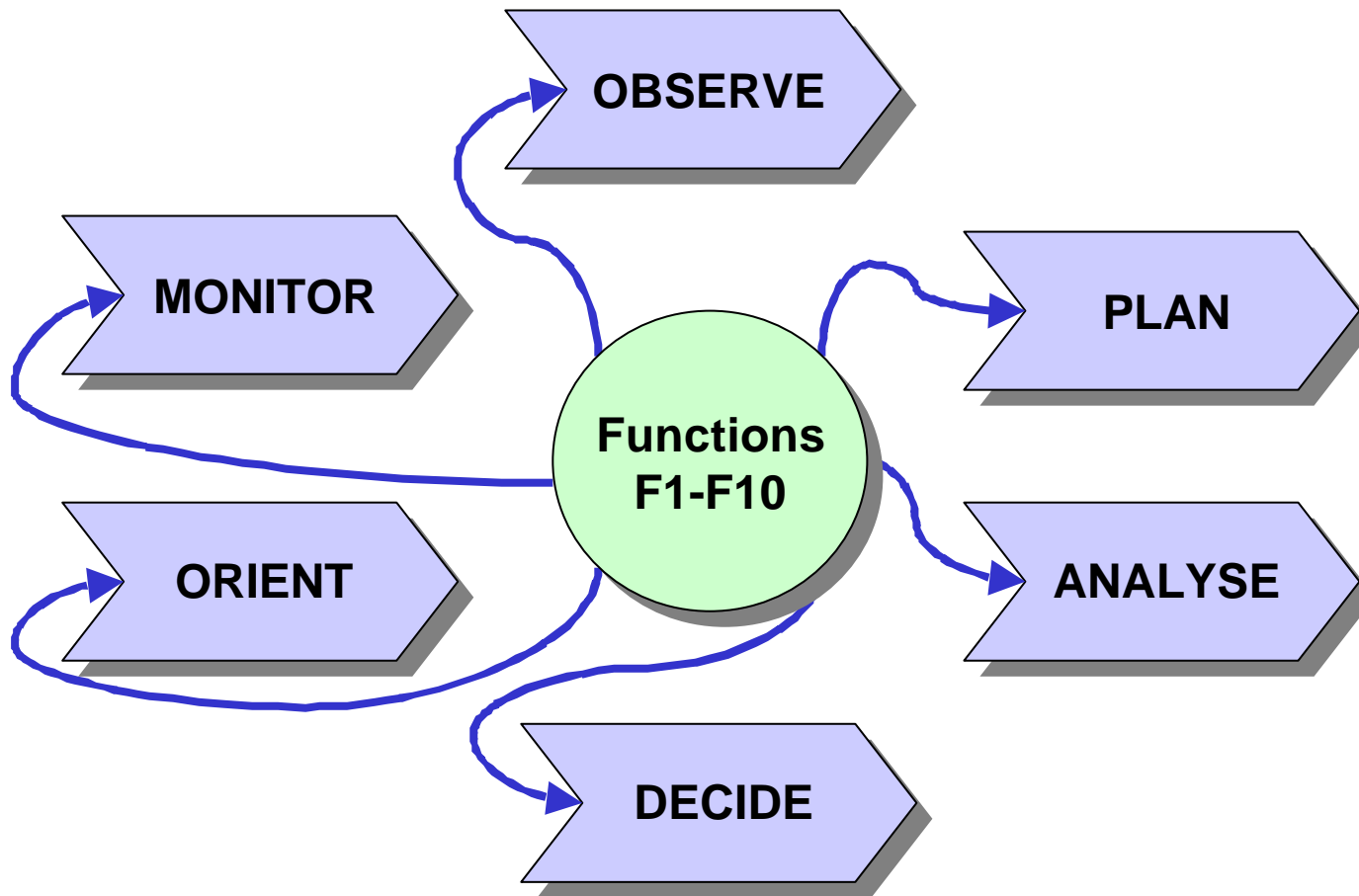
Functional Areas



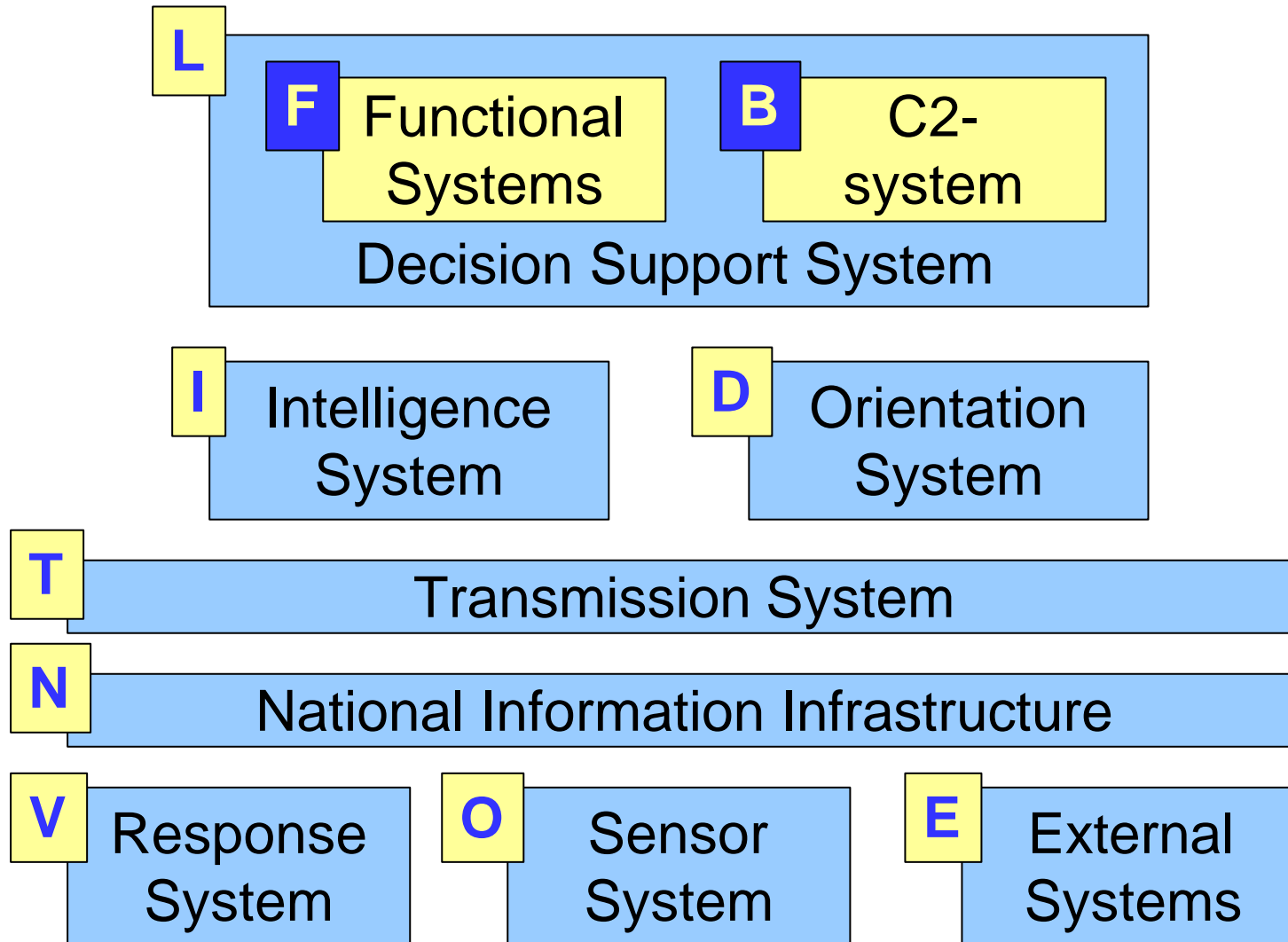
- 1. Personell
- 2. Intelligence
- 3. C2
 - 3.1 Ground
 - 3.2 Air
 - 3.3 Maritime
 - 3.4 Combat
 - 3.5 C2IW
- 4. Logistics
 - 4.1 Support
 - 4.2 Transport
 - 4.3 Medical
 - 4.4 Infrastructure
- 5. Planning
- 6. Communications
- 7. Training
- 8. Production
- 9. CIMIC
 - 9.1 Civilian
 - 9.2 Military
- 10. Staff Cmd



Generic Activities



Domain Architecture - SVP



Demonstrator Architecture(s)

Expected Characteristics of SwAF C4ISR Demonstrator Architectures

- *Component based*
- *Loosely coupled interfaces*
- *Open & standards based*
- *Network oriented*
- *Non-hierarchical information structure*

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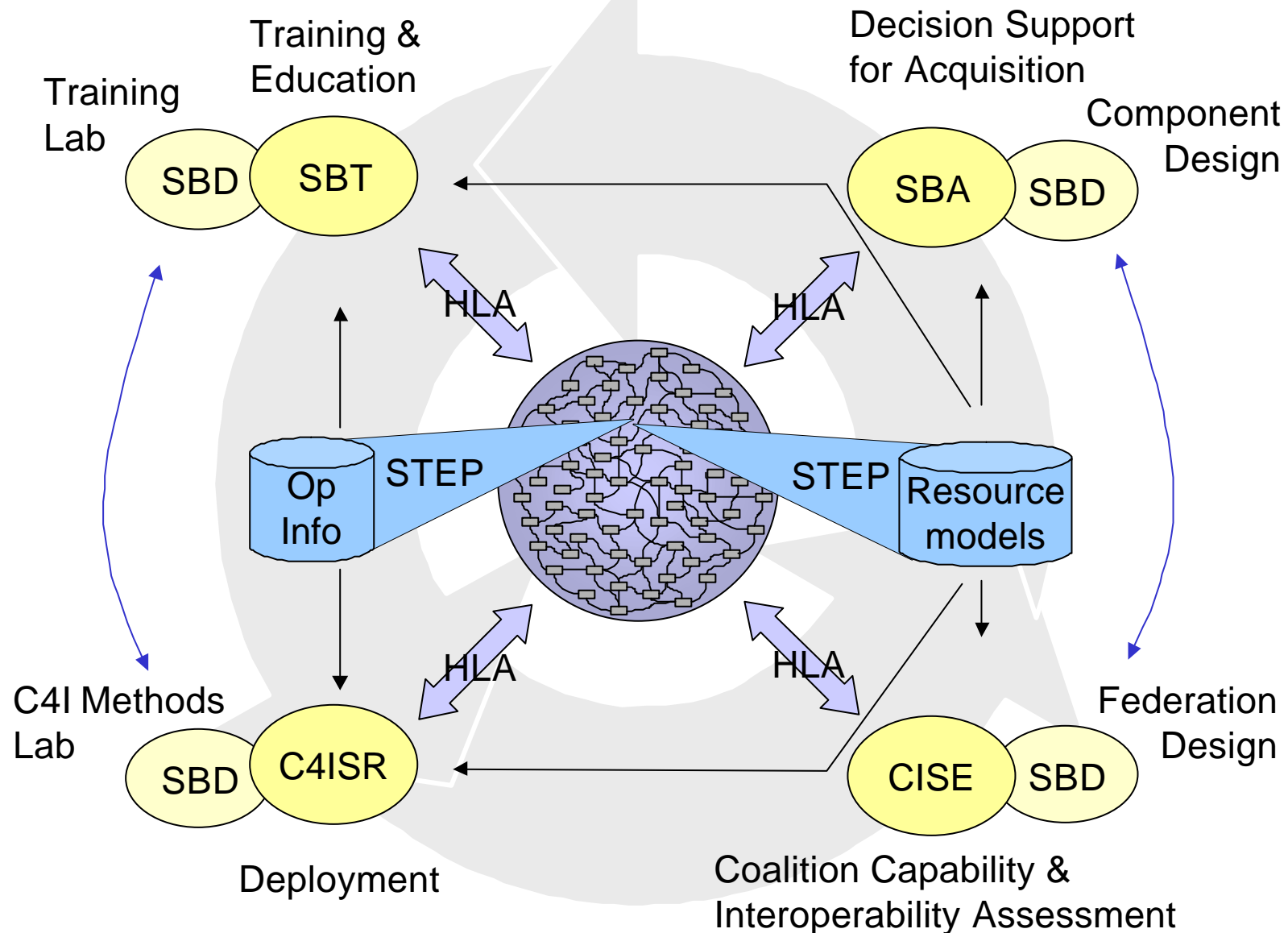
CHALLENGES

- *Evolutionary development*
- *M&S-based systems management*
- *IT Defence System*

Evolutionary development

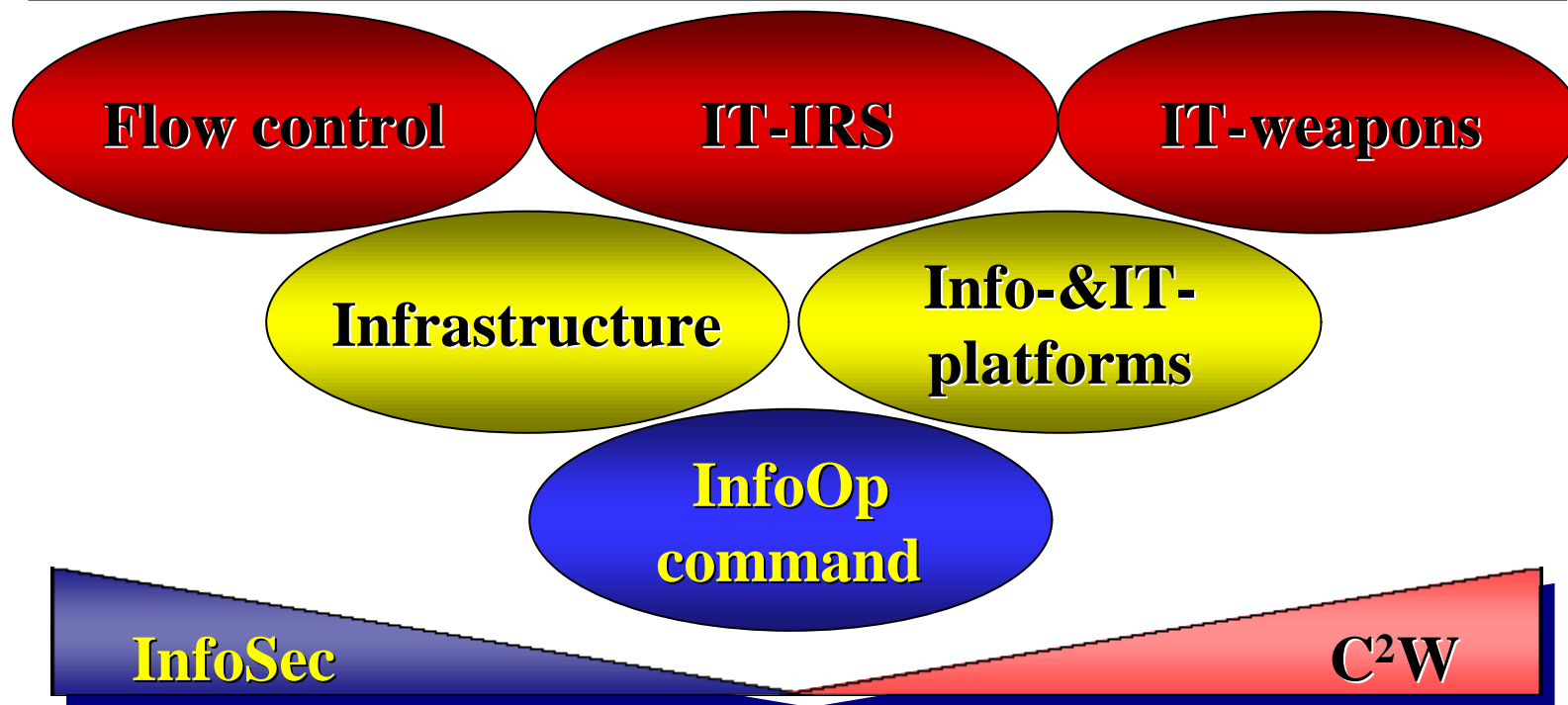
- *Constant change requires constant adaptations*
- *Evolution occurs in increments*
- *Evolution requires mutations (creativity)*
- *Mutation is promoted in a heterogenous environment*
- *Thus we must encourage "dissimilarities" and be capable of handling them*
- *BTW - International Cooperation requires the same capabilities*

CISE - SBA - SBT - C4ISR



IO - IA - IW

IT defence system



The End

