University of Karlstad - Colloq. 10. Oct 2011

Security, Privacy and Dependability in the Internet of Things

represented by:
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on behalf of the
Center for Wireless Innovation Norway
CWI Norway (http://cwin.no)

Outlook

- *Integrated operations*: from oil and gas industry into the business of every sector
- Aspects of Integrated Operations
  - trust-based security
  - content-awareness (and context-awareness)
- Challenges in ICT security for the Internet of Things (IoT)
  - Security, privacy and dependability in sensor systems
  - Heterogeneous infrastructures
  - security metrics
- Example: Artemis pSHIELD project
  - Use case: Railway data through Telenor Objects Shepherd platform

Integrated operations

From Wikipedia, the free encyclopedia

In the Petroleum industry, **Integrated operations** (IO) refers to new work processes and ways of doing oil and gas exploration and production,

External experts

Service Company's onshore operation centre

Trondheim

External experts

Bergen

Stavanger

Control room offshore

Aberdeen

Real time data

Real time data

Remote collaboration room

Operator's onshore operation centre

* Data integration	* Knowledge
* Information	* Decisions
* Visualisation	* Actions

y Association

www.olf.no

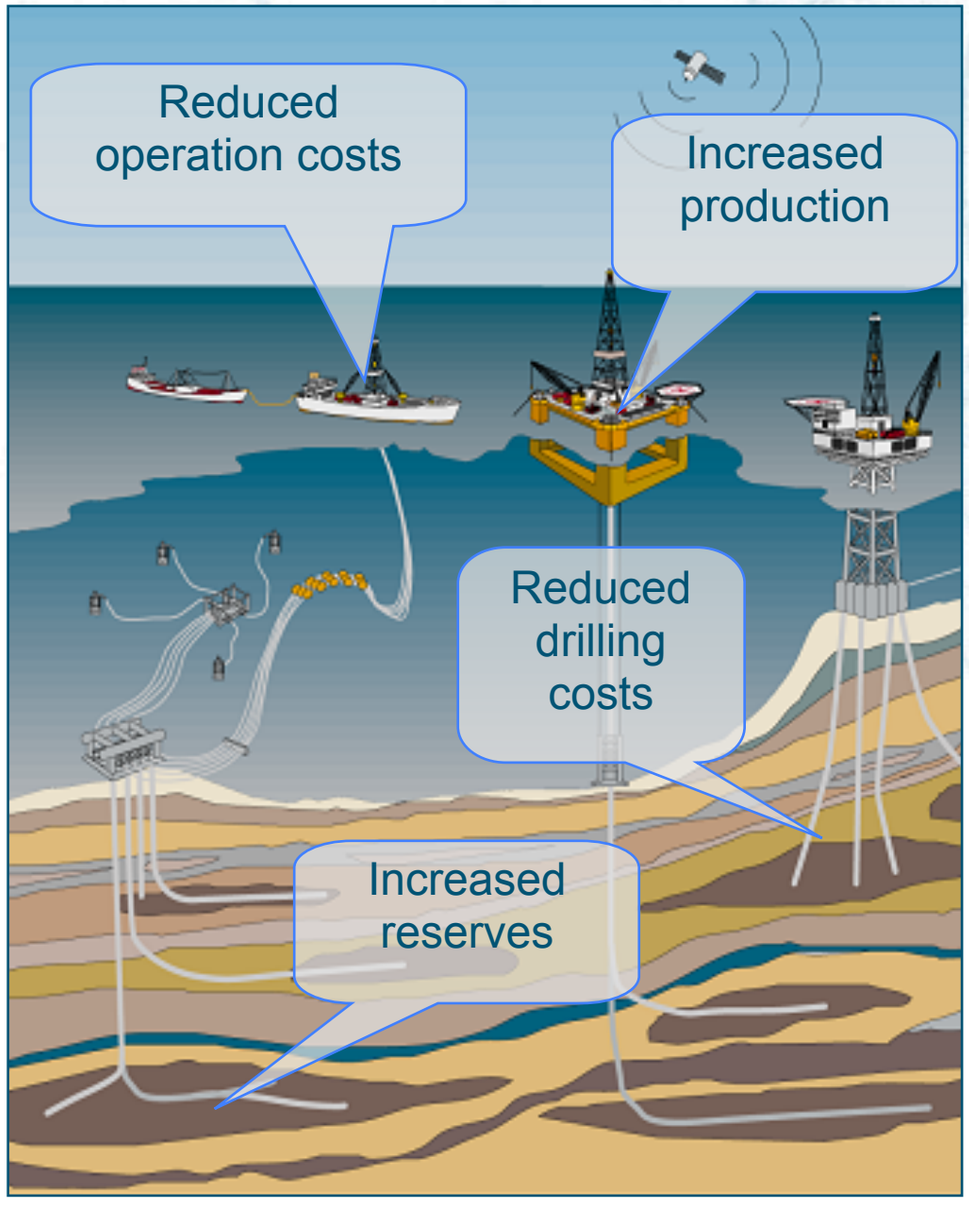
source: Fjellheim&Norheim, Computas

computas

40 bill US$ added economic value (now-2015)

Integrated Operations on the NCS - OLF numbers

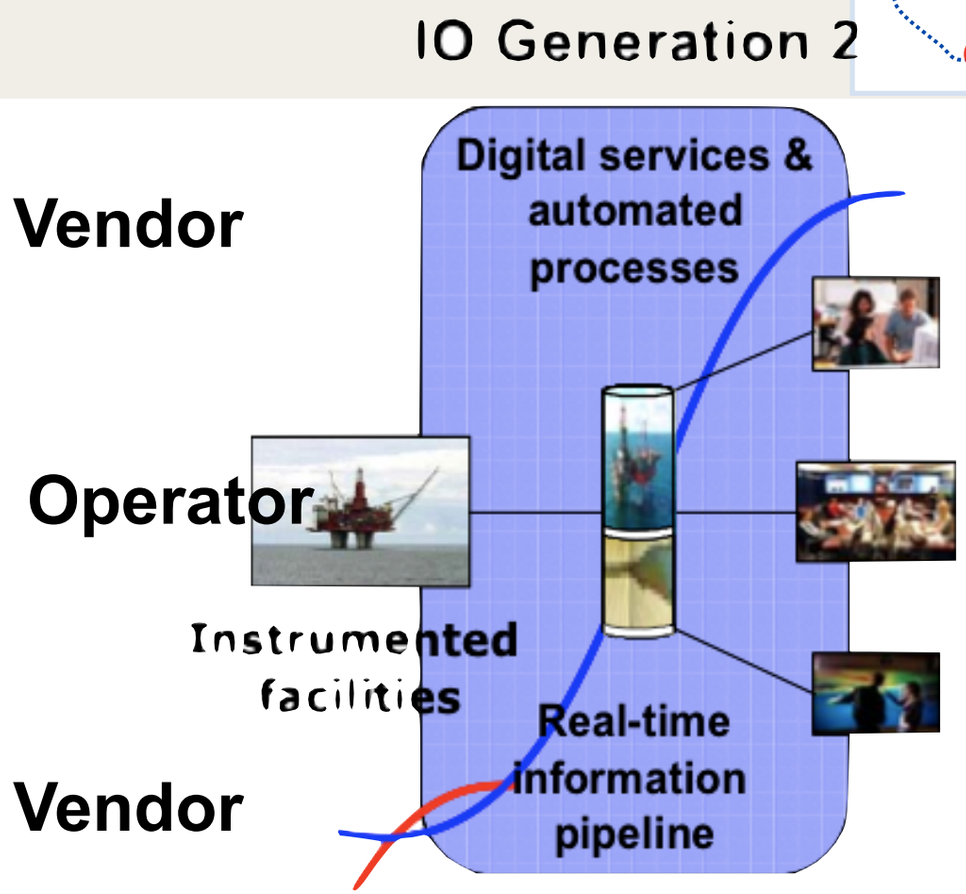
- **Increased production (5 -10 %)**
  - Real time coordination between offshore and onshore
  - Real time simulation of process and operation data
- **Increased reserves (5 -10 %)**
  - Improved location of wells
  - Smart wells and real time management of reservoirs
- **Reduced operation costs (30 -50 %)**
  - Conditioned based maintenance
  - Reduced use of personnel offshore
- **Reduced drilling costs (30 - 50 %)**
  - Real time optimized well trajectory
  - Fewer off-track
  - Reduced use of personnel offshore



source: Fjellheim&Norheim, Computas

Challenges in integrated operations

- Automatic detection of events
  - well, process, critical equipment
- Automatic evaluation of the effect of events
  - Production targets, costs
  - From corporate to equipment level
- Automatic generation of advices on how to manage events



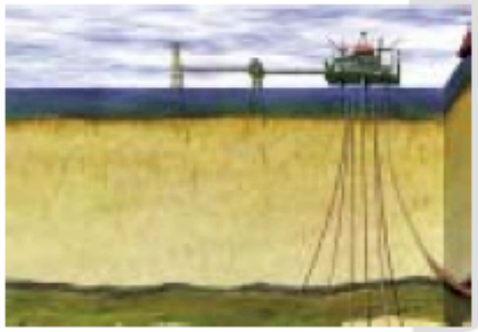
- Automatic processing of events
- Automatic follow-up of events, e.g. actions required to handle events

source: Kaare Finbak, IBM

Need for new & highly scalable technologies

Process control systems

Sensors
Downhole & onboard facilities

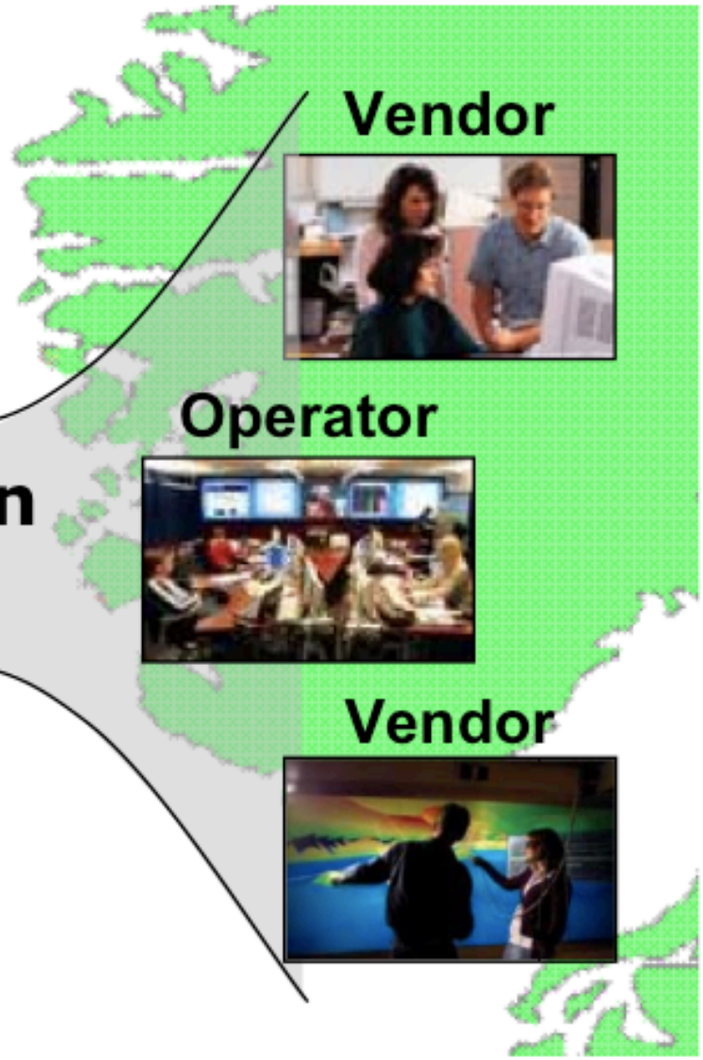


Web services
Open IT standards

Real-time integration solution

Semantic models
Open industry standards

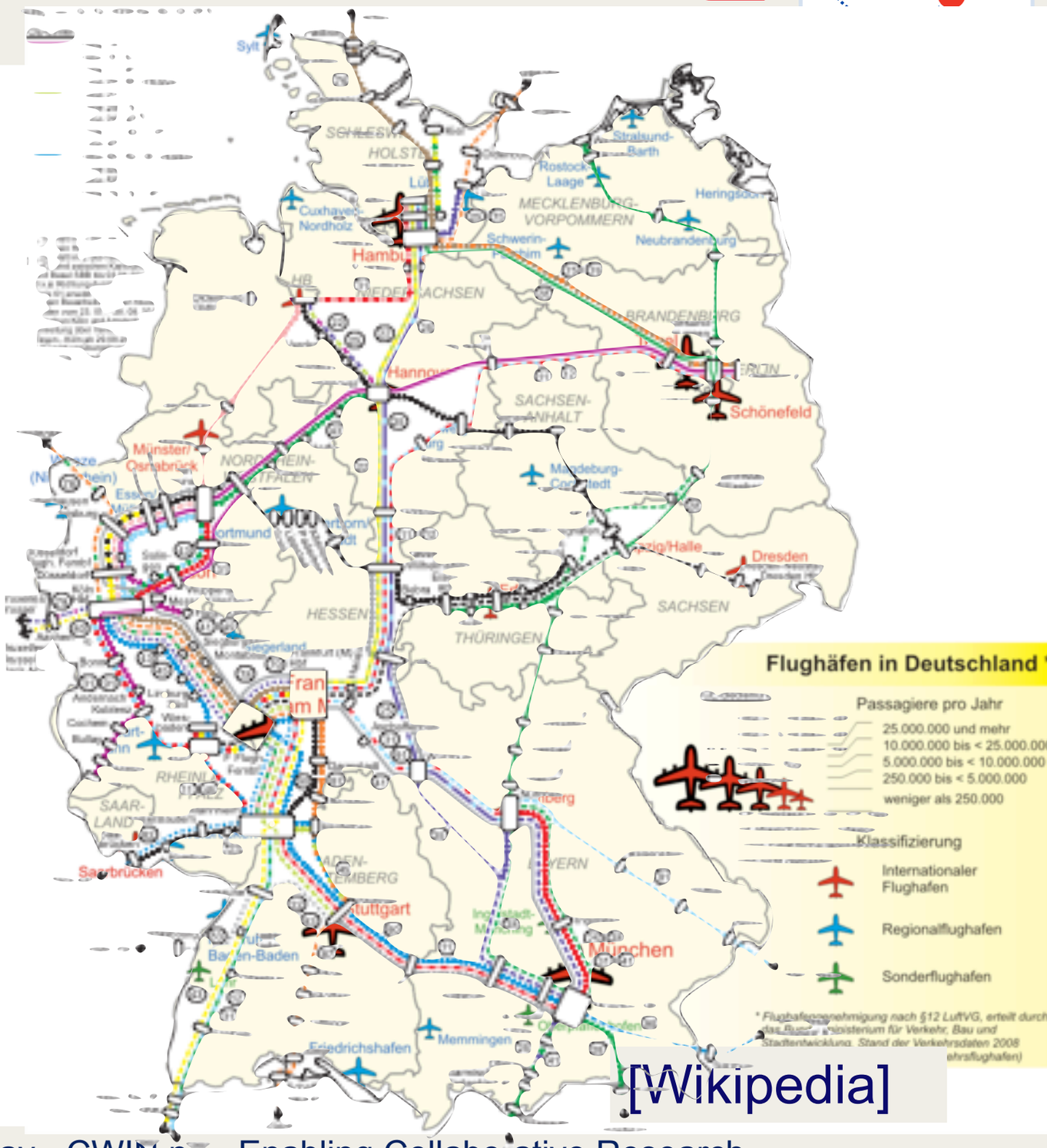
Broadband communication
Fiber optic cables & wireless networks



source: Kaare Finbak, IBM

“Integrated Operations” in transport

- Missing: Integrated transport
  - –“From Oslo to Svolvær with train, flight, boat, bus”?
  - –combined travel Haugenstua to Mainz (flight & train)



[Wikipedia]

Online traffic

- Example: TOMTOM
- TomTom HD traffic in Nov 2007 using Vodafone network data in NL

- TomTom Live in Oct 2010
  - using Telenor SIM in the Nordic Market
  - update every 2nd minute
- API for 3rd party
  - Antenne Bayern: “more accurate”

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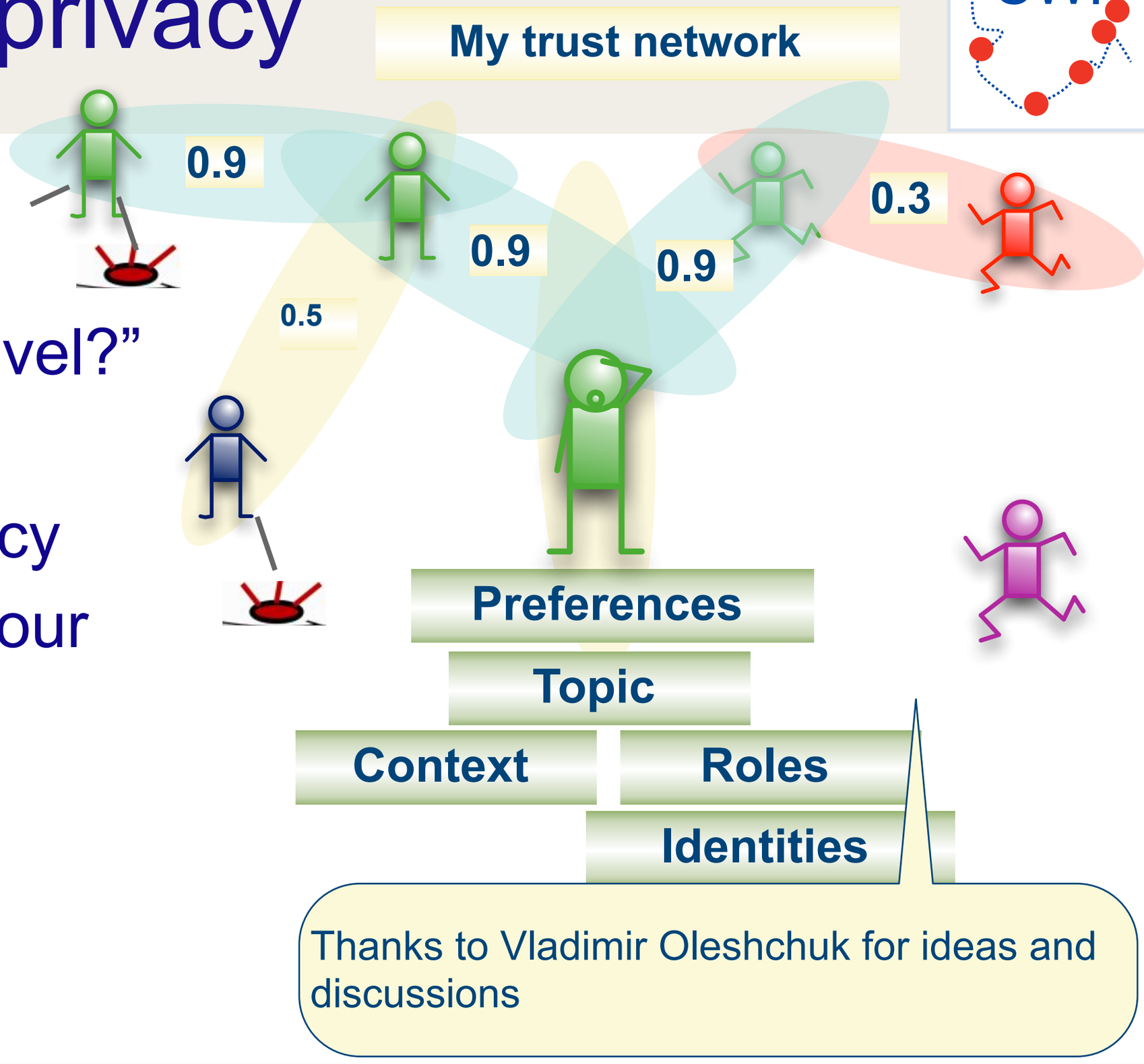
Challenges

- trust-based security
- content-awareness (and context-awareness)

Trust-based privacy

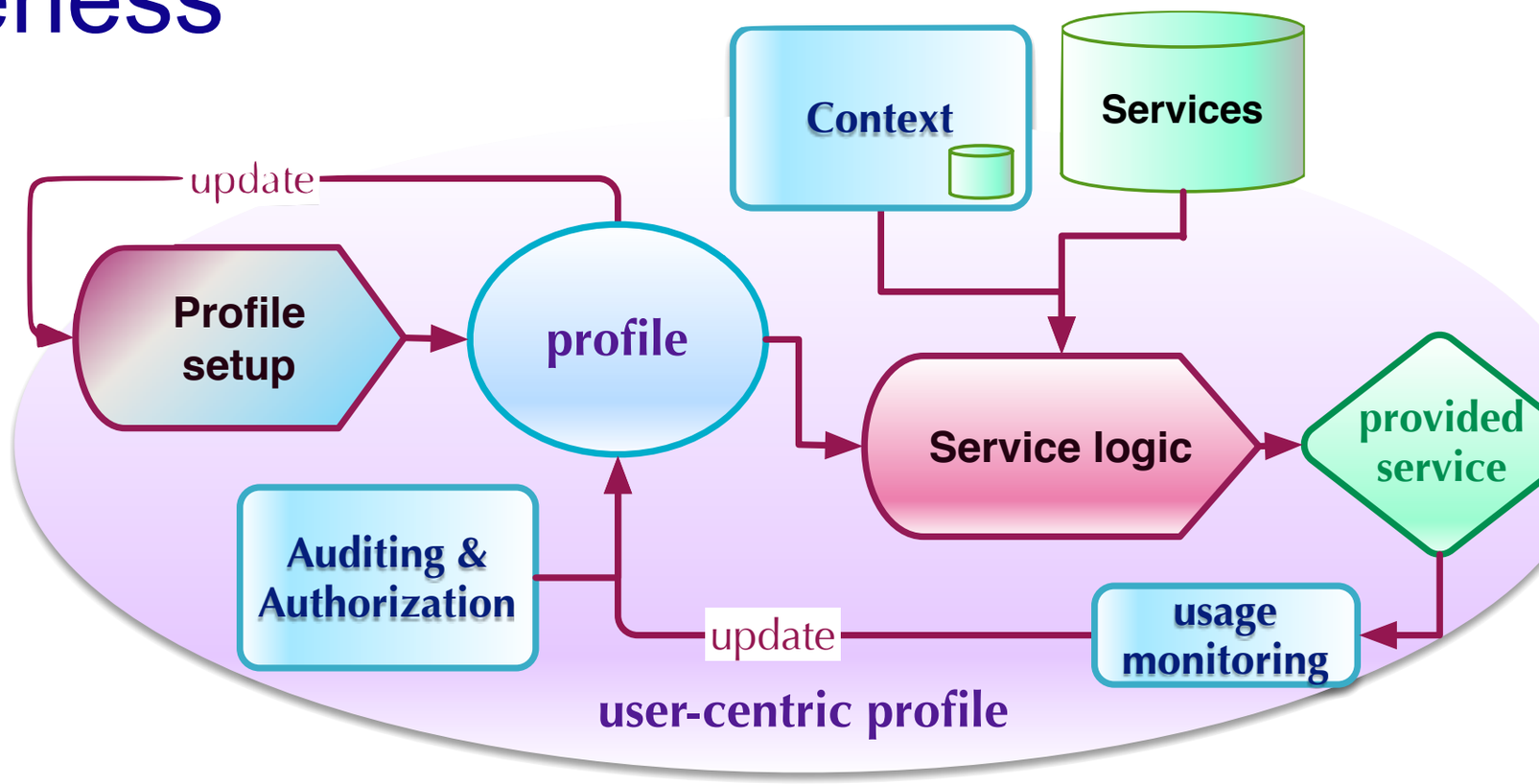


- "With whom to travel?"
- Share data?
- Trust-based privacy
- Information and your social life
  - Entertainment
  - Infotainment
  - **SocialTainment**

Thanks to Vladimir Oleshchuk for ideas and discussions

Content-awareness

- Context-awareness
- Personalized



source: WWRF - outline - user profiling

- Content-awareness
  - –urgent: “breaking the glass”
  - –“normal operation” - system status

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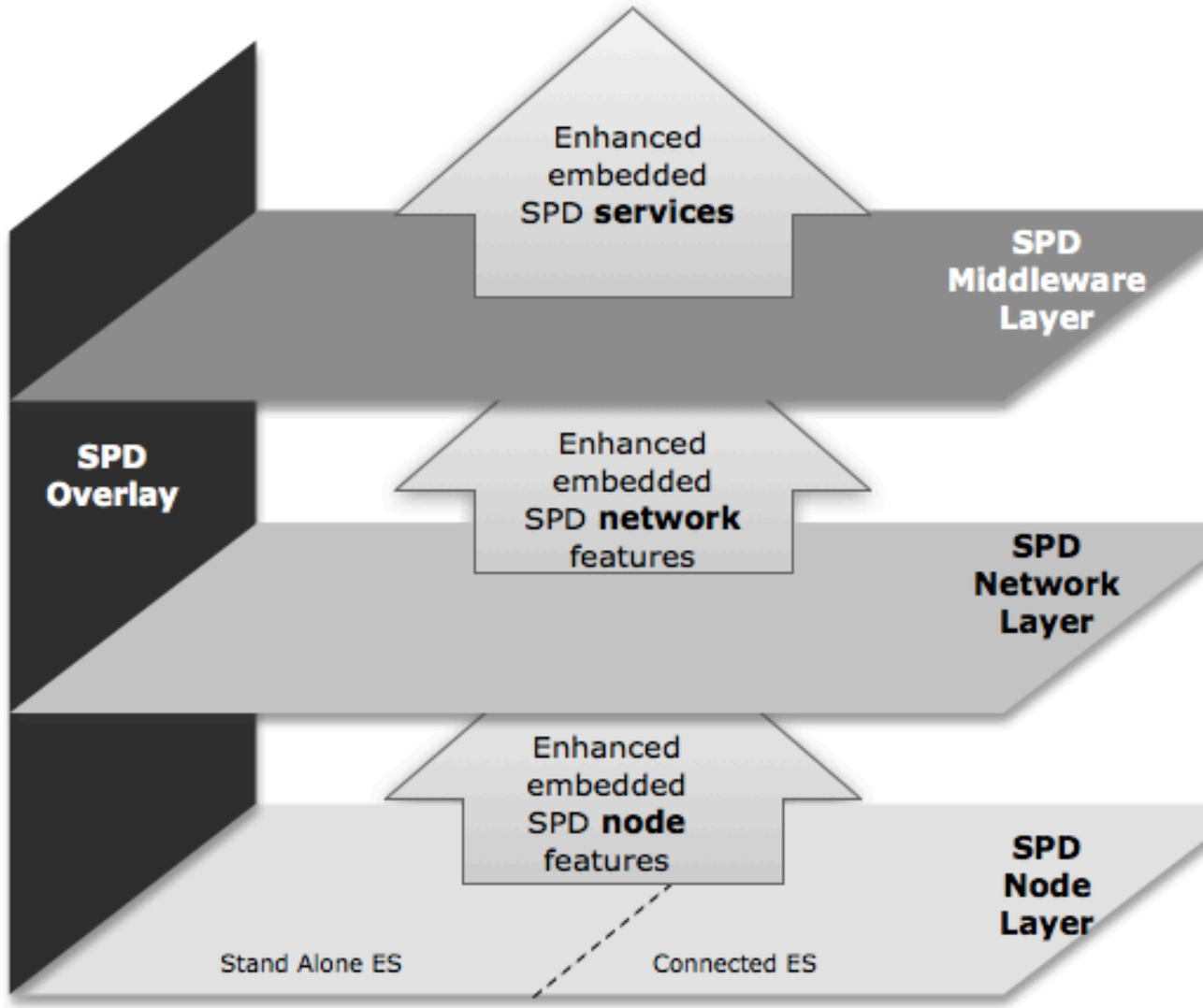
Security Challenges in embedded ICT

- Security, here
  - –security (S)
  - –privacy (P)
  - –dependability (D)
- across the value chain
  - –from sensors to services
- measurable security?



Measurement of Security, Privacy and Dependability (SPD) functions

***SPD Function** : a software, hardware or firmware component, that must be relied upon for the correct enforcement of the security, privacy and dependability policy.*

To obtain → *SPD level : a quantification of SPD function expressing the protection which can provide against Faults (FUA, NFUA and NHMF)*

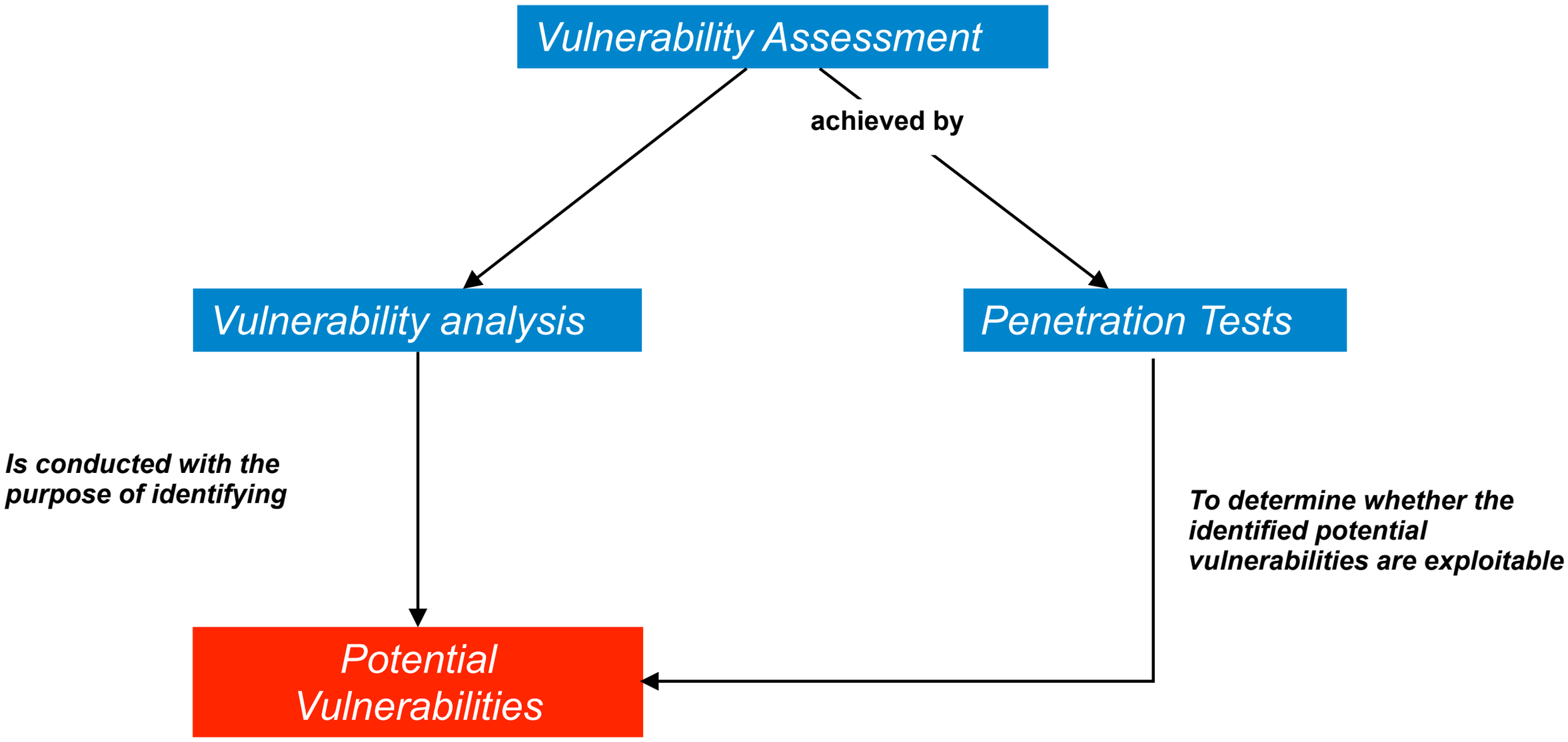
SPD Metrics specification: SPD value

With our calculation method we obtained the SPD level:

- ***Gathered following an international standard: ISO 15408***
- ***Consistently measured, without subjective criteria***
- ***Expressed as a cardinal number***
- ***Contextually specific, relevant enough to make decisions***

SPD level is not expressed using at least one unit of measure, such as “defects”, “hours” or “dollars”

SPD Metrics specification: SPD functions for reducing FUA metric construction method



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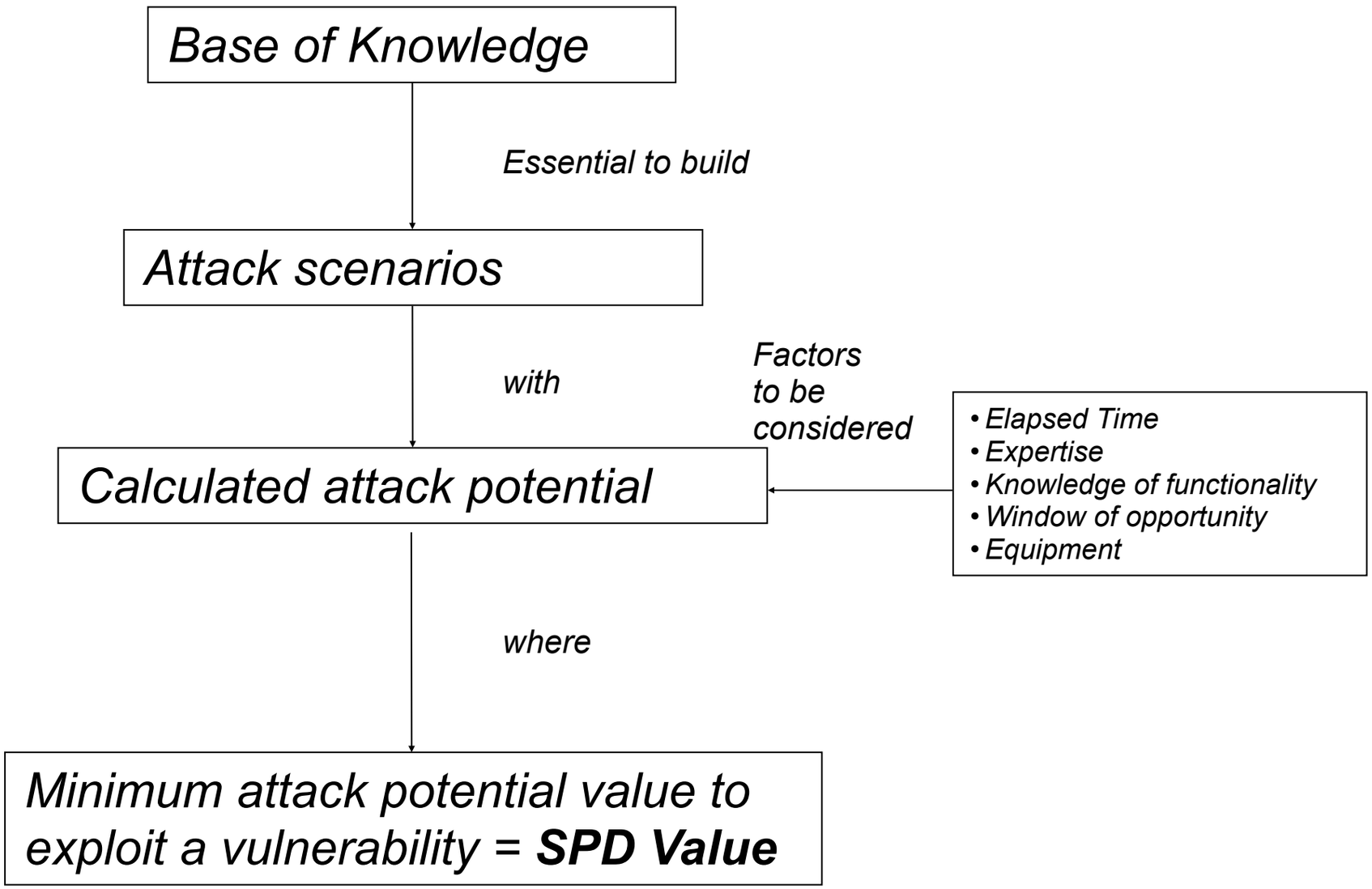

Factor	Value
Elapsed Time	
<= one day	0
<= one week	1
<= one month	4
<= two months	7
<= three months	10
<= four months	13
<= five months	15
<= six months	17
> six months	19
Expertise	
Layman	0
Proficient	3*(1)
Expert	6
Multiple experts	8
Knowledge of functionality	
Public	0
Restricted	3
Sensitive	7
Critical	11
Window of	
Unnecessary / unlimited access	0
Easy	1
Moderate	4
Difficult	10
Unfeasible	25**(2)
Equipment	
Standard	0
Specialised	4(3)
Bespoke	7
Multiple bespoke	9

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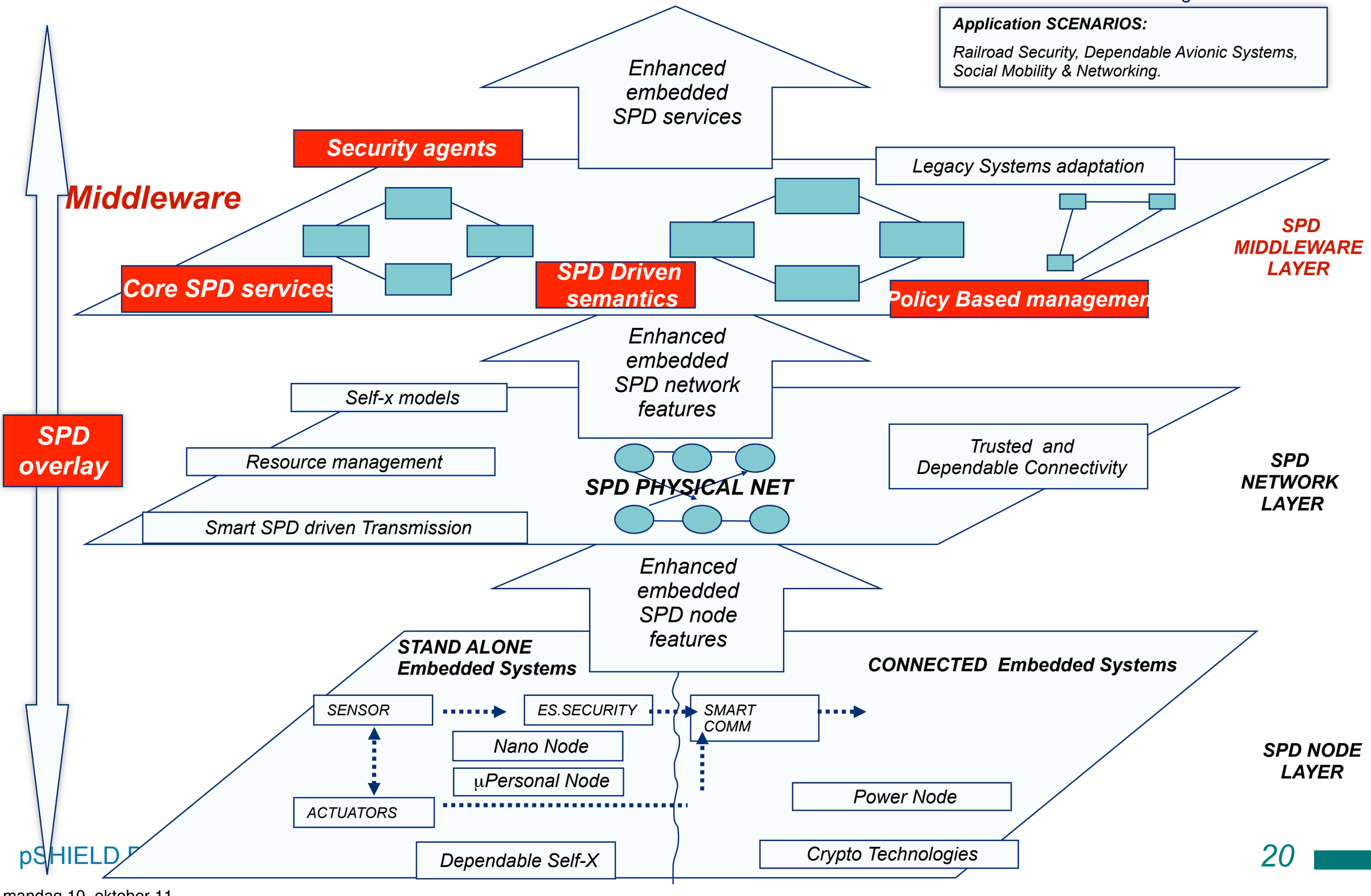
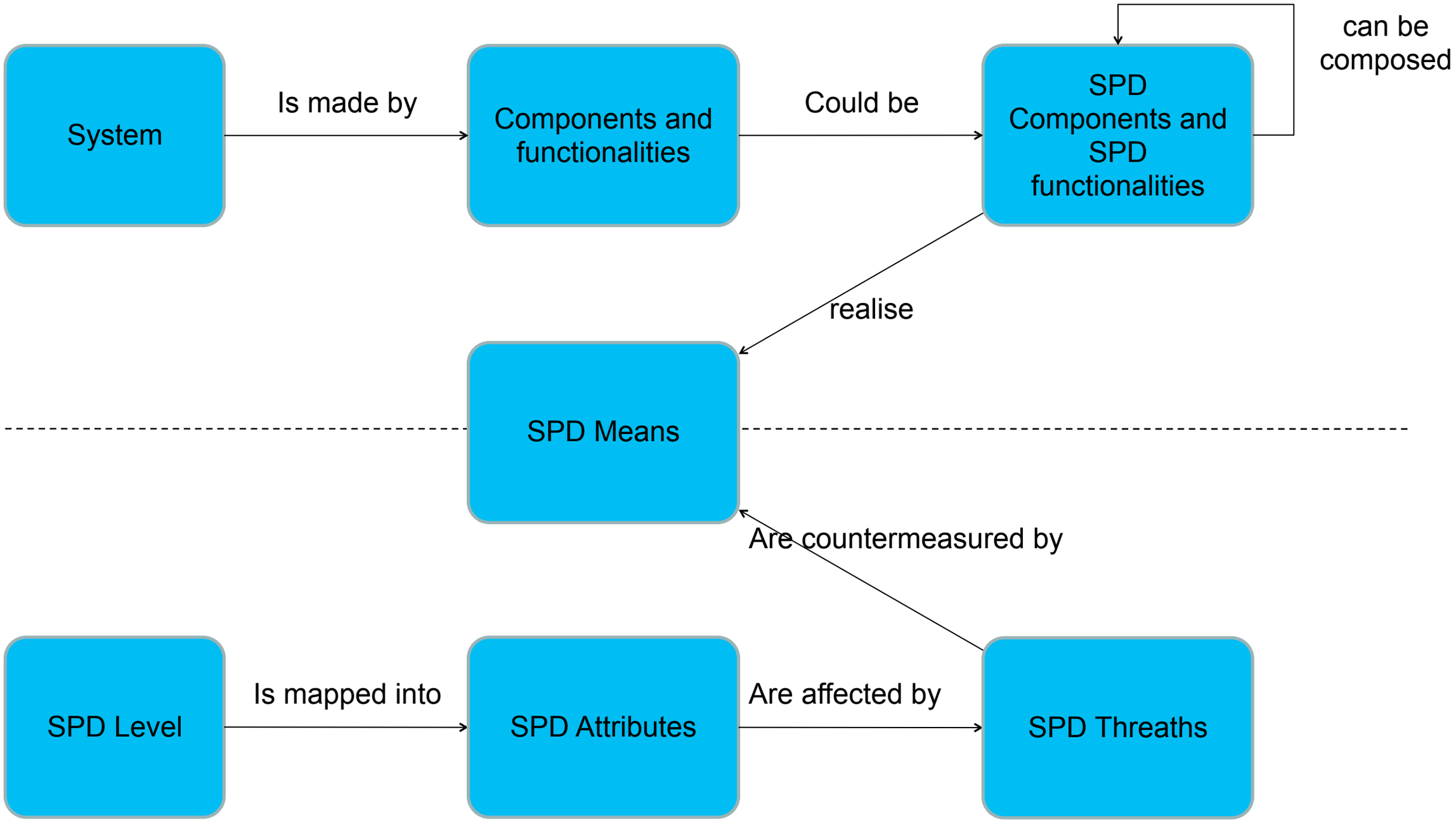
Middleware Contextualization



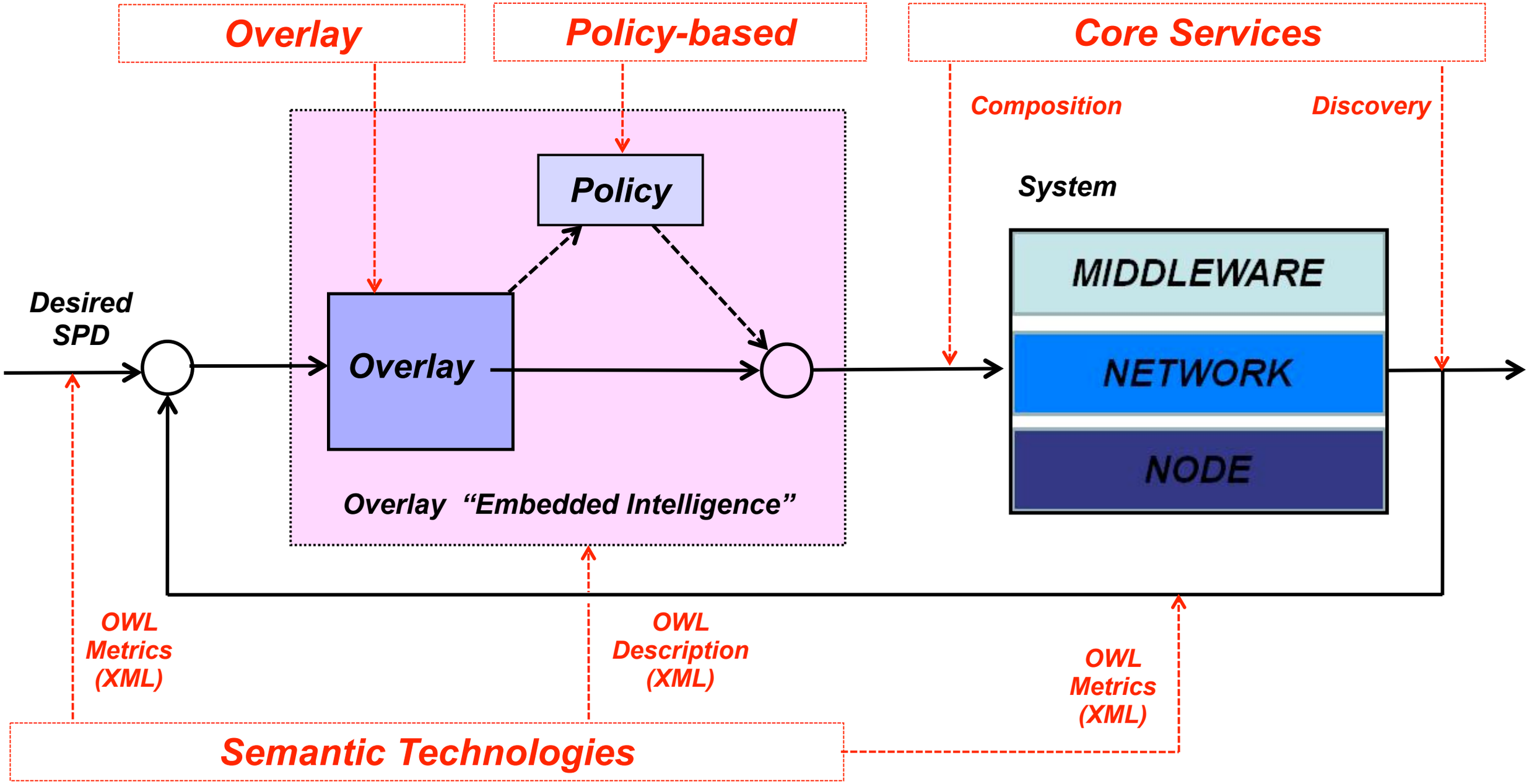
Semantic in a nutshell (see prototype)

Ontology logical representation: each concept is modeled and the relations are identified in order to have the logical chains that enables the SPD-aware composability



Semantic Representation

In order to realize the pSHIELD key concepts, the tasks are mapped and justified in this way:

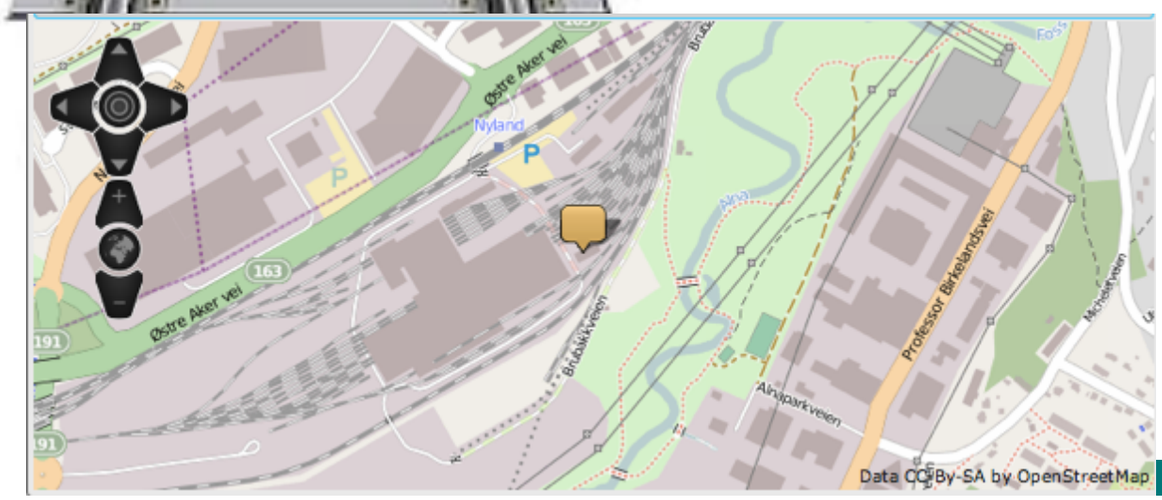


Overview - prototypical demonstrations

- SPD levels are achieved through specific configurations by the overlay
- Nano-Micro-Personal-M2M Platform
- Monitoring trains with WSNs
- FPGA Power Node Prototype
- Cognitive Radio Node Prototype

Also prototypes for

- pSHIELD semantic model prototype (ontology)
- Policy-based management and hyb automata model

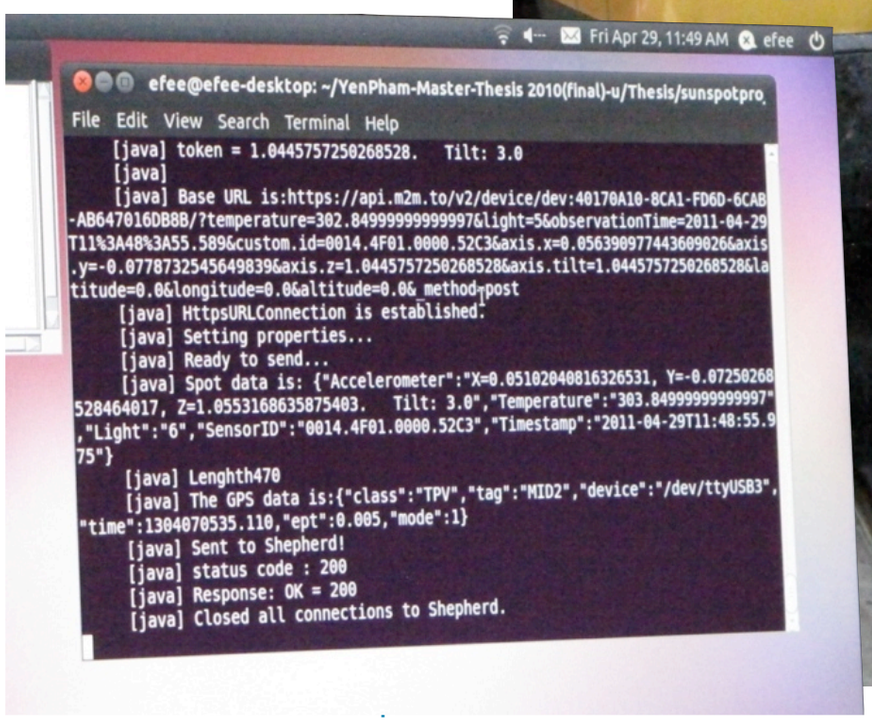


Pilot: Semantic Overlay and Composability

- SPD levels are achieved through specific configurations by the overlay
  - demonstrating the behaviour of the pSHIELD middleware
  - demonstrating SPD-driven composability
  - using metrics-formulation from WP2

Pilot: Nano-Micro-Personal-M2M platform

- Nano-Micro-Personal-M2M Platform
  - security interworking between embedded sensors and Telecom service platform
  - Identify SPD functions in an integrated embedded sensor testbed
  - opens for SPD metrics based composability

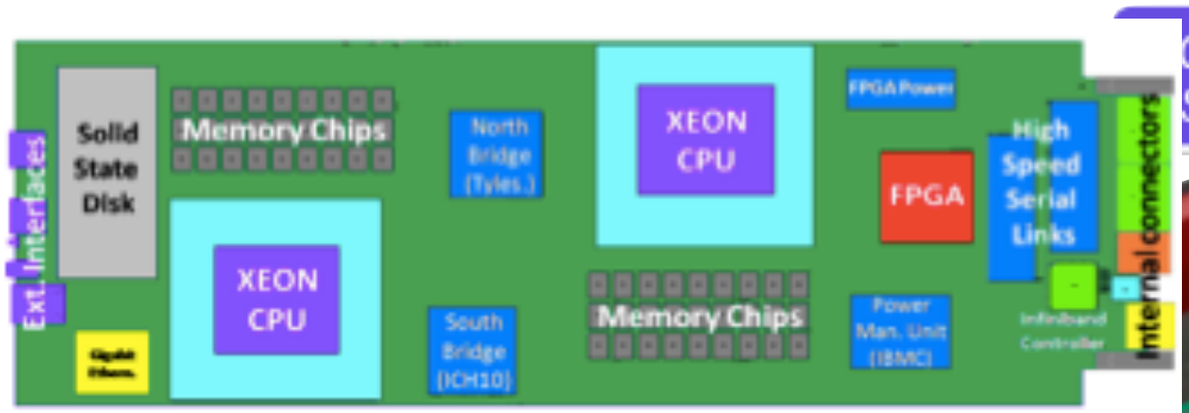


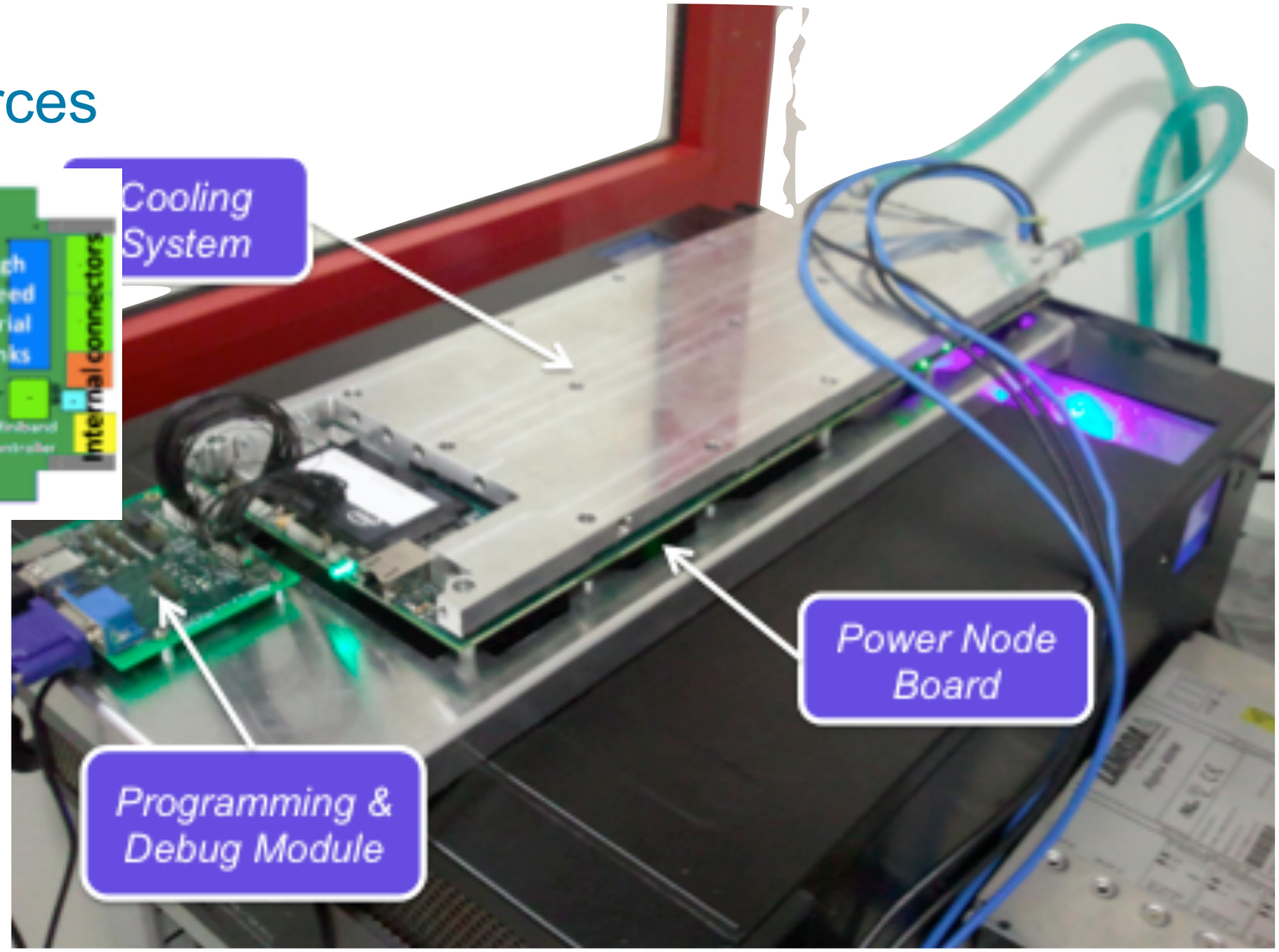
Pilot: Monitoring trains with WSNs

- Monitoring trains with WSNs
  - identity requirements of real-world applications
  - Identify SPD functions in an integrated embedded sensor testbed
  - opens for SPD metrics based composability

Pilot: FPGA Power Node Prototype

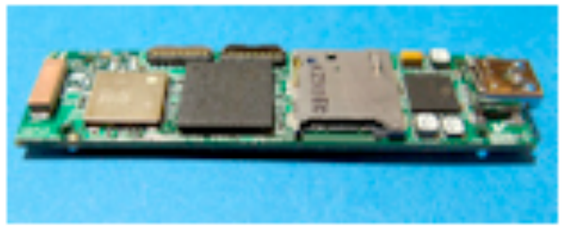
- FPGA Power Node Prototype
  - modular system reconfiguration
  - self-dependability at node layer
  - hardware and software security and privacy service provider
  - management of power sources





Pilot: Cognitive Radio Node Prototype

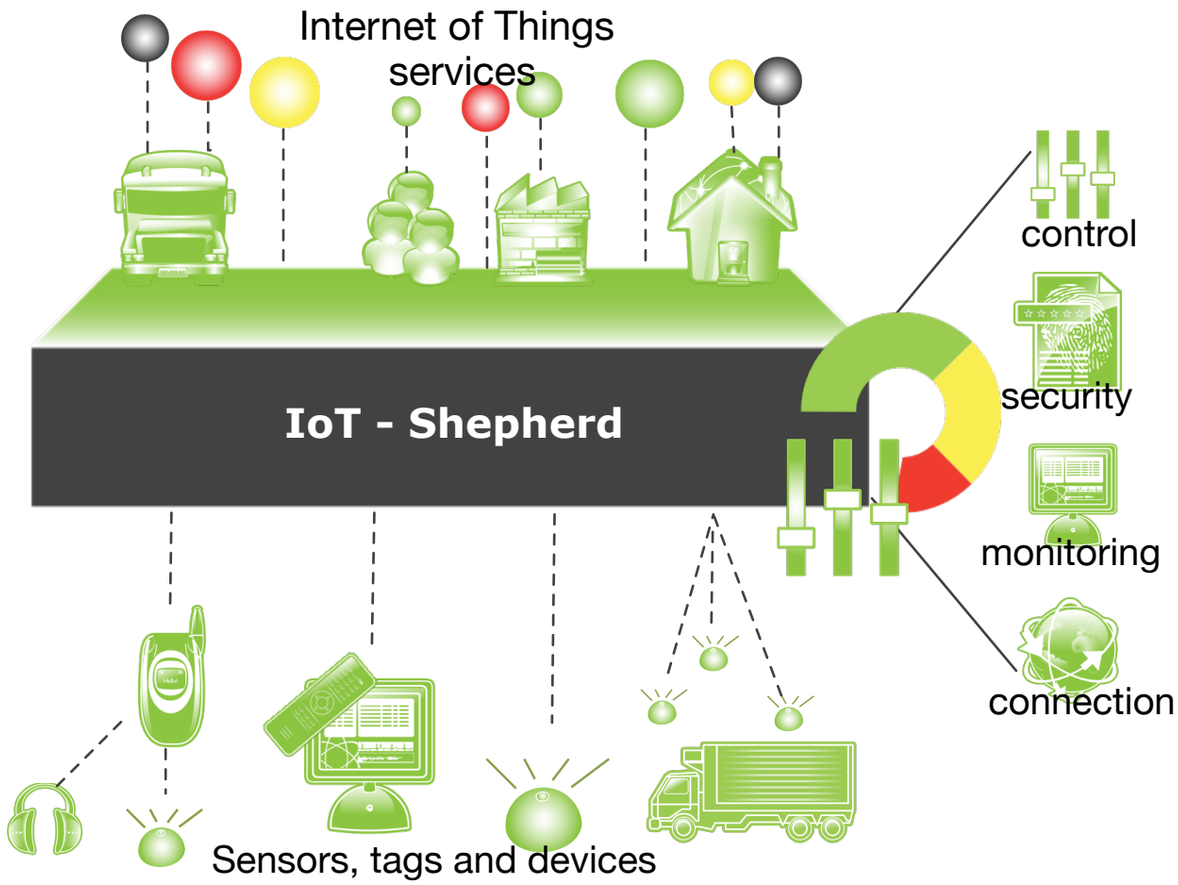
- Cognitive Radio Node Prototype
  - reconfigurable radio components with waveform Tx parameters
  - Sensing mechanisms to acquire awareness about resources
  - Cognitive algorithms elaborating available resources
  - Embedded platform adaptation for validation of algorithms



PCB OMBRA-pSHIELD – OMAP uP (18x68 mm)
WCP (1K pieces) =~150 Euro
Computational Power 5X

Integrated Operations for Telenor Objects

- Telenor Object's Shepherd platform contains SPD features
  - device ID
  - encryption
- Ongoing the Shepherd platform to cope with
  - role-based access for guests, suppliers
  - identification of security threats
- Contribute to ETSI TS102.690 for M2M functionality
  - extension toward heterogeneous environments



Conclusions

- Security, privacy and dependability
  - Sensor systems
  - Heterogeneous infrastructures

- The value of integrated operations
  - oil & gas: Billions of US$/year

- Integrated Operations
  - for the whole privat sector
  - for the public sector

- Open Issues
  - trust-based security
  - content-awareness (and context-awareness)
  - security metrics

My special thanks to

- JU Artemis and the Research Councils of the participating countries (IT, HE, PT, SL, **NO**, ES)
- Andrea Fiaschetti for the semantic middleware and ideas
- Inaki Eguia Elejabarrieta,Andrea Morgagni, Francesco Flammini, Renato Baldelli, Vincenzo Suraci for the Metrices
- Sarfraz Alam (UNIK) and Geir Harald Ingvaldsen (JBV) for the train demo
- Zahid Iqbal and Mushfiq Chowdhury for the semantics
- Hans Christian Haugli and Juan Carlos Lopez Calvet for the Shepherd interfaces
- Przemyslaw Osocha for running the project
- and all those I have forgotten to mention