



*“Architecting the
Internet of Things”*



Dieter Uckelmann
Mark Harrison
Florian Michahelles
Editors



Universität Bremen

Motivation for the Book „Architecting the Internet of Things“



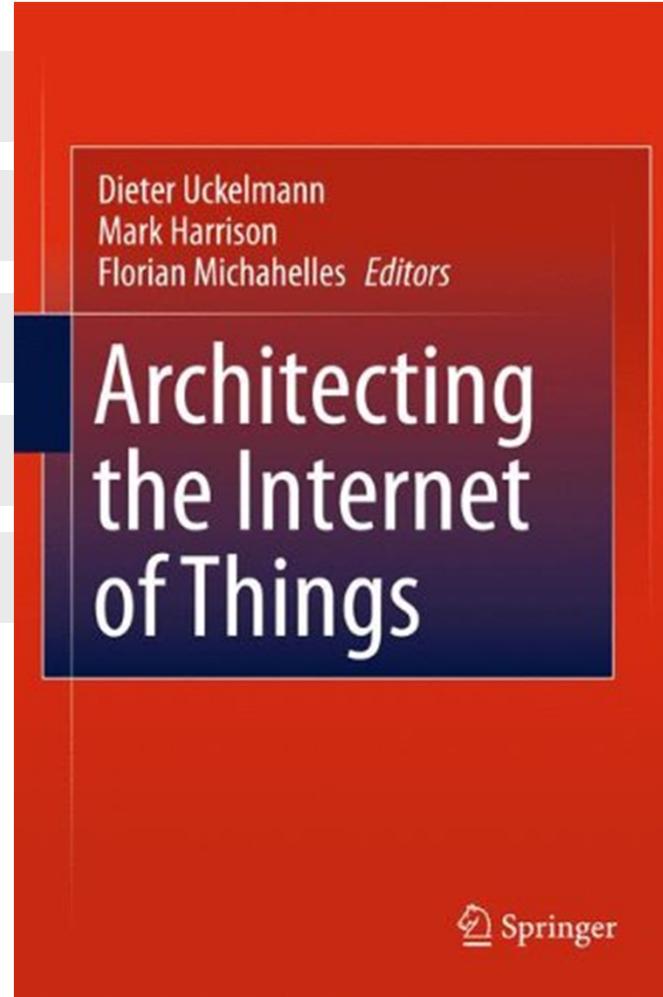
1 Envision

2 Extend

3 Enable

4 Excite

5 Evaluate



Architecting the Internet of Things

Uckelmann, Dieter; Harrison, Mark;
Michahelles, Florian (Eds.)

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Hardcover

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Universität Bremen

PSPS Planung und Steuerung
produktionstechnischer Systeme

Architecting the Internet of Things

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The Internet of Things – Threats and Opportunities of Improved Visibility



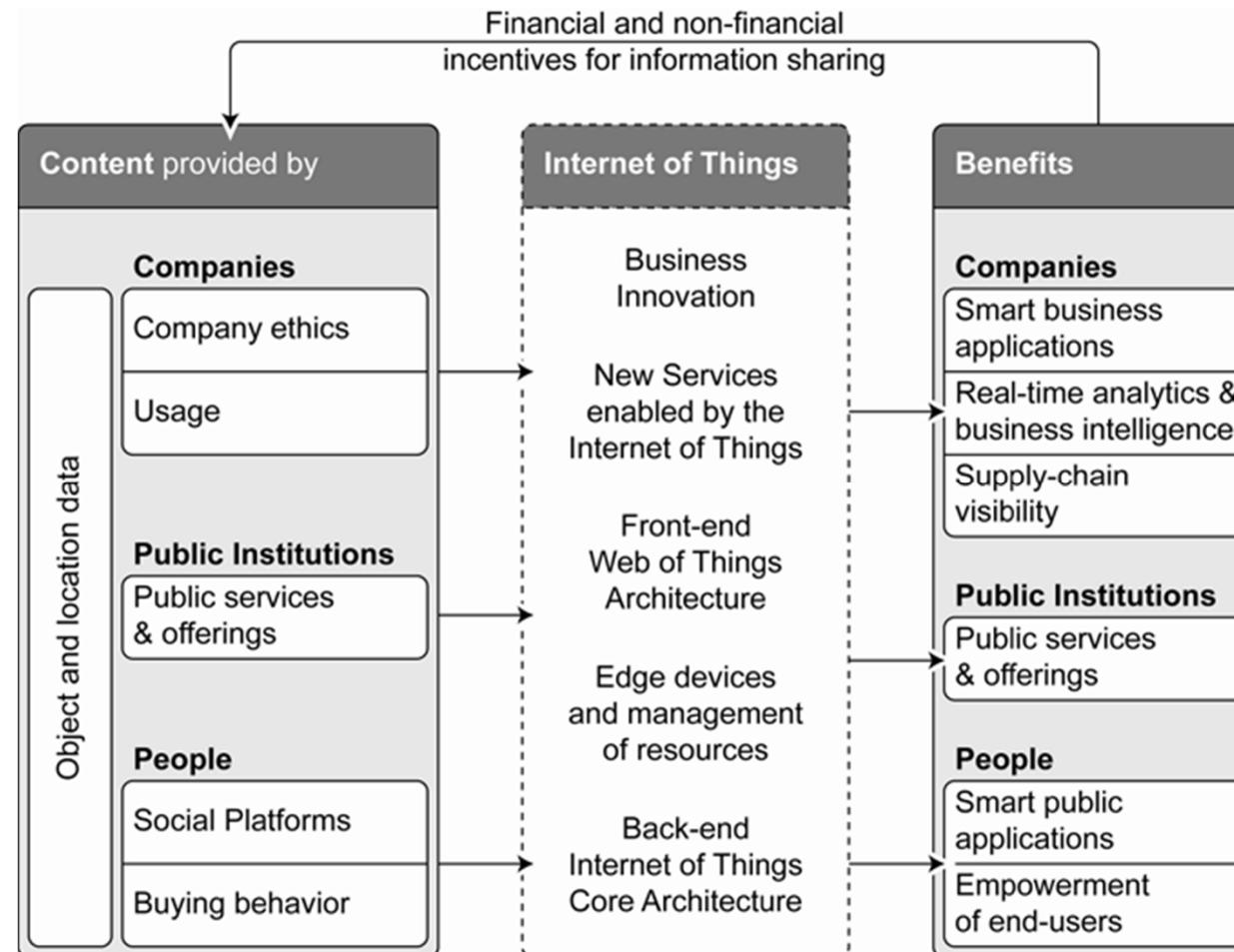
- **Foreward by Prof. Dr.-Ing. Bernd Scholz-Reiter**
- *“Responsible usage will be rewarded in a world that is more and more influenced by social and sustainable management. Businesses have already seen boycott requests in the Internet of Things that have forced them to rapidly change their strategy. It will be important for enterprises to understand that these self-regulating mechanisms are extremely powerful and can change their business for the better or worse. We should always remember the power of a web-cam showing an oil stream from a broken oil pipeline. The Internet of Things provides far more visibility than a webcam – yet, it also enables faster exception handling and agility, which may help to save money, the environment or even lives.“*

1. An Architectural Approach Towards the Future Internet of Things

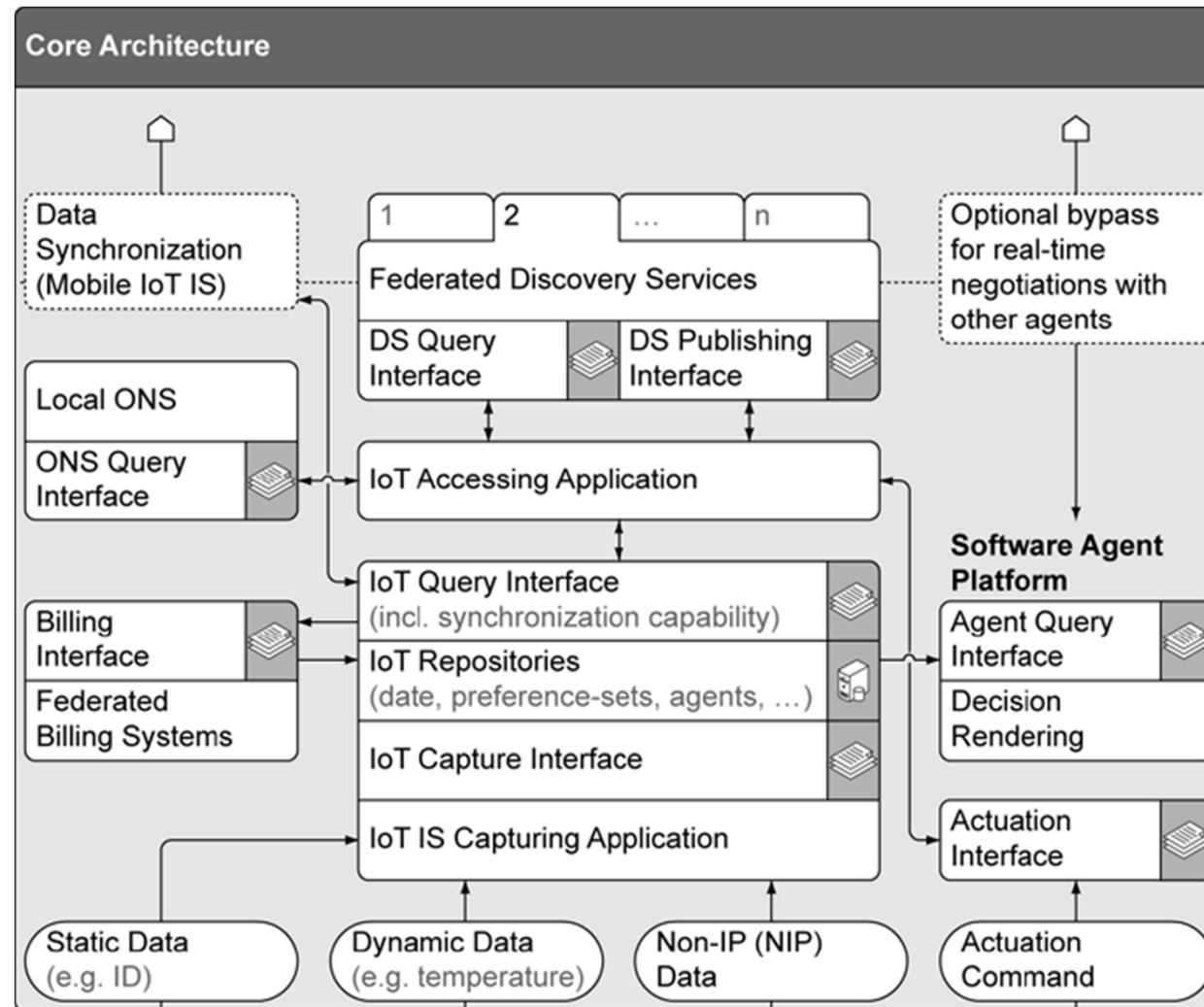


- Dieter Uckelmann, Mark Harrison, Florian Michahelles
- „*The future Internet of Things links uniquely identifiable things to their virtual representations in the Internet containing or linking to additional information on their identity, status, location or any other business, social or privately relevant information at a financial or non-financial pay-off that exceeds the efforts of information provisioning and offers information access to non-predefined participants. The provided accurate and appropriate information may be accessed in the right quantity and condition, at the right time and place at the right price. The Internet of Things is not synonymous with ubiquitous / pervasive computing, the Internet Protocol (IP), communication technology, embedded devices, its applications, the Internet of People or the Intranet / Extranet of Things, yet it combines aspects and technologies of all of these approaches.*

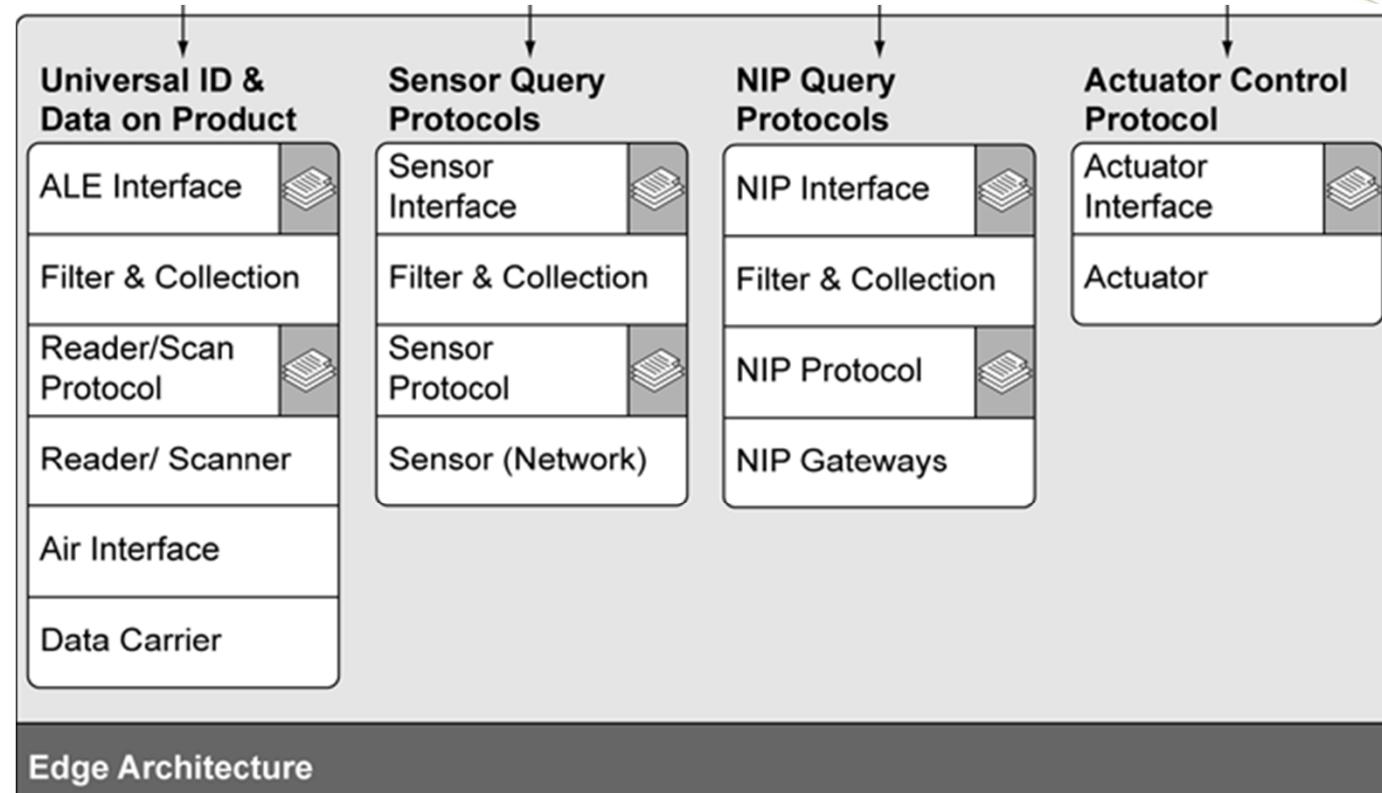
A Holistic Internet of Things Scenario Including Companies, Public Institutions and People



Core Architecture



Edge Architecture



2. About the “Idea of Man” in System Design – An Enlightened Version of the Internet of Things?



- **Sarah Spiekerman**
- *“If we take today’s Idea of Man in the Western world, which views men as responsible and mature (German: “mündig”), able to act rationally, and capable of defining themselves through moral autonomy and freedom of choice (Kant 1784/1983), we already establish some high level guidance for how systems should be built.”*
- *“Human Centric Computing considers how users can manipulate machines and how the contact is designed (Zhang 2005). Yet, less emphasis has been put on how to respect ethical system behavior systematically when designing backends.“*

3. Enabling the Masses to Become Creative in Smart Spaces



- Marc Roelands, Laurence Claeys, Marc Godon, Marjan Geerts, Mohamed Ali Feki, Lieven Trappeniers
- Based on: ITEA2 DiYSE Project
- *Tangible user interaction*
 - *the Call-Out Internet of Things (location, tags, image recognition)*
 - *the Smart Composables (DiY smart objects) Internet of Things, and*
 - *the Phenomena (collection, feedback, iteration, application) Internet of Things.*

Typology of DiY Creation in the Internet of Things



Sensor (actuator) data in
DiY web apps

Use Thing Data



DiY installation
(wireless) sensors/actuators

Connect Thing



Smartening & composing
DiY tangible objects

Build Thing



4. The Toolkit Approach for End-user Participation in the Internet of Things

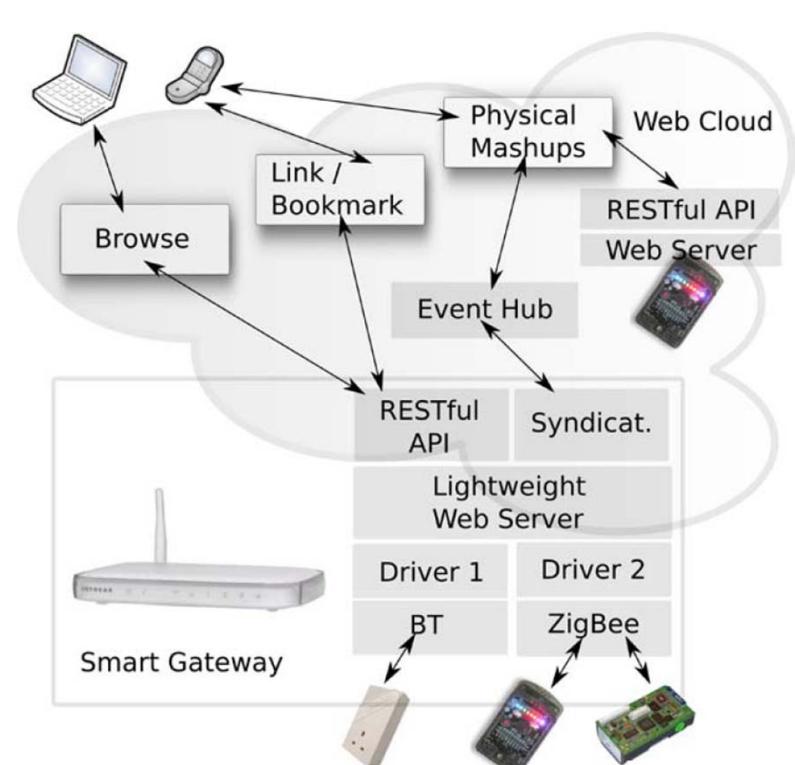


- Irena Pletikosa Cvijikj, Florian Michahelles
- *"In terms of Internet of Things, collaborative programming in all of its forms is a growing research field, aiming to involve end-users, i.e. individuals already in possession of the relevant need-related information, and allowing them to actively participate in the development of the next generation of Internet of Things. ... To achieve the high level of participation and excellent quality of resulting products, an environment has to be provided where barriers to contribute are low."*
- **I/O Boards and HW Based Systems (Wiring, Arduino, LilyPad, Make Controller, Phidgets, I-CubeX)**
- **SW Based Solutions (d.tools, iStuff, Lego Mindstorms, Pachube)**

5. From the Internet of Things to the Web of Things



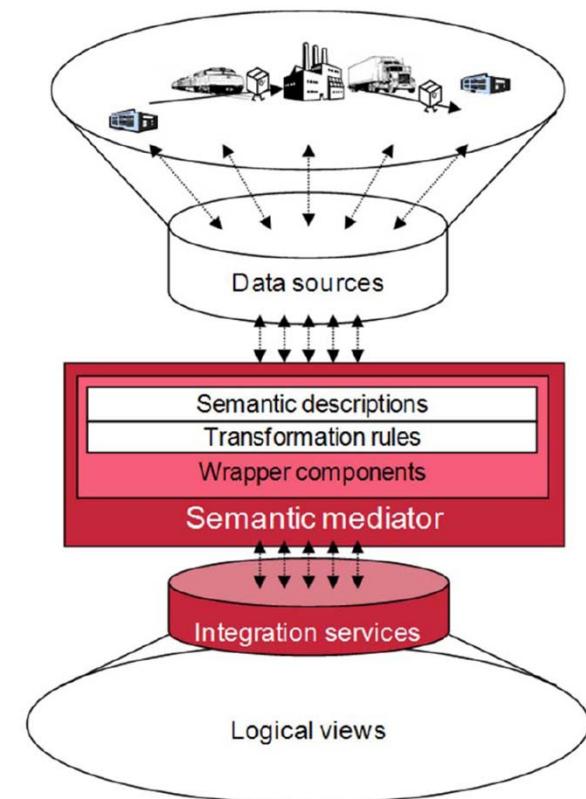
- Dominique Guinard, Vlad Trifa, Friedemann Mattern, Erik Wilde
- “*In the Web of Things concept, smart things and their services are fully integrated in the Web by reusing and adapting technologies and patterns commonly used for traditional Web content. More precisely, tiny Web servers are embedded into smart things and the REST architectural style (Richardson and Ruby 2007; Fielding 2000) is applied to resources in the physical world (Guinard et al. 2010c; Luckenbach et al. 2005; Duquennoy et al. 2009; Hui and Culler 2008).*”



6. A Service-oriented, Semantic Approach to Data Integration for an Internet of Things Supporting Autonomous Cooperating Logistics Processes



- Karl A. Hribernik, Carl Hans, Christoph Kramer, Klaus-Dieter Thoben
- *“The proposed system architecture follows the traditional pattern of a semantic mediator - besides the actual mediator component, which possesses an ontology of autonomous cooperating logistics processes, the wrapper components each contain extension ontologies, which fully formalise the data sources they are responsible for as semantic descriptions. Heterogeneity conflicts are solved either by the mediator component itself or by the respective wrapper, depending on the type of conflict.”*



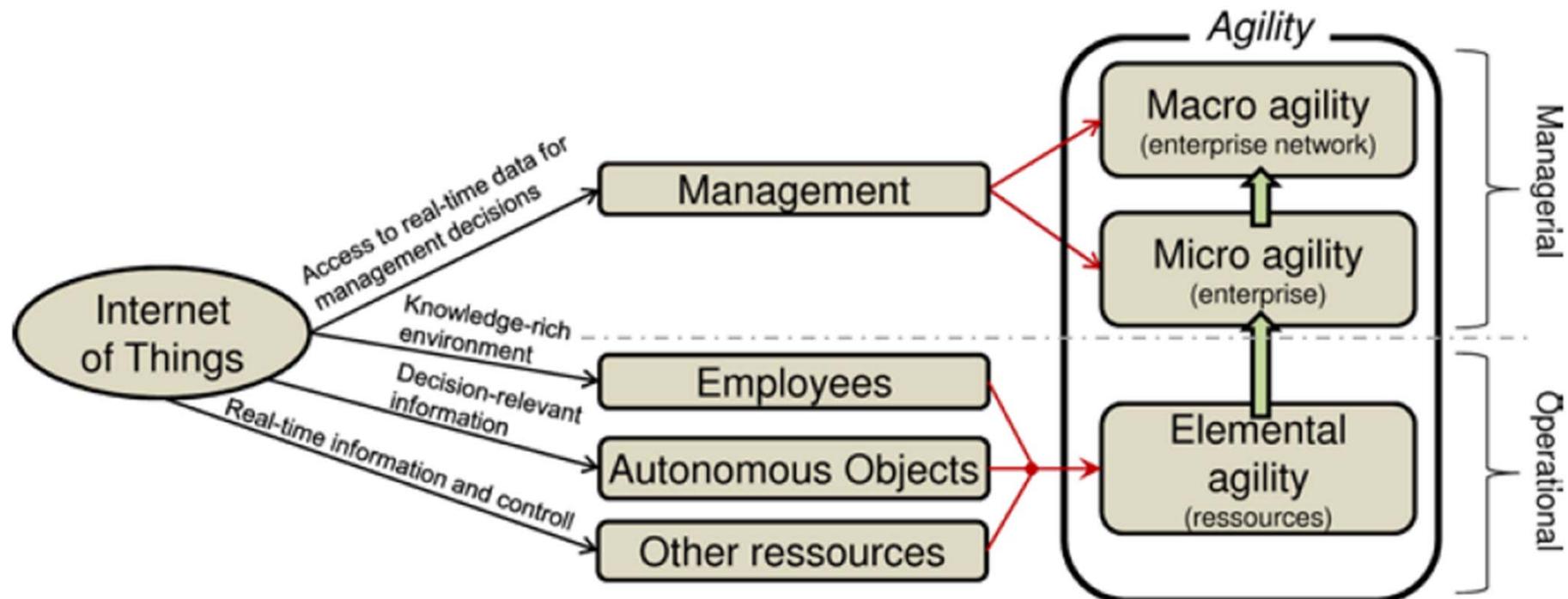
7. Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents



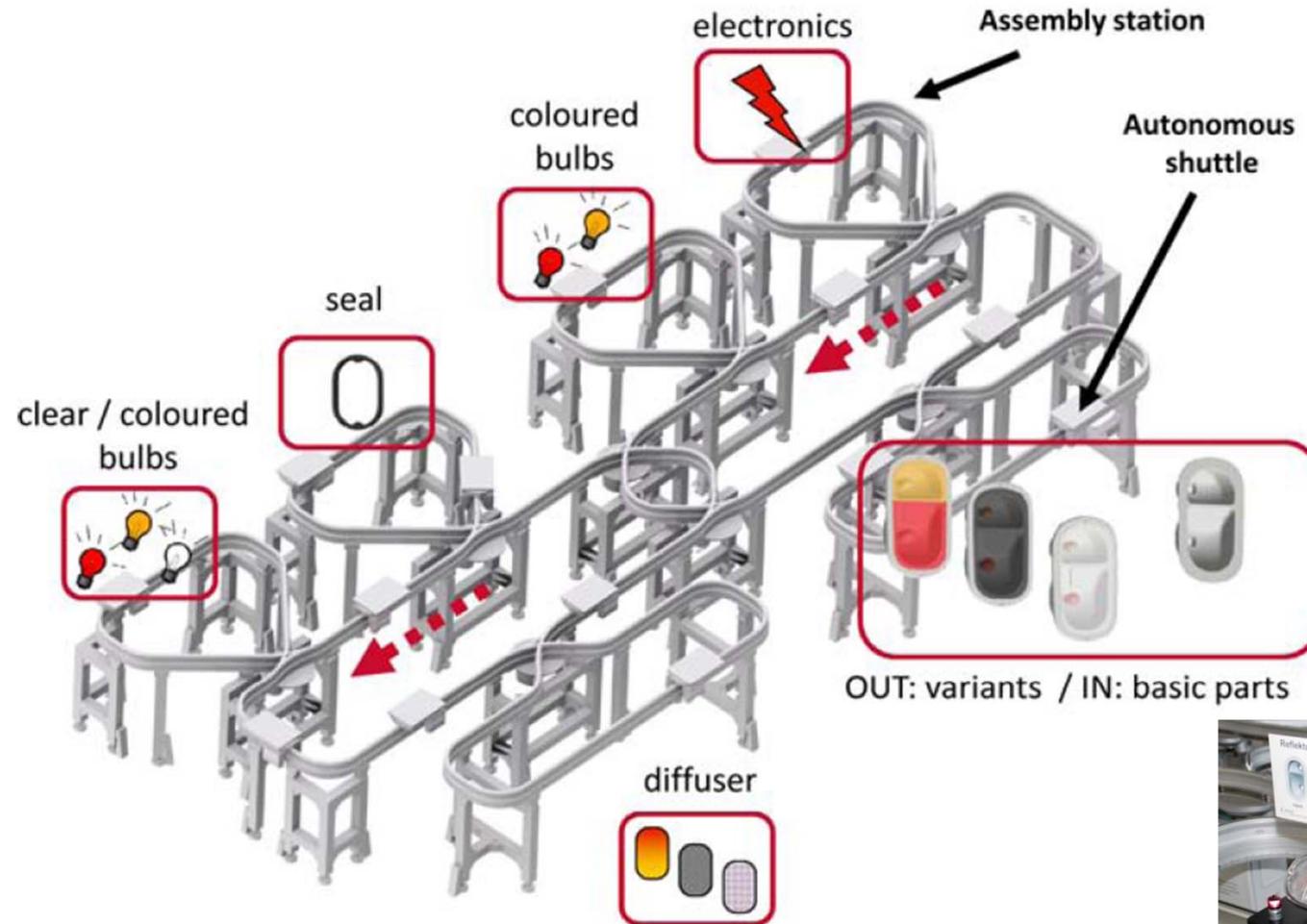
- Tomás Sánchez López, Alexandra Brintrup, Marc-André Isenberg, Jeanette Mansfeld
- *“Among the many challenges in the realisation of the Internet of Things vision, many times the management of the resources of the embedded devices that will power the Internet of Things objects is overlooked. In this chapter, we have discussed three techniques that will assist these constrained devices to empower the Internet of Things services for extended periods of time, while providing the objects with enhanced capabilities that positively influence the collection of object information.”*

8. The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments

- Marc-André Isenberg, Dirk Werthmann, Ernesto Morales-Kluge, Bernd Scholz-Reiter



A Practical Assembly / Production Scenario



9. Integrated Billing Solutions in the Internet of Things



- Dieter Uckelmann, Bernd Scholz-Reiter

The image shows two overlapping software interfaces. On the left is the 'EPCIS query interface client' showing a configuration window for a 'Billing Integration'. It includes fields for 'Query Interface URL' (http://192.168.170.56:8080/epcis-repository-0.4.2/query), 'Authentication Mode' (Basic), 'Username' (bottler_A), 'Password' (*****), and a 'Get Invoice' button. Below this are sections for 'Subscribe Management' and 'Events to be returned' (with checkboxes for Objectevents, Aggregatorevents, Quantityevents, and Transactionevents). A 'Query arguments' section shows 'event time >=' set to '2010-10-01T05:20:31C' and 'ignore' set to '[]'. A large 'Run query' button is at the bottom, with a callout pointing to a modal dialog box titled 'Fittable results' containing the message: 'The query result contains fittable rows. Do you want them to be included in your result?' with 'Ja' and 'Nein' buttons. On the right is the 'ORDERS - VIEW' screen from LogDynamics. The top navigation bar includes 'Orders', 'Payments', 'Reports', 'System', 'Users', 'Items', 'Refunds', 'Invoices', 'Process', and 'Notification'. Sub-menus like 'Create', 'List', 'Reports', 'Help', and 'Periods' are also visible. The main area is titled 'Order Details' and displays a table of order information:

Number	210713
Status	Active
Period	Monthly
Type	post paid
Active Since	30-Nov-2010
Active Until	
User Number	3220
Login name	bottler_A
Date created	30-Nov-2010 06:28:29 AM
Next Day to invoice	321
Created by user	Euro
Currency	No
Notify customer on expiration	
Notification step	
Date of last notification	
Due date	Default
Notes	
Include notes in invoice	No

Below this is a table of items with columns: Item ID, Number, Description, Prov. Status, Quantity, Price, and Total. The data is as follows:

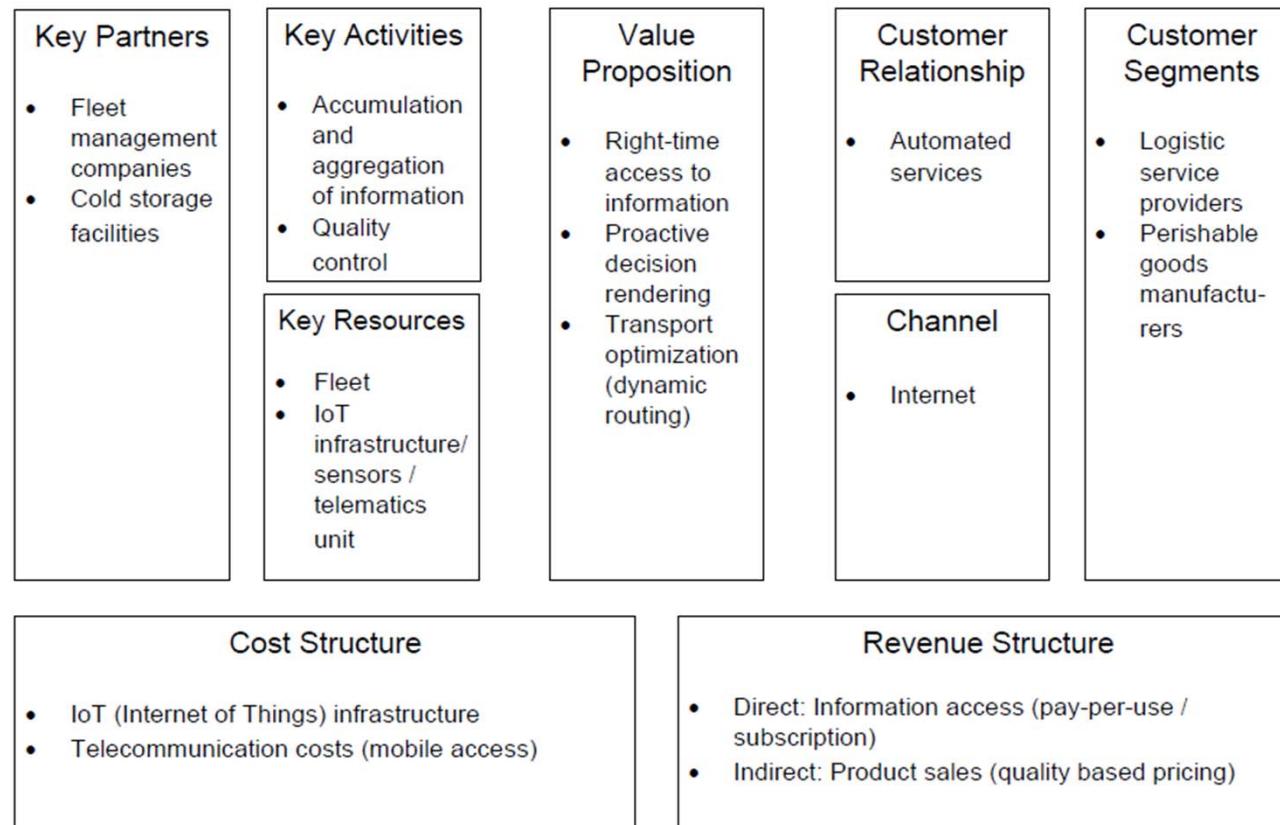
Item ID	Number	Description	Prov. Status	Quantity	Price	Total
1800	D-100 Deposit pallet	Inactive	5	80.00	400.00	
1801	D-101 Refund pallet	Inactive	3	-80.00	-240.00	
1802	D-102 Deposit dolly	Inactive	0	40.00	0.00	
1803	D-103 Refund dolly	Inactive	0	-40.00	0.00	
1804	D-104 Deposit tray	Inactive	75	10.00	750.00	
1805	D-105 Refund tray	Inactive	45	-10.00	-450.00	
1806	D-106 Deposit bottle	Inactive	900	0.15	135.00	
1807	D-107 Refund bottle	Inactive	540	-0.15	-81.00	
1811	I-100 EPCIS Query (per record)	Inactive	1	100.00	100.00	
1812	S-100 Monthly submission fee	Inactive				
1808	U-100 Usage time pallet (per day)	Inactive	5	0.08	0.40	
1809	U-101 Usage time dolly (per day)	Inactive	0	0.04	0.00	
1810	U-102 Usage time tray (per day)	Inactive	75	0.01	0.75	

€ 616.75

10. Business Models for the Internet of Things

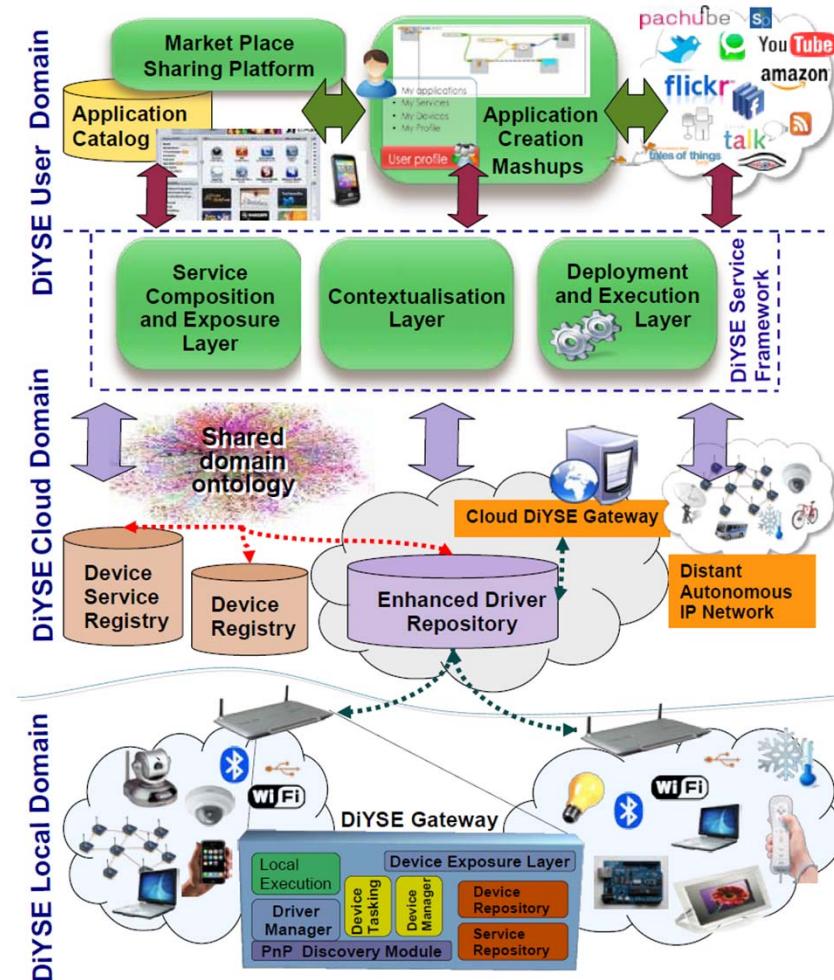


- Eva Bucherer, Dieter Uckelmann



11. The DiY Smart Experiences Project

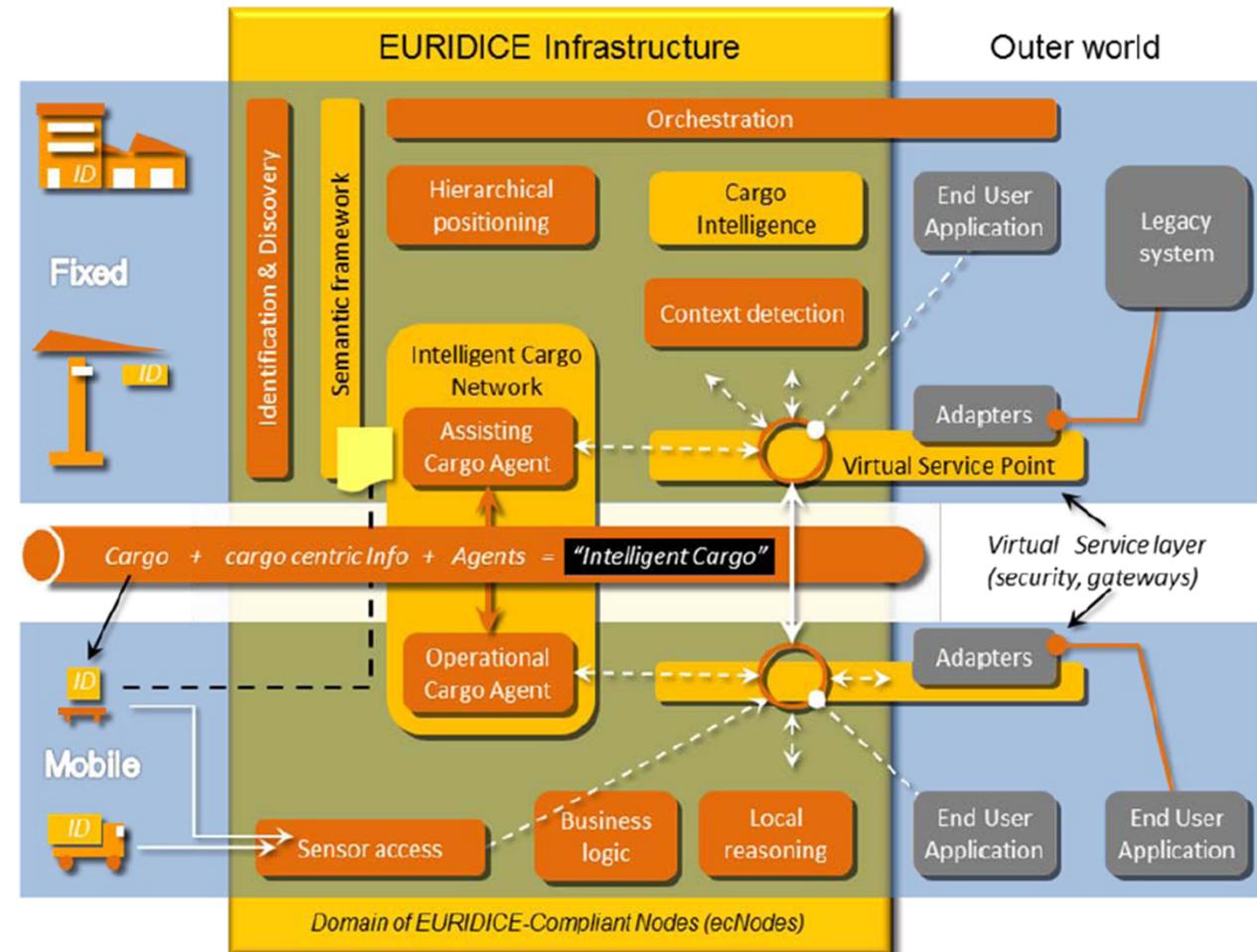
- Marc Roelands, Johan Plomp, Diego Casado Mansilla, Juan R. Velasco, Ismail Salhi, Gyu Myoung Lee, Noel Crespi, Filipe Vinci dos Santos, Julien Vachaudez, Frédéric Bettens, Joel Hanqc, Carlos Valderrama, Nilo Menezes, Alexandre Girardi, Xavier Ricco, Mario Lopez-Ramos, Nicolas Dumont, Iván Corredor, Miguel S. Familiar, José F. Martínez, Vicente Hernández, Dries De Roeck, Christof van Nimwegen, Leire Bastida, Marisa Escalante, Juncal Alonso, Quentin Reul, Yan Tang, Robert Meersman



12. Intelligent Cargo – Using Internet of Things Concepts to Provide High Interoperability for Logistics Systems



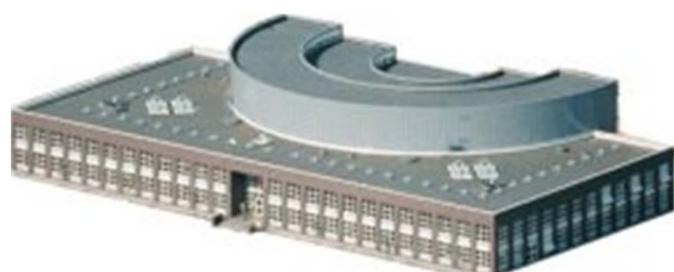
- Jens Schumacher,
Mathias Rieder,
Manfred Gschweidl,
Philip Masser



Contact



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