IoT-A
Internet of Things - Architecture

Internet of Things
Architecture

IoT-A Community Newsletter Special # 6

EDITORIAL

IoT-A Newsletter Special #6

"But one thing I know for sure is, now that the Internet of Things is the present and not the future…
The human race is going to continue to grow. The quality of our lives is going to continue to grow; the length of our lives is going to continue to grow. And so the task for this new generation of technology and this new generation of technologists is to bring tools to bear on the problems of scaling the human race. –
It is really that simple."
Kevin Ashton, in his opening talk at IoT Week 2013, Helsinki

You find this special edition mainly covering the recent line up of events for IoT-A: IoT China 2013, IoT Forum Brazil and IoT Week 2013, Helsinki with selected sessions, in particular on the stakeholder workshops.

In this issue:

Interested to follow up on any of these items?

Mail Rob van Kranenburg,
Stakeholder Coordinator kranenbu@xs4all.nl

IoT-A, the **European Lighthouse Integrated Project** addressing the Internet-of-Things Architecture, proposes the creation of an architectural reference model together with the definition of an initial set of key building blocks. Together they are envisioned as crucial foundations for fostering a future Internet of Things. Using an experimental paradigm, IoT-A combines top-down reasoning about architectural principles and design guidelines with simulation and prototyping to explore the technical consequences of architectural design choices. More Information at **www.iot-a.eu**

IoT China 2013, Shanghai

IoT China 2013, Shanghai

Wang Lie of CCPIT Shanghai Sub-Council stated that as IoT leaves the factory and gets closer in people's livelihood, the focus should be on upgrade technologies of IoT.

Jia Hongbao, Deputy Director of Shanghai Radio Administration Bureau, welcomed the full Conference Room at Yangtze Marriot to the Fourth Internet of Things Shanghai Conference and the amazing speed with which the new developments in IoT were showing promise for better life of citizens. Zhang Aiping, Deputy Director, Economic & Information introduced the concept of IoT Styles, and focused on Pudong as a specific style of smart city development. About 80 application programs look at what can be connected in Pudong, and investments follow the public private partnership procedures of 90% funding by industry and 10% driven by government. Through open sessions and a process of iteration the indicators that are used to build best practices have been brought down to 20. The expectations of citizens should be met, that is the key issues. There even is a smart dustbin use case; as lids are sometimes so dirty people do not use them. In Pudong Smart City IoT is seen as a strategic initiative, and the aim is to offer a series of platforms that can be scaled.

Highly personalized services: that was also the key message of **Joe Chou**, of Microsoft. The key to data is personalized. This leads to three issues: we need good feedback and the main prerequisite to manage the quality of that for group services is to manage trust. The bottleneck is legal issues, as a lot of data need to be shared. We need to move from a stable concept of privacy to sets of privacies, building new balances between the stakeholders: government, industry and citizens. Director of Bosch Communities and Innovation through Internet of Things, **Stefan Ferber** stated that although Iota is horizontal technology the biggest system human mankind has ever build - it has to be successful in verticals.

It is a system that we are building, but cannot observe anymore as a system. It is therefore of great importance how we break down the segments that we can still steering. Bosch has broke down the IoT in mastering 10 challenges, going fully for an internet of things – searching for a tcp/ip for IoT – instead of lots of intranets of things: robust connectivity and usable security is essential. The user experience should be as simple as a key but less complex than millions of keys. In a hybrid ontological space of and a reality of de-perimeterized entities, identity, according to Stefan Ferber, is the new perimeter. Throughout the subsequent meetings in Wuxi it became clear that this is indeed the case. It feeds the ideas of building a world of IoT platforms based on the current identity management system of the passport (a piece of paper with a chip), turning that into a device (a chip plus a screen). Especially in the meeting with **Andy Qiu** and **Michael Cheung**, with representatives from the Wuxi government, it became clear that this process is already set in motion with the existing platforms of the Wuxi One Card (home, work access, shopping, parking…) and the One Screen pilot that looks publishes real time community information.

Stefan argued that a lot of technical (big data, big code) issues would be solved along the way, but that governance issues need a lot of careful negotiation between the top down – ITU – players and the growing bottom up ecology on Kickstarter, Open IoT Assembly and IoT Meetups. It is essential that these groups talk to each other. All stakeholders will have to give up some agency in order to reach the win-win-win situation where we have collective accountability (a community approach is necessary as software agents are not accountable -, open x (data, innovation, hardware, platforms) otherwise data will stay in silos, innovative business ecosystems instead of value chains (like the Eclipse Foundation that treats technical API's as business API's finding new ways of building business models combining products and services.) In a business ecosystem enterprises are living in the same space. The platform is the water.

The mastering of the challenges posed by technology, trust and business need a strong purpose. This is a mental and philosophical task.

IoT China 2013, Shanghai

Ms. **Chen Shudong**, Professor, Institute of Microelectronics of Chinese Academy of Sciences & Lab Director, Jiangsu R&D Center for Internet of Things, agreed to this view stating that there are more then only technological challenges in IoT. Although real time monitoring combined with a seamless network leads to a clear understanding it takes more then a high performance network to run a city. A city is not a factory. It is where we live. Data need to be shared between the different stakeholders, and for this a new type of systematic network is necessary. Without such a system, interoperability cannot be achieved.

Again this argument leads to the OIP pilot, One IOT China. As according to Shudong Chen smart city developments should be led by government, China – and Wuxi more specifically- is the best location globally to start building the model that Steve Jobs proposed for Apple: one device, one platform and one app store.

Stefan Ferber of Bosch, Rob van Kranenburg, Stakeholder Coordinator of IoT -A, and Gu Chunting, President CCPIT Shanghai Sub-Council, Shanghai International Exhibition CO, Ltd.

Markus Eisenhauer, Department Head of User-Centred Computing and Head of Ubiquitous Computing of FIT Fraunhofer Institute for applied Information Technology, presented the EU project EBBITS, of which he is the coordinator. With use cases in smart food and smart production the project looks at what is actually happening in IoT deployment, as well as envisaging roadmaps for nearby scenarios to help directing current investment strategies. In smart manufacturing collaboration should happen at the lowest level; among the devices themselves. This integration on device level is necessary so you can focus on delivering meaningful services. Again this argument, from another perspective leads to the OIP pilot. The one device, platform, app store is a logical IOT management framework for multi-stakeholder cooperation. Ideally it will be adopted by all current large blocks, including Europe. In Europe it could lead to a 500 million single market overnight, leaving the bankrupt current value chain in order to move a new ecosystem and value model. The biggest drawback to this however is its current political and administrative leadership that is incapable of grasping the disruptive aspects of IOT in a way that the Chinese leadership – mainly engineers – is capable.

Armin Schneider (Technical University Munich, Research Group MITI) and **Thomas Jell**, Program Manager, Infrastructure & Cities, Mobility, Technology & Innovations, Siemens AG, are part of the Stakeholder Group of IoT-A. IoT-A, the Internet of Things Architecture, is the European flagship project in the Seventh Framework Program for Research and Technological Development concerning the EU commission's main instrument for funding research in Europe. The project aims at laying the foundation for a future Internet by overcoming not only technological, but also socio economic challenges.

The IoT-A stakeholder group is one of the considerable sources for obtaining external input as well as feedback on the current status of project work. This shows very plainly the two main functions of the stakeholders within this project, viz. to contribute to the requirements and the validation. The success of reaching IoT-A objectives are measured in particular by validating the outcomes against the expectations of the stakeholders involved in the IoT-A project and the stakeholder group. On a more practical level, the implementation of the health use case will prove the applicability of the IoT-A architecture in real life settings and scenarios. **Christoph Thuemmler**, IoT-A Stakeholder and part of the Health use case with Armin Schneider and Thomas Jell, was surprised to see that the requirements of the other Stakeholders at the first IoT-A Stakeholder Workshop in Paris were so similar. In Shanghai at IOT China 2013, **Armin Schneider** explained how medicine becomes more personalized as professional competence is that put into practice, will be subjected to continuous documentation. This kind of full monitoring will be found invasive, yet although it does show when things go wrong it also and equally forcefully show when things go right. The basic idea is that IoT will become a knowledge base and actuator that is as good as an experienced nurse. Next to doctors and nurses Armin predicts engineers in the operation theatre within ten years.

IoT Week Helsinki 2013

Franck Le Gall, **Sophie Vallet Chevillard**, and **Zhang Xueli** of PROBE-IT argued that deploying IoT in large scale still encounters various issues both on technical and non technical dimensions, and that moving to larger scale requires a better understanding and assessment of the actual benefits of IoT deployments. PROBE-IT compares and evaluates IoT deployments to allow stakeholders to make thought choice having in hands elements to compare, evaluate & assess the actual benefit of IoT deployment, whatever their application field, and own characteristics are:

Benchmarking as a decision making tool
A decision making tool based on comparison:
To produce a judgment (black-box) (normative)
To identify the good practices, related to the implementation (instrumental)
To learn from the others deployments (cognitive)
→A benchmark answers to the users' questions
→A benchmarking framework provides direction for the development and use of benchmarks

IoT Week Helsinki 2013

Kevin Ashton, the British technology pioneer who co-founded the Auto-ID Center at the Massachusetts Institute of Technology, which created a global standard system for RFID and other sensors, opened IoT Week with a pre-recorded video message [http://kevinjashton.com/2013/06/17/pre-recorded-opening-talk-for-internet-of-things-week-helsinki-june-17-2013/] as he could not make it in person, alas. He spoke to "the vibrant and growing community of stakeholders he is proud to have been a part of it for about 15 years now." He insisted on the realization that IoT is here now, it is not future but present:

"But one thing I know for sure is, now that the Internet of Things is the present and not the future, we have a whole new set of problems to solve. And they're big problems. And they're to do with architecture, and scalability, and data science. How do we make sure that all the information flowing from these sensors to these control systems is synchronized and harmonized, and can be synthesized in a way that brings meaning to data. It is great that the Internet of Things is here. But we have to recognize we have a lot more work to do."

Claiming that it is not just important to do the work. It is important to understand why the work is important:

"The Internet of Things is a world changing technology like no other. We need it now more than ever. There are immeasurable economic benefits and the world needs economic benefits right now. But there is another piece that we mustn't lose sight of. We depend on things. We can't eat data. We can't put data in our cars to make them go. Data will not keep us warm."

Kevin ended his impressive and productive talk by expressing his confidence in the community and the inevitability of the technological convergence by saying that he has "no doubt that we have to build this network and no doubt, that is going to help us solve the problems of future generations by doing a much more effective job of how we manage the stuff that we depend on for survival."

European Commission Cluster Coordinator **Peter Friess** agreed wholeheartedly with Kevin Ashton and stated that indeed the key focus had to be on what do we want to do in the next years to bring it back to society. It is not easy to 'sell' IoT as it is so pervasive and a generic enabler to provide for application silos from smart cities to regions. The speed of the development also requires for the community to have fast and evolving iterations of improving the message of what IoT can bring to society as a whole and industry in general. He sees three key challenges:

1. **Interoperability**: Work is needed on generic and broad platforms, as they are the materialization of the Architecture Reference Model(s)
2. **Semantics**: how to exploit data from one sensor with dedicated context to other domains and contexts
3. **Representations**: A representation of a real world in a virtual world can explore scenarios and feed them back to the real world. If we connect these virtual worlds then we might bypass a lot of real world difficulties.

IoT Week Helsinki 2013

Ovidiu Vermesan, Chief Scientist SINTEF, Oslo, Cluster Coordinator of the IERC-European Research Cluster on the Internet of Things - funded under 7th FWP (Seventh Framework Programme) underlined the same issues of platform convergence and virtualization and added that in the coming years we need to see more cooperation between different external stakeholders as well as more focused interplay between the projects themselves.

Mario Campolargo, Director of the Net Futures Directorate, EC agreed that the continuous challenges caused by the network convergence calls for focused and swift action within a holistic perspective: societal models, smarter cities, sensing enterprises and ecosystems of SME.

Kimmo Ahola, of Tekes, Finnish Funding Agency for Technology and Innovation invoked that China is Number 1 when it comes to publications on IoT and although IoT is high up the hype cycles he referred to the still silo structures and vertical non integration of IoT applications.

Jan Arkko of Ericcson, Chairman of the International Internet Engineering Task Force (IETF), carried the word of the Conference: **Permissionless Innovation**. He started from the fact that a lot of successful things have happened recently in conceptually quiet new spaces where you don't have to ask anyone for permission. The Open Innovation of the web enables real time communication in your browser facilitating programmable networking. As the key to IoT is general purpose technology he stressed again and again how important it is to reach interoperability at all layers. **Return on Information** (ROI) was the second keyword to come out of IoT Week. It was coined by Lion Benjamins who pitched his spin off project from PROMISE in the Business Model Contest session organized by **Franck Le Gall**, **Sophie Vallet Chevalier** and **Betrand Copigneaux**. The third new term is by **Abdur Rahim** (ICore) Internet of thing (IoT) is "an enabler of **Internet of Relation** (IoR). IoR is main driver of IoT. IoR can also play important roles in privacy and security. If I give you a pile of data, you will not be interested in all the data but only the data is related to you." He brought this term to bear on the debate on smart cities. A session that was notable for the clear, concise and very productive presentation by **Zach Shelby** who hammered on standards as the key enabler of IoT (watch out for IETF CoAP soon) and the tremendous potential globally in building new urban environments from scratch dropping the notion of gateways and deploying end to end connectivity and security from the cloud to the device, building a value chain all the way down to the sensors. **Yo Nakajima** of Hitachi (once a small electrical repair shop, he reminded us) conveyed that their 2015 Mid term Management Plan is focused on social innovation. The keyword is visibility: going back to the roots of the social interaction to add value and meaning with services and products. He showed an electrical vehicle use case.

Michael Koster, invited by the 6th IoT-A *Stakeholder Workshop*, agreed wholeheartedly with this focus on interoperability stressing that predominantly we are still building highly efficient silos. Building IoT on top of M2M will exponentially increase value; network effect, yet we are currently not easily enabling resources to be connected. Broad interoperability will enable this second wave of value (beyond the initial one of optimizing and efficiency): Common Data Models, API's, System Abstractions, REST API and event driven software (apps can run in the cloud, gateway, local or even on device) in short an *Open, Horizontal Platform* is needed to create this common layer. Building this Platform from the ground up this Open Source Internet of Things (osiot.org) linking to all standard organisations it attempts to create a small compact API where IoT applications themselves could look like a graph with the semantic web as an information backplane. We do not need a lot of top down research at this moment, according to Koster. He praises the EU approach that has been publishing research in this field (ubicomp, pervasive computing, intelligent information interfaces, Disappearing Computer, ambient intelligence…) for the over 20 years. Combining this theoretical effort with a bottom up and agile approach that is not bogged down by the next quarter as bottom line profit statement syndrome. An American IoT integrated research programme has only recently kicked off, and at the same time we are on the ground and running. There is no not so much need a common platform; we need middleware as the goal is to be able to relate concepts around/across platforms and language. In Europe IoT-A started as some common ground, where all architectures could come together and meet. Michael Koster says he and osiot.org s going to try to plug in to this "standard", not so much as confirming to the ARM but hook in with what is being done there and cooperate to move it fur-

IoT Week 2013 Helsinki

ther as a de facto standard. This led to a question from **Sergio Gusmeroli** whether this focus on open data, access, innovation, open source was not the logical way to get most, if not all, stakeholder requirements as early as possible.

To **Alex Bassi**, the Technical Coordinator of IoT-A who moderated the morning opening session, and has always conceived the EU IP with **Sebastian Lange** (until recently Coordinator of IoT-A) that ends in November 2013, as a kind of TCP/IP for IoT, a horizontal layer of deep interoperability, these arguments aligned perfectly with his own ideas of building an OS that runs *in between* the devices.

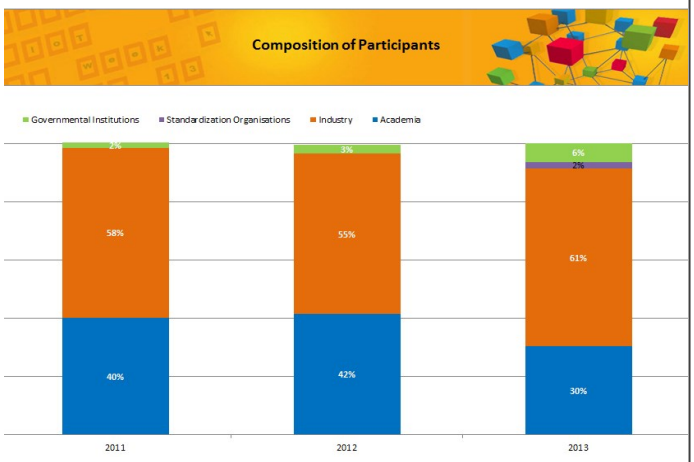
Keynoting in the *Business Model Pitch session* were Alicia Asin Perez and Stefan Ferber. **Alicia Asin Perez**, CEO of Libelium shared a story of bootstrapping in the network by doing the opposite of the general advice; no patents, but open source, not hiding of data but publish fiercely, raise the first capital with a creative business plan, do not invest in pitching for VC. Libelium started to make a little money after six months with a strong product, always focused on making money, not borrow or raise it – and was in the market from day 1. The company culture of Friday evening dinners cooking together has actually inspired a spin off – cooking hacks; step by step ingredients for cooking a 'hack'. It's open innovation and agility because of tester and customer feedback (often the same) brings to Libelium the organic growth it wants keeping course with this adagium in mind: the best IP protection is continuous innovation. **Stefan Ferber**, Director Communities & Partner Networks of Bosch explains how IoT is shifting power to R&D and agility bringing twittering machines (mqtt is the protocol also used by Twitter) to the manufacturing space. That has traditionally (and still is) been the forte of Germany. CEO's and politicians realize that if some other region would leapfrog Germany in manufacturing that that would be extremely problematic for the social model and the social contract. There is a lot at stake. Germany has identified the to-do's – predictive maintenance, horizontal modelling, extreme mass customization (to the limit of '1'), adaptive logistics, from supply chain to supply networks in a programme called Industrie 4.0. Stefan foregrounded the importance of the real interest and involvement of the Chancellor.

Citizen involvement and political commitment, these are the keywords for Member of European Parliament, **Maria Badia i Cutchet**, who chaired the resolution on Internet of Things from Parliament on IoT in 2010, that called for a multi-stakeholder approach to foster trust by citizens in the infrastructure and political commitment from the member states. She focused predominantly on the social repercussions of IoT and hyper connectivity. She sees Horizon 2020 as a tool for IoT and the investments in R&D as pragmatic and opportunistic leverage. In privacy and data security, people's right and privacy should come first. The right to silence of the chips is an important tool.

Internet of Things is becoming something of an issue, the beginning of a 'solid' set of research questions as was evident from the tone of questions raised in the audience. **Ina Lauth** expressed her hopes that interfaces to the EU data-analytics community could be made as soon as possible. **Lion Benjamins** related how he and the PROMIS project felt they were not able to interface easily or not at all with the IoT community. Although for most in the community this was really strange to hear, it is clear that a) events like IoT Week offer the possibility to voice and redress issues like this early, b) his initial point is strong, true and well taken; there is too little building on what is been done, there has organization of competition between flagship projects and especially in a fast moving and agile field like IoT the EU has to capitalize on what has been already done. **Ovidiu Vermesan** agreed that more could be done in tuning the IERC projects into a repository of building blocks, but they disagreed that it was difficult to interface to the IERC/ioT community, a very open one. Besides that, IoT is a continuum and very difficult to define with hard boundaries. The Activity Chains are active and apart from IoT-A there are a number more Architecture projects (Butler, I-Core) that are co-developing. After IoT-A is finished these project will, together with IoT Forum be the first points of reference for the legacy of IoT-A. **Philippe Cousin** who organized the International Session used this confidence as the guideline for his session; the EU has a lot to offer, we want to cooperate and we will start to market ourselves better.

Dear **IoT week 2013** enthusiasts,

we would like to take this opportunity to thank all participants and co-organising projects of the IERC Research Cluster who invested well a lot of effort into setting up a rich and interactive programme consisting of numerous dedicated workshops and plenary sessions this year with a strong focus on businesses and trends, offering insight into the latest proven concepts on architecture, interoperability, deployment, business models, IP technologies for the Internet of Things.



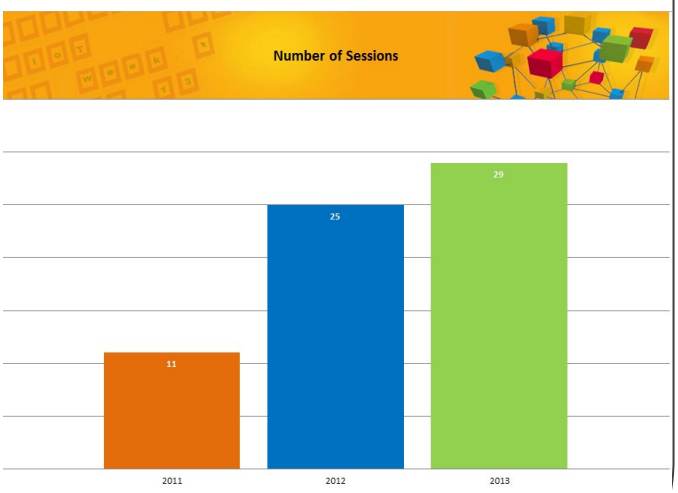
More than 200 experts originating from over 30 countries assembled this time during wonderful mid-summer-season in Helsinki and enjoyed high-level presentations, interactive sessions, advanced-IoT solutions and products at the collocated exhibition as well as sea breeze and delicious Finnish food in a maritime setting.

The **IoT Week 2013** saw a great line-up of welcomes and keynotes with Kimmo Ahola, Jari Arkko, Kevin Ashton (video message), Maria Badia I Cutchet, Mario Campolargo, Michael Koster and numerous high-quality speakers in the various sessions. Thanks to all for bringing expertise, opinion and valuable analysis in the field of Internet of Things to the attention of and for providing solid interaction with our participants.

Thus IoT week proved again a splendid meeting place for researchers and representatives from industry and politics active in the area of the Internet of Things to present, network, exchange and build upon new projects and ideas.

You can find all presentations and some impressions on the event website www.iot-week.eu.

We're proud, that for IoT Week 2013 edition we received encouraging feed-back and are able to again draw a very positive overall concluding résumé.



Finally **IoT Week 2013** saw the official inauguration of the IoT-Forum with the foundation statutes signed in Helsinki. The IoT Forum as a sustainable and heterogeneous international group of interested people and institutions will venture the organisation, promotion and development of the IoT Week in the future.

Thanking you very much again for your valued support and for being part in this mutual endeavour made possible with the support of the European Commission, **IoT week 2013** sponsors and the IoT-community.

Laure Quintin & Günter Külzhammer, IoT-A
on behalf of the IoT Week 2013 organizing team

IoT-A 101 in Brazil

IoT-A 101 & the IoT-A Meetup in Brazil

Can IoT create a value model for its 200 million citizens and 25 million mega cities like Sao Paulo that are at breaking point as their infrastructure was build for less then half of that? That was the underlying question of the IoT Brasil forum that organised a two day Conference. **Gabriel Marao**, **João Neves Fernandes** and **Luis Fernandez Lopez**, organisers, cleverly build it around a Interop test of RFID by ETSI in the EU project Probe-IT.
a two years European project that aims at supporting exploitation of European research advances in IoT deployments.

Gabriel Marao and João Neves Fernandes are close to real deployments on the ground as they operate from their company Perception. They also realise however that without strong organisation, real cooperation and sharing resources and infrastructure a Brazilian IoT will not get of the ground.

This need for cooperation and management was stressed in basically every talk. Apart from a strong focus on application areas of RFID and safety and security, especially in the two interventions of **José Roberto Amazonas** and **Gilson Schwartz** a strong focus on ethics was voiced. Gilson Schwartz stressed the importance of 'choice' in the entire shift towards a connected society, not just in end-user services. José Roberto Amazonas with his double background: Telecommunications Engineer and Psychoanalyst related that he was convinced that psychoanalysis can also contribute to the IoT ethics discussion. Many of the concerns of the issues raised in the ethics inside website (an IoT-i deliverable) can be expressed in psychoanalytical terms and adding this new perspective may, in his view, enhance the understanding of the challenge the society has to face.

It is not possible to ensure traceability, sustainability and security linking up the gateways of the different area networks that make up Internet of Things (BAN/body, LAN/home, WAN/car; VWAN/ city) without interoperability at architectural, domain specific and application level.

IoT-A, the Internet of Things Architecture, is the European flagship project in the Seventh Framework Program for Re- search and Technological Development concerning the EU commission's main instrument for funding research in Europe. The project aims at laying the foundation for a future Internet by overcoming the technological, and the socio-economic challenges we have outlined above.

The IoT-A stakeholder group is one of the considerable sources for obtaining external input as well as feedback on the current status of project work. It is no longer possible to build architectures in the lab or without real world input. IoT-A was very early in acknowledging this new reality where the lines between R&D, Innovation and emergent technologies are blurring.

To this day, the stakeholder contributions have been considered to a large extent as the stakeholder requirements from Stakeholder Worksop 1 formed the basis for the initial draft of the Architecture Reference Model (ARM), particularly the domain model and the functional decomposition. Each building block of the ARM was developed in view of the fact that all requirements are met to follow a holistic approach.

In *What Stakeholder Theory is Not*, Philps, Freeman and Wicks explain why an integrated stakeholder framework is so difficult: "The term stakeholder is a powerful one. This is due, to a significant degree, to its conceptual breadth. The term means different things to different people and hence evokes praise or scorn from a wide variety of scholars and practitioners."

According to them "public and private organisations are increasingly employing stakeholder engagement as an important strategy for improving external stakeholder relations", because "Incorporating stakeholders' opinions is valuable for improving decision-making processes and project implementation." Currently, the prevailing practice domain for stakeholder engagement is largely characterized by complex and dynamic environments containing a wide range of stakeholders, from hostile to conciliatory, from obstructive to collaborative".

This is an apt characterisation of The Internet of Things: complex and dynamic environments containing a wide range of stakeholders. As such it is an open and on-going

IoT-A Meetup in Sao Paulo / IoT-A 101 in Helsinki

ecology of environments, characterised by change and real-time combinatorial innovation.
For all their different backgrounds - automotive, health, logistics, retail… - the stakeholders were surprised to see that their requirements were so similar. In their real world cases the same principles and same abstract level required that "in this IoT-world things become active participants", the goal is seamless chain of real time tracking and tracing, the elite of expensive high level item tracking and the multitude of low level items should be balanced for cost efficiency. Interoperability was validated in the independently generated use cases by the stakeholders as number 1 requirement.

The IoT-A Meetup Sao Paulo showed similar results. During an interactive and lively second day of the Conference, Alessandro Bassi (Technical Coordinator) and Rob van Kranenburg (Stakeholder Coordinator) divided the participants into groups on the basis of one keyword that each of the participants voiced: Health, Security, Education, Protocols & Standards, and Applications and Services.

The Meetup drew young driven entrepreneurs like **Marcia Cristina dos Santos** who was selected to do a pitch at DEMO Brasil in June, "the most important global Start Up event of the Silicon Valley, where it's been happening for more than 20 years!"

She was selected with my project ON THE GO, that creates a crowdsourcing work of the population to organise its own distribution within the public transport system, taking its efficiency to the maximum, saving resources and generating high accurate reports to public transportation management and decision making. To do so, she uses QR Codes, a gamefied App, cloud computing and big data. According to her: "It's a basic type of IoT, very simply implemented but able to generate great social and economical change, in cascade, in every big city in the world."

The groups were formed in the morning and were so lively in debate and discussion that they all failed to go for coffee during the break! We are expecting brief reports and will publish them on Council.

In the second part of the IoT-A Meetup **Alex Bassi** went through the IoT-A Meetup structure explaining the Reference Model and the different modelling blocks of which IoT-A is comprised ending with 'How to Build an Architecture'. As IoT-A is aimed at at software and hardware architects it is very abstract, yet it was still possible to take the use case the security group came up with: a gun that would fire only when it recognised the hand holding it as its rightful owner - and work with that through the different models to show that if you use IoT-A it is possible to generate domain specific architectures based on general requirements and models that relate to interoperable architectures.

The Helsinki ARM 101 Session followed the same format, but both the keywords and the themes/use cases were different. As the IoT Week draws predominantly researchers the keywords were very high level: accessibility, traceability, connectivity, addressability…
The themes were related to

- Food traceability, fork to farm
- Tracking drugs, medication
- More flexible work
- Richer interactions: richer life

Slides are available here
https://dl.dropboxusercontent.com/u/16647161/Claudiu/IoT-A-complete-poster-package.zip

The session had two keynotes. **Bob Moskovitz** of Verizon focused on Naming as names are critical for Things on the Internet. All stakeholders must be secure in trust of these names. Asymmetric cryptography for naming: a public key is the identity, a private key provides identity proof, and the less contextual attribution as possible – avoid overloading names themselves with context – are necessary building blocks. **Carsten Gregersen** of Nabto related how they started out in 2007 as a service over Skype. Since then they have been pioneering with offering security over p2p in a market that is purely driven by cost and not used to seeing their low energy and computer power devices getting an added connectivity that might compromise critical services in the home. Their elegant solution reminds one of how Usman Haque conceived of Pachube, (then Cosm, now Xively) as a patch on a building management protocol, EEML .

IoT-A Stakeholder Workshop 6.1: The Health Usecase

IoT-A Stakeholder Workshop 6.1:
The Health Usecase

With Christoph Thuemmler, Alex Salinas, Martin Fiedler, Stefan Gessler.

This session showed how IoT-A was instrumental in developing Stakeholders ideas in linking up with an ongoing project - Munich - and exploiting it beyond IoT-A in FI-WARE. **Christoph Thuemmler**, IoT-A Stakeholder, was surprised to see that the requirements of the other Stakeholders at the first Stakeholder Workshop in Paris were so similar. The same principles and same abstract level: "in this IoT-world things become active participants":

- **goal**: seamless chain of real time tracking and tracing (of 'every pill' in health scenario
- **specific**: objects entering and leaving the system must be identified ('for example 'alarm')
- **measurement of success**: if elite of high-level item tracking and multitude of low level 'pill' items can be combined then cost efficiency through item misplaced/anti theft/mismanagement, counterfeiting and fake drugs + quality of care: less mixed identities+ ageing
- **why is it not happening now?**: because the marketing+ strategy+ patent system in the companies does only see the benefits in the long term and does not want to risk short term losses
- Interoperability was validated in the intrinsic and independently generated use cases by the stakeholders as number 1 requirement

The point of care is moving to the home: how to exchange information or locate objects between the hospital and people's home is fundamental to overcome acceptance issues by intensive exchange with the medical community on such technical solutions. From a surgeon's point of view the IoT is considered an ideal tool for monitoring even complex operations. There are high hopes that soon new devices and things entering the operating theatre during an on-going surgical procedure will be integrated seamlessly into the existing network of things without having to be set up and adjusted to the environment. This would certainly require novel interoperability strategies. These are shown in the IoT-A movie. In order to interface to a broader audience of non IT architects it talks of installing a 'sort of grammar', breaking down 'components in smaller networks' and a 'toolbox for developers to make things talk'. After the movie and the exposé by **Martin Fiedler** on how real Stakeholder requirements had been instrumental in IoT-A, a question came on how long it would take the time to add a new functionality, to which Martin replied: a few weeks for an integration that does not require many large companies with their own requirements. He showed how the MUNICH use case was used to reverse map the IoT-A Architectural Reference Model (ARM) on a specific implementation. He introduced the used IoT-A views and models (Functional View, Domain Model and Information Model) and proceeded to the findings of the reverse mapping process in detail.

Alexander Salinas gave an introduction of the business case for two IoT use cases (logistics/retail and healthcare) performed within the IoT-A project. The first business case reveals the benefits of using the IoT ARM in the development process while the second business case is focused on the IoT application itself and its economic effects.

The discussion focused on three main issues:

1. **Shape shifting of organizations**. **Matti Muukkonen** of mpy.fi, Finnish business development manager talks about how a regional phone operator is becoming a service provider in quite an organic way, as it has to confront the fact that most of its customer in the region are over 50 years of age, so it starts offering services based on the mobile phone (fall detection for example). Christoph Thuemmler sees these shifts everywhere as for example cars – sensors on wheels, according to Kevin Ashton in his opening speech – become interconnected (with eCall for example). For him, that deep interconnectivity of objects that can (semi) autonomously trigger a response was the key vision he saw becoming possible at the first Stakeholder Meeting of IoT-A in Paris. It then also became more logical to work from generic requirements that could be spread out over different use cases (for example tracking and tracing in Retail and Health) but linked together by potentially different technologies.
2. **Atta Badii** brought in the term **affordability engineering**: Monitoring in the home is no longer and issue technologically, according to Thuemmler. Socially and culturally arguments can be made that care will become scarce. Keeping people longer at home, even with the first five years of first

stage dementia can be done is economically interesting and necessary. We should look at the normal household. The key is the business model. The minute we generate new services, we introduce the question: who is going to pay for these new services? Currently healthcare is not funded in a way that can handle this type of innovation. The funding schemes handicap everyone. Some institutions require ROI in the first year! But definitely within the first three.

3. **From products to a care ecosystem**: The EU cannot compete with China and Japan on the cost of supporting products and systems (ie robots). A general set of business models has to start from the assumption that everything you have to do ultimately costs money. Unplanned admissions are most costly. Therefore minimizing unplanned admissions is a huge cost saver. According to **Atta Badii** aligning budgets in regular healthcare with the second health market (the family) and the third (house owners and building associations) requires that we put the business propositions at the level of ecosystem not at the level of gadgets and applications.

Clearly, the e-health community is heterogeneous in terms of their needs.
Health care providers and professionals have very clear understanding of their needs and their demands with view towards the IoT in health care. In the long run, there are high hopes for seamlessly integrated user-driven and professional care domains, the former providing high-quality and secure personalized wellbeing care as well as strong baseline for professional healthcare services, and the latter becoming more personalized, user-centred and real-life-data-empowered.

IoT-A Stakeholder Workshop 6.2: The Open Horizontal Platform - Adoption of IoT-A through IoT Open Source Toolkit

In *What Stakeholder Theory is Not*, Philps, Freeman and Wicks explain why an integrated stakeholder framework is so difficult: "The term stakeholder is a powerful one. This is due, to a significant degree, to its conceptual breadth. The term means different things to different people and hence evokes praise or scorn from a wide variety of scholars and practitioners."

According to them "public and private organizations are increasingly employing stakeholder engagement as an important strategy for improving external stakeholder relations", because "Incorporating stakeholders' opinions is valuable for improving decision-making processes and project implementation." Currently, the prevailing practice domain for stakeholder engagement is largely characterized by complex and dynamic environments containing a wide range of stakeholders, from hostile to conciliatory, from obstructive to collaborative".

This is an apt characterisation of The Internet of Things: complex and dynamic environments containing a wide range of stakeholders. As such it is an open and on-going ecology of environments, characterized by change and real-time combinatorial innovation.

In line with *Decision-Making Criteria of PPP Projects: Stakeholder Theoretic Perspective* that "the process of selection, that is, the decision making, is important to ensure that every stakeholder has equal access to the game of interests. The success of PPP model hinges on whether stakeholders are satisfied through the game, which requires them to select their own decision-making criteria. The format was therefore very open and inviting to the Stakeholders:

- Tell us about your needs/concerns
- Take this in the form of a "use case"
- Think of it like a "business scenario" where you Explain how you see IOT-A can help you
- How it can bring value to your customers
- List of problems that you want to solve, with IOT-A
- Give us a business process, application or set of applications enabled by the architecture (ex. novel application)

IoT-A Stakeholder Workshop 6.2: The Open Horizontal Platform

- Could also describe an actual problem that needs to be solved
- An objective you want to reach
- You could also make one UC = wish (no restraint)

For all their different backgrounds - automotive, health, logistics, and retail - the stakeholders were surprised to see that their requirements were so similar. In their real world cases the same principles and same abstract level required that "in this IoT-world things become active participants", the goal is seamless chain of real time tracking and tracing, the elite of expensive high level item tracking and the multitude of low level items should be balanced for cost efficiency. Interoperability was validated in the independently generated use cases by the stakeholders as number 1 requirement.

The IoT-A stakeholder group is one of the considerable sources for obtaining external input as well as feedback on the current status of project work. This shows very plainly the two main functions of the stakeholders within this project, viz. to contribute to the requirements and the validation.

To this day, the stakeholder contributions have been considered to a large extent as the stakeholder requirements from SW1 formed the basis for the initial draft of the ARM, particularly the domain model and the functional decomposition. Each building block of the ARM was developed in view of the fact that all requirements are met to follow a holistic approach.

The first draft of the ARM was published in June 2011 close before SW2. During SW2 the main concepts of the ARM were discussed together with the requirements list as its foundation. The second part encompassed the presentation of the validation process to get feedback on improvements and its technical feasibility.

SW3 was held in November 2011 and its main objective was to validate both the then collected requirements and the initial architectural reference model without neglecting new requirements. Furthermore first results concerning the business and socio-economic validation could be obtained.

SW4 was co-located with IoT Week in Venice. It led to very productive comments on the domain Model. The results of the SW4 Questionnaire suggested that it was most productive to split the technical validation sessions from the business and the socio-economic ones. This result leaded to a further fine-tuning of both the technical validation session in the form of a Tech Day (January 2012) and the socio-economic and business elements that were foregrounded in SW 5 that was co- located with Living Bits and Things and IoT Forum in Bled.

In SW5 we focused on the RFID PIA (articles with Djordje Djokic forthcoming) and the questions raised by Boris de Ruyter (Philips Research): How can we model the learning of the environment itself, and create a common understanding between different companies to facilitate and exploit this? If we share layers of data at which point do we envisage identity management. The question then is where does the intelligence/information related to users reside? What information do I want to share with what environment? Who may have access to this information as a result? New interaction forms with devices may need to be introduced to relate to how devices convey their status.

This lead to the following task: How does the ARM support or fosters this common understanding?

In order to answer this the main focus of the past months has been on identifying conceptual partners to discuss the Reference Model Architecture. There have been extensive discussions with Sandy Klausner, who proposes a clean slate approach and Michael Koster, Alex Bassi and **Joachim Walewski**.

Michael Koster keynoted on Monday on his initiative Open Horizontal Platform (see above). In the 6th Stakeholder Workshop we discussed how IOT-A can be a strong driver/component.

Europe's main problem has always been its incapacity to move swiftly and effectively from R&D to innovation – the two cultures remain largely independent. In the US, they are able to devise and implement a holistic approach from fundamental research to applied research to innovation and standards. The main role of IERC (which is the grouping of all IoT-related EU-funded R&D&I projects) should be to foster and manage the sharing of as much knowledge as possible in order to reduce the time to market and help Europe be on the cutting edge of ICT while at the same time being one of the first to put on the market new products, services, concepts etc. Therefore IoT-A, Butler, iCore and others should not only seek excellence in IoT science and tech-

nology but also focus on exploitation, use cases, innovative applications.

Philippe Cousin remarked that BUTLER is instantiating IoT-A, iCore is doing the same and FIWARE benefited from the IoT-A experience of some of his partners. Any open source approach has to rely on a business ecosystem to attain critical mass and reach sustainability. These means components to be identified, tested, maintained, developed, marketed...

Martin Bauer explains that the IoT-A Architectural Reference Model will be sustained and further developed by the IoT Forum (www.iot-forum.eu), which was formally founded during IoT Week. This will enable all interested parties to contribute. The IoT Forum will also organize future IoT Weeks,
the next one will be in London in June 2013.

Kevin Ashton referred to the Stakeholder Workshop in his opening talk: "One of the most important things that is going to happen this week is the work on IOT-A. It is really important to have a reference model architecture for the Internet of Things. And one of the reasons is that for most of those 15 years, we've been talking about the Internet of Things as something in the future, and, thanks to amazing work by this community and the work of the European Union, which has been amazing for many, many years now — the Internet of Things is not the future anymore. The Internet of Things is the present. It is here, now."

Michael proposed to start with these observations:

1. *ARM usage*

1.1 Of the potential uses of the ARM, we would currently get the most benefit from it's use as a cognitive aid and to provide common grounding. We are bringing in members that are familiar with the general technology but unversed in the Internet of Things. The common grounding will help anchor developers around key concepts so we can bootstrap the communication and discussion process with people who are joining our organization.

1.2 As a cognitive aid, we expect to make use of the ARM to help structure our organization's working groups around natural elements in order to separate and modularize the components of the architecture and application platform.

1.3 For generating compliant architectures, we will be using model-driven approaches, which are a natural fit for the ARM's focus on defining models.

1.4 The other uses of the ARM to differentiate architectures and for benchmarking may be less important to us, at least in the short term. These can be used to evaluate competing proposals and compare our architecture with other high level approaches. Modelling competitive approaches could be useful in identifying which features have the best value for a particular model and use case.

2. *Example KPIs*

2.1 We are focused mainly on the Virtual Entity, Resource, and Service abstractions. As such the important capabilities of the ARM are to represent a rich information model that can represent software Resources and Services as well as virtual entities. A real time event model is also needed in order to properly abstract all of the underlying features of asynchronous M2M systems and provide for interoperable application software.

2.2 The current ARM contains models and relationships that represent Virtual Entities quite well, and provides Resource and Service abstractions that can be used to provide a consistent view of these architectural features to application and service software.

2.3 The current ARM does not provide a framework for event models, and as such would not support a standard asynchronous application-programming model, that is, no standard way to invoke real time event handlers or even to define events as a system attribute. the ARM would need to contain event and event handling as architecture features of the programming model.

2.4 We are also architecting a new relationship between users and VIrtual Entities that specifies ownership and access policy. This needs to functionally connect with a model for users and with the security model, and may influence the relationships in the functional model. For example, the security component may be considered to interact with the virtual entity. The functional model seems to exclude this direct association.

2.5 We are also providing for service components and application software to be located in various execution containers, for example in gateways, devices, and rout-

ers. These would be Active Digital Artefacts that would be associated with service components, but it's not clear how these are mapped to the proper architecture feature to express the location independent processing. The gateway description seems to exclude running application software from the services available, yet the deployment model shows local services in a gateway.

2.6 The "Privacy model" contains Identity, Authentication, and access control, which is a logical grouping given the owner-resource-policy graph connections we are building in our architecture. It's not clear if it's a general model that represents a range of architectures.

2.7 Virtual Entities and Services should be decoupled in the functional view and in the information view. Applications should be able to resolve abstract VEs using URI addressing without knowing particular service details. This seems to be provided for in the information model.

3. *General*

The ARM has become more specific and offers more detail in many areas. This will require more review and alignment with our architecture to determine issues and compatibility. In particular, the functional view and the risk/security models will need more study to identify issues.

Three main topics emerged from these observations and general IoT debate, during the Stakeholder Workshop:

A. **Support and questions of exploitation of IoT-A**. It made a lot of sense that the Architecture would approach this way, the work looked to be right on track, said Koster. Creating a large sort of ecosystem, even just the potential that that is possible creates a lot of hope for cooperation on a large number of levels. That gives us a lot of hope as architects that something truly global can be achieved. This was supported by **Grace Carvalho** (Cisco CTO Consulting Engineer) who sees a lot of common ground for communication in IoT-A, adding: we recognize good output when we see it. How to take it further? **Harry Doukas** brings up the idea of some kind of 'label' or certification. A similar idea was proposed by Rob van Kranenburg in ethicsinside.eu. This is further supported by **Francois Carrez** and will be a topic for debate in the IoT Forum, the organization that could host such a label. I would expect to continue to work with IoT-A and with this common intention, **Michael** explains. It is a good framework and basis for further development as well as a strong indicator for open source to the deepest of levels. As a framework for common ground it currently is the only framework for describing the relationships between components at this high level of abstraction.

B. **Semantic web, open data and output based business models**. Data modelling should include tools for debate and tools for opening up databases as well as tools for validating unsigned and crowd-sourced datasets. Having open data without notions of quality of these data is not enough. Education is an important activity in this respect. There is no culture of 'data' among end users/citizens. People do not know how to verify crowd-sourced data. There are huge opportunities here to align with the growing group of young app makers and the work on pollution sensors that is being done in fab- and hack labs across Europe. **Harry Doukas** explains that the EU projects should interface with the hacking communities as they are doing real fast agile testing of soft- and hardware tools and building blocks for IoT. They could benefit from the structured work plans of the EU projects. There is a shift to understanding that contexts themselves will be heterogeneous and that levels of abstraction will need strong focus if they are still to address what is happening now and what will happen when the IoT shft has occurred. The challenge is (as we saw in the Stakeholder Workshop on Health) that we have to build tools to deal at the level of ecosystem and ecospheres. Information, not data, will be the new abstraction. **Lion Benjamins** has a term for that: *Return on Information*. Benchmarking and marketing the competitive advantages well is the first phase, says **Tomaz Vidonia** of *Living Bits and Things*. Working in Central Europe he finds that companies keep looking for closed and idiosyncratic soft- and hardware solutions that do not scale or are interoperable also because they find it difficult to look over the borders. **Raffaele Giaffreda** (iCore Project Coordinator) agrees that showing integration in a demo, which has up till now been the key output of a lot of EU sponsored projects, is no longer good enough. It is really important to be able to show value on the ground and show for each partner and role in the ecosystem and value model what the added value is. **Gabriel Marao** from IoT Forum Brazil states that assuming this critical mass by no means implies only big industry. Stability in for example Brazil needs to be ensured by

bringing together the local sme culture with the agile innovation of the internet. **Ben van Lier** (Centric) agrees and would like to see strong and central leadership from the EU on this high abstract level. The Industrie 4.0 program looks very strong but is it devised as a program for the whole of Europe? Are there specifically German specs in it that make that the program as a whole can not be ported to EU level? He adds that the key to value proposition is that these must fit the timing.

C. **Less papers and more work on the ground**! To **Alicia Asin Perez** (Libelium) the benefits of standardization are clear. However she states that we are all - big and small – having two main issues; not enough traction in the market because the customers are mainly municipalities that do not want to be the first, nor have budget. The second is that we are still designing too many theoretical things, we need to build leverage in the real world. There is enough on the research side, we need to go out and show added value to citizens! **Grace Carvalho** agrees; we do not need more small demo's, but engage on a different level to achieve a critical mass to build trust with the end users. Alicia relates how Libelium is encountering very savvy citizens who ask questions like why are you installing these sensors? What do they do? Why do we have to pay for it with public funds? Is it not better to invest in schools or hospitals, or jobs? Our engineers are realizing more and more that we are living in times of social change. You really have to show value and should we prioritize our set of 50 applications the scenario should be very ingenious. **Alexander Pflaum** (Bamberg University) wonders if the demo culture has actually sped up market implementation. He is seeing the transition towards larger ecosystems and thinks that it is at that level that research needs to be done. The key to the label is that you would be able to facilitate integration services (where the cost is) and interoperability at the level of ecosystems, it would certify not so much a set of characteristics but compliance to a set of generic tools and standards. Grace Carvalho agrees, outlining that the CISCO ecosystem of partnerships has a strong economic side. **Rasmus Blom** (Grundfos) – like Bosch Foundation owned – thinks to that what IoT-A is trying to do is a good approach but he also feels that we need to get practical fast and learn as we go along. Therefore Grundfos Connect, which he leads, has started a bottom up process to build a new platform (former Pachube style) in order to open that up for citizens and learn as a company as a whole what it means to deal with the messiness (unsigned data, untrusted communication, lack of accountability) of IoT. For their part, with the solid reputation and strong financial position of Grundfos they can ensure sustainability of the platform, Gatesense. **Gérald Santucci** (who was not present but send in this statement) states that the future of IoT is not only a matter of market size in this or that application area but above all an evolution towards interoperability, inter working and economist of scale/scope/integration. The IoT can only be understood from an horizontal, cross-cutting perspective because the objects will have identifiers moving across space, jurisdictions, application areas etc. A pure vertical, silo approach does not work. Furthermore, the IoT will also be essential because of its presence in the personal sphere of individuals, the economy, the factory or the supply chain. The appropriation of the IoT by individuals will produce a disruptive change in our relationship to objects, hence among human beings, and later an even more disruptive change in the relations of power among individuals, organisations, geographic and political areas. IoT is not business as usual with more objects and larger markets, it is actually pregnant if a new organisation/ structure of our societies with new values, drivers, ambitions...

Key question to come out of SW 6 Open: how to negotiate the loss of economic value in the chain and move to ecology of business models in a value model.

More information?

www.iot-a.eu

Mail

Rob van Kranenburg, kranenbu@xs4all.nl

Events

Recent Events:

Future Internet Assembly (FIA) 2013

From May 7 to May 10, 2013 IoT-A was presenting the Architectural Reference Model at the FIA in Dublin—stay tuned for a report in the coming IoT-A Community Newsletter #7.

CE-Week, New York

Following the IoT Week 2013, as part of IoT-A's disruptive marketing strategy, IoT-A was presented to the consumer electronics world in New York and mastered a huge interest by the visitors at our booth: "… quite a few people with insight in IoT… very excited about our approach… invitation to speak at IEEE - New York chapter, … several journalists coming by and taking very long notes ..." A detailed report is prepared for the next IoT-A Community Newsletter #7.

A press coverage on IoT-A in i³ October issue will complement the dissemination to this target group.

IoT-A continues international presence:

ICT 2013 - Create, Connect, Grow

November 6 - 8 2013, Vilnius, Lithuania

IoT-A is striving to participate at ICT 2013 with a networking session „ARM in Action" and a further demonstration of IoT-A use-cases (applications filed)

IoT-A Community Newsletter **Special # 6** (July 2013)

Editors: Rob van Kranenburg, Günter Külzhammer

kranenbu@xs4all.nl; heinz-guenter.kuelzhammer@vdivde-it.de