



FROM CONNECTIONS TO CHANGE: THE INTERNET OF IMPORTANT THINGS

A DISCUSSION PAPER BY
FORUM FOR THE FUTURE AND SUPERFLUX

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About Forum for the Future:

Forum for the Future is an independent non-profit that works globally with business, government and others to solve complex sustainability challenges. We believe it is critical to transform the key systems we rely on to shape a brighter future and innovate for long-term success.

Find out more at www.forumforthefuture.org, and find us on Facebook and Twitter.

About Superflux:

Superflux is a London based design studio in the business of humanising technology and its implications. Operating both as a Consultancy and a Lab, Superflux works in the realm of design and technology innovation for business, cultural and social purposes. The consultancy is client-facing, developing strategy, foresight and design work for a wide range of organisations, while the Lab projects are self-initiated, exploring the implications of technological change on people, society and the environment.

Find out more at www.superflux.in, and find us on Twitter.

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**‘Where is the wisdom we
have lost in knowledge?
Where is the knowledge we
have lost in information?’**

T. S. Eliot

EXECUTIVE SUMMARY

This is a brief position paper produced by Forum for the Future and Superflux to discuss whether the Internet of Things could be a vital tool in tackling the sustainability challenges we face.

The world we live in runs on unsustainable systems that struggle to meet the basic needs of all of us today, and are wholly inadequate to fulfil the requirements of tomorrow. But they needn't be that way, and in The Internet of Things (IOT) we have a technology with the potential for being a major driver of sustainable change – if only we seize it.

Digital technologies have two basic characteristics that make them powerful enablers of system change - they help people understand complex information, and they enable us to collaborate to create new systems. These two principles - information and collaboration - are what the IOT is founded on, making it almost unparalleled in its ability to meaningfully improve the world around us.

2014 has been heralded as the year of the IOT: everything that can be connected is being connected. So, as we embrace this incredible new set of tools and welcome technology further and further into our lives, it seems important to ask why are we connecting everything and what is the bigger goal?

In this paper we argue that whilst the idea of the IOT is not new, the narrative and ambition are still stuck in the past and could be hampering its potential; for example, we're still being promised a connected fridge¹ that tells us when we're running out of milk. To really drive change, organisations in this space need to quickly move away from stories about the number of potential connections and the size of the market, and instead develop compelling examples of how the IOT could have a meaningful impact on lives all over the world.

¹ <http://on.aol.com/video/ces-2014--hands-on-the-lg-connected-fridge-518104470>

¹ Hands on the LG connected fridge



² The Internet of things Award: Iaqualink



To do this, we need to put human needs at front and centre of the conversation and focus on the ‘last metre’ - the (representative) distance between a person and the digital service or device that they are interacting with. All too often the journey stops at just providing data from the latest smart device, which results in data spectatorship at best and apathy at worst. Human interaction must be put at the heart of the IOT experience to avoid it becoming a technology without a user and encourage meaningful action.

We also need to analyse and then focus on where this kind of technology actually has the most potential to create positive change. If we don’t do this, the IOT is in danger of becoming a frivolous plaything², providing a more tailored and automated existence for only the wealthy. We suggest that there needs to be far greater focus on applying this technology where it can completely change how needs

are met rather than just making current approaches ‘smart’. We also begin to imagine how the IOT could be put to use to solve a range of global challenges - from air quality to ecosystem restoration and poverty.

This document provides a brief summary of the IOT, looks at where it is currently making progress, and begins to show potential for systemic change. It is based on a brief overview of materials available on the internet, interviews and conversations with selected experts³ and Forum for the Future’s work on sustainability and system change. Its aim is to provide a lens to view the opportunities, rather than proscribe definitive answers, and to look for ways that the IOT revolution can create meaningful solutions to our problems rather than largely remaining as a technology in search of a use.

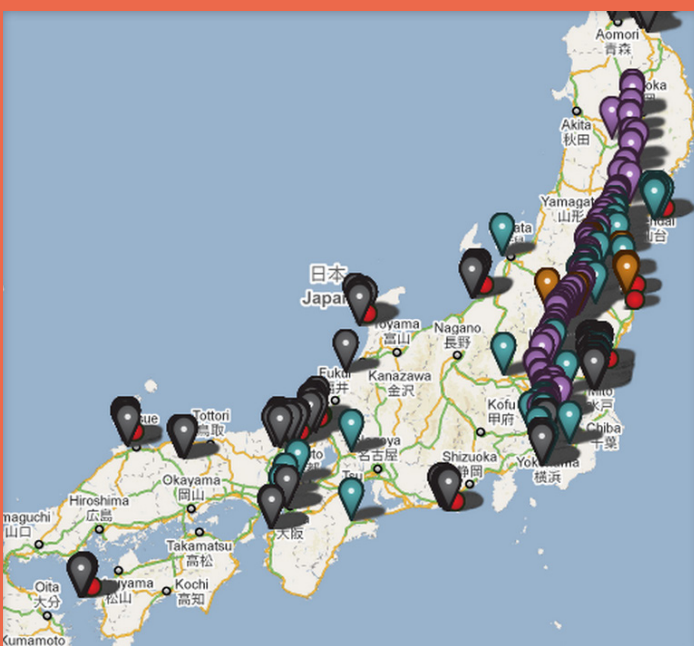
² <http://postscapes.com/internet-of-things-award/project/iaqualink/>

³ See Appendix 1

INTRODUCTION

It has been suggested that 2014 will be the year of the IOT. As if to emphasise this, whilst we were writing this paper Google paid \$3.4bn for Nest⁴ - a pioneer of smart, automated home-management solutions, and at the World Economic Forum in Davos the IOT was a very hot topic.

So are we at the start of a genuine revolution or is the IOT instead at “the peak of inflated expectation” in the Gartner hype cycle⁵? The IOT provides lots to be excited about, but there is also plenty to temper that excitement. Now is an appropriate time to review where we think the IOT might deliver genuine change.



¹⁴ Japan radiation monitoring goes crowd open source

⁴ <http://www.ft.com/cms/s/0/90b8714a-7c99-11e3-b514-00144feabdc0.html>

⁵ http://en.wikipedia.org/wiki/Hype_cycle

The Internet of Things - the story so far

The phrase “Internet of Things” was coined by a British technology pioneer, Kevin Ashton, in 1999 - but we have long been promised a host of connected devices that will change our lives for the better. To add to our phones and computers would come connected cars, street signs, white goods, and even cutlery. And yet, despite the fact that a coffee pot was connected to the internet in 1993⁶, we still seem to be waiting for an application of this technology that is really going to connect with consumers and create meaningful change in our lives.

It’s true that there is currently a great deal of excitement about wearable technology, and consumers do seem to have embraced connected items like fitness trackers⁷; but there is not a clear sense of how this is going to match the hype. As one interviewee pointed out, *“the most overhyped aspect I think is that somehow that data will liberate us...because I don’t think that the causal relationship between data and behavioural change has been established”*.

The narrative about what might actually change as a result of connecting devices seems absent from much of the public dialogue on the subject. Look for any commentary and you’ll find that it almost always relates to the numbers of connections and market size. Take these figures that came out of CES2014 as a case in point:

- \$8.9 trillion market in 2020, 212 billion connected things⁸
- 26 billion devices on the IOT by 2020⁹
- More than 30 billion devices will be

- wirelessly connected to the IOT by 2020¹⁰
- “By 2020, the number of connected devices will be five times larger than the earth’s population.”¹¹
- “During 2014, there will be almost 9.6 billion intelligent systems shipped to manage the 190 billion things that get installed and connected to a network”¹²

The list goes on...

The fixation with numbers as a metric of progress is not recent. Despite connected devices since the 1990s, the IOT was allegedly ‘born’ between 2008-2009 when “more things were connected to the internet than people”¹³.

But rather than assuming connection equals progress, perhaps it would be an alternative metric, perhaps it would be more accurate to say that the IOT was really born when people started doing something meaningful with that connectivity. In which case the IOT would be in even earlier infancy; its real emergence was perhaps in 2011 when people used it to crowd-source more granular and accurate Geiger counter readings during the Fukushima accident in Japan¹⁴.

As Anthony Townsend warns in his book, *Smart Cities*¹⁵, we should be very wary of “*the \$100 billion jackpot*” visions of technology, and question who benefits from it - and where the real value is.

Whilst much is being done to persuade the consumer that they need to have this connected world, less is being done to answer

⁶ <http://postscapes.com/internet-of-things-history>

⁷ <http://www.ft.com/cms/s/0/4ad4bb9e-5533-11e3-86bc-00144feabdc0.html>

⁸ <http://www.zdnet.com/internet-of-things-8-9-trillion-market-in-2020-212-billion-connected-things-7000021516/>

⁹ <http://www.gartner.com/newsroom/id/2636073>

¹⁰ <http://www.abiresearch.com/press/more-than-30-billion-devices-will-wirelessly-conne>

¹¹ <http://www.4-traders.com/news/Expert-Discusses-Monumental-Impact-of-the-Internet-of-Things-IoT-Trend-at-International-CES-2014--17761210/>

¹² <http://www.4-traders.com/news/Expert-Discusses-Monumental-Impact-of-the-Internet-of-Things-IoT-Trend-at-International-CES-2014--17761210/>

¹³ <http://postscapes.com/internet-of-things-history>

¹⁴ http://news.cnet.com/japan-radiation-monitoring-goes-crowd-open-source/8301-17938_105-20060639-1.html

¹⁵ www.smartcitiesbook.com

the question, why? The narrative seems to be that this is a good thing simply because “the Internet of Things will make the world smart”¹⁶. But technology is, for now at least, only as smart as its users, and there is a danger that people are overwhelmed by data rather than being inspired or engaged. Few people can cope with the possibilities of three to four connected devices in their homes let alone 50¹⁷; in fact, a new condition called ‘Information Fatigue Syndrome’ was named more than 10 years ago for the unhealthy effects of too much data on the human mind¹⁸. As Pulitzer-Prize winning historian Daniel J. Boorstin put it, “technology is so much fun but we can drown in our technology. The fog of

information can drive out knowledge.” Smart cities are nothing without smart citizens.



¹⁹ Wired.com: MIT vs IDEO opposing approaches design internet things

What is driving the Internet of Things?

Marcus Kirsch, of RAPP UK, believes there are two basic paths in technological innovation. The first is “actively looking at culture, using humanity’s core principles as guidelines for a conscious decision about where technology could take us, and seeing where it could solve problems that couldn’t be addressed otherwise”. The other approach is far more focused on pushing the features of technologies and the idea that, by continually innovating, change occurs when at a “threshold of a certain low price or a certain speed, it will become something else entirely.”¹⁹

The latter approach has huge merit and has driven much of the technological progress in the past. It is unsurprising, therefore, that this also seems to be the predominant strategy for driving the progress of the IOT - develop more, connect more, and the change will happen. But there are two problems with only taking this approach. The first is establishing a clear need: as Kirsch goes on to say, “*people will only buy into your idea if they can get emotionally involved in what you have*

to offer.” Martin Luther King said, “*I have a dream.*” He did not say, “*I have a bunch of new features.*”²⁰ As the marketing mantra goes - you are not selling a bed, you are selling a good night’s sleep. What is the selling point of the IOT?

The second problem is that this technology is arguably more personal than anything that has come before it. Technology is reaching further and further into our lives and making it possible to gather massive amounts of data about many aspects of human behaviour, often in very minute detail. Of course, this isn’t novel to the IOT - on social networks, for instance, we’re used to sharing staggering amounts of information about ourselves (whether we always realise the implications of that or not). But the difference with the IOT is one of degree, and active as opposed to passive control.

Social networks harvest information about us from the curated details that we choose to actively share, and use it to suggest things that we might want to interact with. The IOT,

¹⁶ <http://www.bigdata-startups.com/BigData-startup/internet-of-things-will-make-our-world-smart-infographic>

¹⁷ http://www.huffingtonpost.com/2013/04/22/internet-of-things_n_3130340.html

¹⁸ <http://workplacepsychology.net/2011/05/18/information-overload-when-information-becomes-noise/>

¹⁹ <http://www.wired.com/insights/2014/01/mit-vs-ideo-opposing-approaches-design-internet-things>

²⁰ <http://www.wired.com/insights/2014/01/mit-vs-ideo-opposing-approaches-design-internet-things>

on the other hand, is looking to change the world around us automatically - whether that be as simple as turning off our lights, or as complex as arranging our social interactions based on the movements of our friends. By having the potential to use our devices to measure and ameliorate our personal environment, the IOT requires a totally different level of information intimacy and trust in the outsourcing of our lives and all the data that goes with it.

Given the lack of understanding most people have of the implications of their current data exhaust - the sheer volume of data they produce with every digital interaction - we are walking into this data-driven world with astonishing naivety. And whilst there is no stopping this runaway trend, there needs to be a more concerted effort to help people to understand the consequences of their position in it, to identify where they really need this interaction, and to decide how best

to use it. We believe that effort to encourage active, rather than passive, engagement with this technology will yield remarkable results.

We think that both the 'needs-based' and 'technocentric' approaches are necessary but that the balance and the tension between the two is currently wrong. This is a common thread throughout this paper and is central to our assessment of how the IOT could fail to really deliver on its promise.

It is an issue exemplified by the poster child of the Internet of Things - the connected fridge - a classic technocentric solution. The demand has never appeared because it doesn't meet a clear human need. As Dave McClure, Silicon Valley pioneer and angel investor has said so many times when presented with pitches for technology without a clear need... "*Your solution is not my problem.*"²¹

However, we are not short of problems.

²¹ <http://500hats.typepad.com/500blogs/2009/08/your-solution-is-not-my-problem.html>

THE INTERNET OF THINGS AND SUSTAINABILITY

The world is facing numerous intractable, complex and pressing problems, and although technological innovation is rarely a solution in itself there is good reason to believe that a connected world could be a more sustainable one. We have written before²² about how information and communication technology can be used to create a more sustainable society:

- **Directly**, by improving the current performance of technology (e.g. by making it more energy efficient to run, or less resource-intensive to make).
- **Indirectly**, by using technology to improve or make alterations to current practice - the indirect benefits of videoconferencing, for instance, are a reduction in physical travel.
- **Systemically**, through using technology to meet needs differently or changing the fundamentals of the way society operates (e.g. the rise in health tracking and data analysis of DNA sequencing could revolutionise the healthcare sector by enabling preventative medicine to flourish).

Despite our reservations about the current narrative around the IOT we are aware that this technology is already being used directly and indirectly in a number of innovative and important ways to deliver sustainability. This is covered in other literature (see suggested reading in Appendix 2), but we note that often the focus seems to be on direct/indirect changes even where systemic changes are possible - for instance, on smarter traffic management rather than also looking to remove the need to travel in cars at all.

²² <http://europe.nextbook.com/nxteu/o2/connectcollaboratechange/index.php>

SYSTEMIC CHANGE

Given the scale of the challenges that we face this century we are most interested in the radical transformation that comes from the systemic change to society.

Systemic Change: How?

We believe that digital technologies help drive genuinely radical systemic change in two basic ways:

1. By changing the structure of information flows – through simplifying complex data, making the invisible visible, and so allowing new people to make new decisions in new ways;
2. By empowering people to create their own systems – by giving them a greater capacity to meet their needs through collaboration and the combination of their resources.

These two ‘levers for change’²³ are altering the world around us. Digital technologies are unparalleled in their ability to simplify and optimise complex data into usable information. It is little wonder that we see everyone from individuals through to multinationals collecting more and more data to help them understand their operations. For instance, the addition of a spatial dimension

through GPS has driven location-based services and revolutionised logistics.

Similarly, digital technologies can link millions of strangers together around a common purpose (such as buying, selling, sharing, or innovating) in an instant. Human progress has always been accelerated by the meeting, sharing and building of ideas - digital technologies have made this an almost frictionless global experience. Witness, for instance, the rise of the collaborative consumption and creation movements and their impacts on changing attitudes to ownership, distributed manufacturing, and the creation of millions of small online businesses.

So what do these levers for change mean for the IOT? The answer, of course, could be ‘everything’ but before we look at where these levers can be used to create change we want to add two important challenges to their application that came out of our research and interviews.

1. THE LAST METER

Fundamentally, the IOT is a networked flow of shared data that allows the connection of things, and the simplification of that information into forms that can drive action – either in people or in the control of their environment. It is built on the acquisition and sharing of new information, and reaches its fullest potential when the combination of that information from many people allows all of

them to learn more and act better than they could have done alone.

The strength of any system can only be judged by its weakest link, and as with most technology solutions, by far the weakest link for the IOT is its lack of real human engagement and its inability to meaningfully bridge the ‘last meter’.

²³ Levers 4 and 6 of Donella Meadows twelve leverage points to intervene in a system
http://en.wikipedia.org/wiki/Twelve_leverage_points

This is plain to see if you do an image search for ‘the Internet of Things’ – lots of clouds, lots of objects, lots of arrows, lots of connections, but precious few people. One of our interviewees said: *“There is a danger of people in a connected city actually kind of being*

forced into the margins even more...because they are not part of the data collection process...they are just being measured. They are not measuring themselves; they are just being measured in their cars, for example”.

2. THE LAST BILLION

It is also worth asking what connecting 20 billion connected devices says about us when there are still billions of people without access to the internet, or clean water, for that matter. There is a danger that the IOT is a technology purely for the privileged, and very little we have seen suggests that companies are thinking creatively about whether this kind of connectivity can help alleviate poverty and improve the lives of those who might have mobile access, but not the benefits that may come with greater connectivity. This is not just

about connecting the unconnected, but rather asking where connection matters and delivers change.

There are a few interesting exceptions, such as Soil IQ²⁴, who are developing a solar-powered soil sensor to help anyone grow fruit and vegetables. Rather than just targeting developed world customers, the company has a dual mission: working in partnership with Orange Telecom, one of their investors, they are looking to use these sensors with farmers in East Africa.

SYSTEMIC CHANGES: WHERE?

There are weak signals of systemic change all around us. They are emergent behaviours or uses of technology that are currently niche, but would be positively disruptive if they became mainstream. For instance, we are already seeing signals that fitness tracking and DNA sequencing could disrupt the health industry. In the case of the IOT we are looking for areas where the trend for connectivity and sensors collides with weak signals and big challenges to create an opportunity space for change that is driven by both (i.e. where trend and meeting the challenge amplify each other).

Our problem is that these collision areas don’t seem to exist at the moment. Given the scale and urgency of the challenges and the size of the opportunity, the lack of response

from the digital community has been both puzzling and concerning. Many commentators have been lamenting that Silicon Valley, for example, often at the heart of technological innovation, has lost its drive for solving really hard problems^{25 26} and is too focused on short-term value creation. The concern is that this distracts the brightest and best from focussing on the next generation of technologies that might change the world, such as the work on semiconductors did in the 1970s and beyond by making the digital age possible²⁷.

This is a depressing situation as it might well be impossible to meet the needs of the future global population with the resources we have available unless digital information and collaboration technologies play a role in

²⁴ <https://edengarden.com/hello>

²⁵ <http://techcrunch.com/2010/02/13/what%E2%80%99s-better-saving-the-world-or-building-another-facebook-app/>

²⁶ <http://blogs.hbr.org/2010/09/silicon-valleys-disruption-def/>

²⁷ <http://www.newsweek.com/sad-truth-about-facebook-movie-72105>

changing almost all aspects of the way we live. Which is not to say that there isn't any activity at the moment, but rather that the scale and ambition of that activity is lacking.

For example, we require a radical rethink of consumption and the complex global flows of people, finances, products and resources. One of the ways to improve that is through a detailed understanding of how these various elements are moving through the economy, how they can be directed to where they are needed most to meet needs and avoid waste, or how they can be deployed in

IMAGINING A DIFFERENT FUTURE

As we have already stressed, information is only part of the equation. As Professor John Robinson put it in the Guardian recently "our failure....is not a failure of information but a failure of imagination"²⁸. We need to believe in another future. But against a bleak backdrop of inevitable climate change, 'business as usual' and a lack of political will, it is little wonder that a sustainable world can be dismissed by many as an unrealistic fantasy.

We have already been working with partners to develop near-term concepts and prototypes. These allow organisations to experiment with very different futures and test reactions and appetite for change. For consumers and society at large, they provide something discrete to react to...something that helps suspend disbelief about what might be possible. It allows new audiences to understand the issues - and feel empowered to be a part of the solution. This is essential if you want to scale and create a lasting impact.

entirely different ways. The IOT and digital platforms could have a huge role to play here in collecting the right information and then providing a diversity of solutions tailored to people and place and time - instead of just making our supply chains 'smart' and speeding up consumption.

There is a huge opportunity for those who help people use information and collaboration tools to create the world in which their needs are met very differently from today. So, how might that happen?

A good concept or prototype should demonstrate what is possible in response to identified opportunity spaces - when one or more trends in technological development converge with a clear need to tackle a challenge faced by humanity. If the concept is well-articulated then it both serves to represent that opportunity space and get people excited about solutions that may be just over the horizon. It should pull people towards a different future, inspire the development of working pilots, and create change.

We have looked for examples that show where the developments in IOT might intersect with the challenges we face and come up with some concepts to illustrate some of the emerging opportunities. The three concepts below - BuggyAir, Objects with Attitude and RestoreIT - are not necessarily solutions in themselves, but rather represent the kind of ideas we hope to see emerge.

CONCEPT ONE: BUGGY AIR

This asks the question of how a wealth of IOT sensors, connectivity and data might helpfully change citizens' perception of risk and help them alter their behaviour and create change. The example challenge we have chosen is rapidly declining air quality in major cities.

Standard urban air quality measurements are taken by a few static sensors often set high above pedestrian level, with the general picture of average ambient pollution shown as an interpolation between these points. These networks are expensive to operate and few cities have the money to build comprehensive monitoring systems. Even then, the information is often not readily available and can be confusing or misleading as it fails to provide the intelligence that people are most interested in - what is going into their lungs; what effects this could have and how it compares to the rest of the world. There is a big difference between air quality and personal exposure to pollution.

BuggyAir remedies this issue with an air quality monitoring sensor fitted to a child's pushchair. It measures the pollution at street level as the pushchair and child is moved around and so records the real-time and place exposure to potentially harmful air quality. GPS records the precise location of each data point, and an in-built accelerometer intelligently combines with the GPS to determine when a pushchair is being walked around, or is instead travelling in a bus or the back of a car.

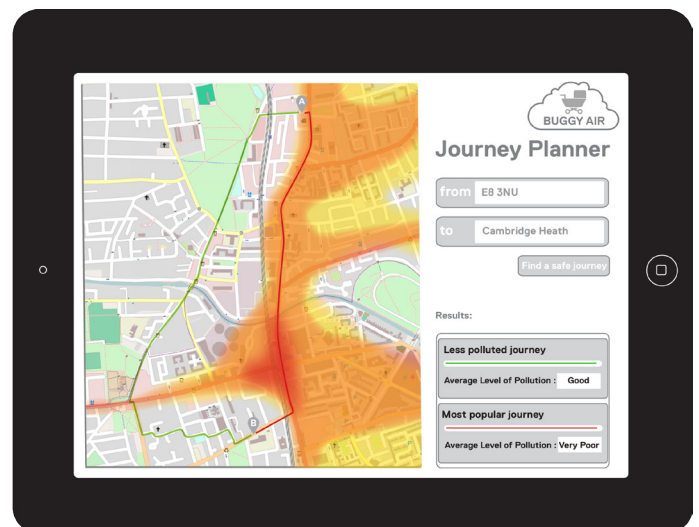
A dynamic air quality map is created by automatically uploading the anonymised data from the device to a platform and combining it with the data from all the other pushchair sensors across the city, as well as embedded air quality information. Together, this helps parents or carers to not only understand the impact of where they are, but make decisions about how to change their routes so as to avoid current or long-term pollution hotspots. The platform can build up a picture of how conditions in the city alter through the day, or week, or year - to provide information for other stakeholders (e.g. lobby groups or policy makers addressing traffic impacts).



Signals of potential:

- A number of crowd-funded air quality projects e.g. Air quality egg - <http://airqualityegg.com/> and Air. Air <https://www.kickstarter.com/projects/1886143677/airair-portable-air-quality-detector>
- Air quality walking maps <https://walkit.com/showcase/air-pollution-aware-walking-routes-in-west-london/>

NOTE: This concept has already attracted a great deal of interest since inception as part of this project. This concept and a similar one for cyclists are currently in development as part of the Internet of Things Academy.



CONCEPT TWO: OBJECTS WITH ATTITUDE

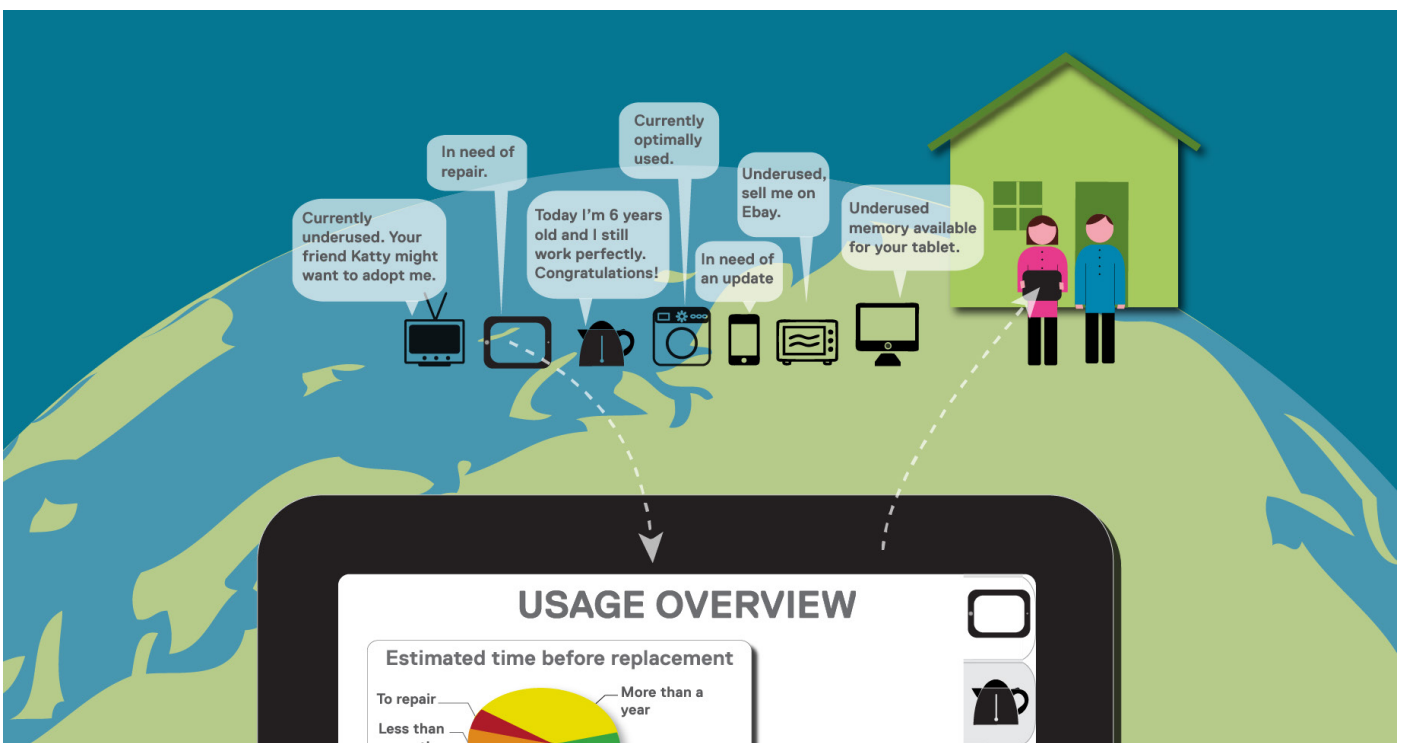
A constant theme in resource management is the idea of 'closed-loop' material cycles. The vast majority of our built economy is based on linear flows of physical resources: they go into the manufacture of a product at one end of the value chain and are discarded when the product is no longer useful and goes into the waste stream at the other. Many materials may then be picked from the waste stream and recycled, but in the process their quality is often reduced and they are unable to be used again by the same manufacturers to create replacement products.

The Objects With Attitude platform (OWA) gives customers the possibility of an alternative material use model which relies on circular flows of resources more akin to those seen in the natural environment. Each product and each sub-component is aware of its material composition, its age, its supply chain history and its current state of efficiency. With a host of devices in a person's life, all connected through the OWA platform, components can be used efficiently until end of life and then inform the user about the best method for recycling back into the system.

For instance, at any stage a product is able to tell its user what its 'health' is and how it could be optimised or enhanced to meet the user needs - which might entail the replacement of parts that are no longer up to the tasks that the user demands of them. In this case, OWA will show people if they own other devices with suitable components that are under-used or link them up with others in their social network who might have parts they can exchange or borrow. Once a component or entire product is no longer functional, OWA will inform the customer how to best manage the transition and perhaps arrange a payment for the best end-of-life solution.

OWA benefits the consumer by ensuring that all of their devices are optimised for their real needs, and avoids any unpleasant surprises that come from unexpected breakdowns. In addition, the consumer can use new technology developments when appropriate rather than upgrading for the sake of it and replacing entire devices.

The benefits to the manufacturer of being able to recover their products at the end of their useful lives are even greater. They include the ability to maintain an uncontaminated and high-quality flow of resources back into their production processes, an improved understanding of how and where their customers really use their products, the potential to offer new product



opportunities and business models of product ownership, and the building of enhanced relationships with consumers.

As with BuggyAir, this is an information-driven service with clear action. But in this case the action is more complex in that it entails M2M collaboration, business to consumer and peer-peer collaboration. The more active the participation by users, the more they get from it.

Weak Signals

- Fairphone have designed their phone to be repaired <https://restartproject.wordpress.com/tag/fairphone/> and parts are labelled with details on how to replace them.
- The phonebloks concept <https://phonebloks.com> - a modular mobile phone has been adopted by Google as Project Ara.

CONCEPT THREE: RESTORE IT

The land around us provides all manner of resources or ecosystem services, but we rarely consciously recognise them. Often their 'health' is not considered until something goes wrong, and then we suddenly notice the huge indirect benefits we've been getting from our environment, such as clean air or pure water. In the UK, for instance, we see the catastrophic impacts of undermining water regulation services – by deforesting catchments, draining and developing floodplains, or channelling water courses – in the annual flooding which claims lives and causes damage and disruption costs which run into the billions.

RestoreIT allows farmers at any scale to combine advances in ecosystem science with sensing technology to actively measure and manage our ecosystems for the benefit of multiple stakeholders. Sensors embedded across the landscape measure soil nutrients, water flows, vegetation density, air composition, and a host of other variables to provide a detailed picture of the entirety of the direct and indirect resources available to the RestoreIT system. These are combined with additional information from sources such as satellite data, local environmental trends, and the updated human needs from the ecosystem, such as food or flood alleviation demands.

The size and components of the measured landscape vary between application cases, but typically include both rural and urban areas which RestoreIT manages for the optimisation of both - coordinating the two-way flow of resources from one to the other and creating detailed management plans that optimise the dynamic use of the land for the good of all over time.

The system can give advanced warning of potential failure by, for example, combining groundwater saturation with weather forecasts and or drops in nutrient levels. It also combs data from latest research or similar situations to provide suggestions for improved management.

Most importantly this concept shows how the management of ecosystem services could provide an additional income for farmers and smallholders around the world as their role as ecosystem stewards is fully recognised and encouraged. This is facilitated by the RestoreIT ecosystem payments engine which calculates the long-term savings of land management activities, and provides the financial transfer system for rewarding actions which support the community.



This solution relies on the optimization of a vast amount of information, and the simplification of it into clear action-driven management plans. It also relies on an even-greater level of collaboration than the previous two concepts – involving participants not only over space, but also over time.

Weak signals

- Using plants as biosensors <http://www.gizmag.com/pleased-project-plantborgs-biosensors/30531/>
- Soil IQ - connected soil sensors <https://angel.co/soil-iq>
- New York pioneered paying for ecosystem services to protect its watershed http://www.ecosystemmarketplace.com/pages/dynamic/article.page.php?page_id=4130§ion=home

WHAT DO THESE CONCEPTS SHOW?

These concepts are not necessarily the solutions that should happen, but rather representations of what could happen, and where the opportunity spaces are emerging. The development of concepts like these could fundamentally shift information flows in society, and we hope these hint at how the targeted rollout of new IOT solutions could lead to the development of a very powerful set of tools for tackling our major challenges.

They require further work, but even initial conversations with potential stakeholders have generated excitement about actually developing these ideas. We welcome input from anyone who would like to help bring them to life.

RECOMMENDATIONS

We suggest a number of steps that organisations could take to ensure that the IOT really lives up to the hype:

- Focus on the 'last metre' - the (representative) distance between a person and the digital service or device that they are interacting with. All too often the solution seems to stop with the data or the latest smart device. This results in 'data spectatorship' at best and apathy at worst. As a start:
- Let people in - open up and simplify IOT applications where they are currently being tested, such as in smart cities, to allow people to create their own solutions rather than relying on proscriptive top-down packages.
- Bring user interface design front and centre for IOT projects.
- Look to deliver needs differently and rise to the challenge - conduct an urgent review of where this kind of technology has the greatest potential to create the most change, not just make current systems smarter. In particular, develop thinking on how it could help tackle some of the really big challenges that we face - like poverty - to prevent it becoming a frivolous plaything that only provides a more tailored and automated existence for the wealthy.
- Imagine and communicate the possibilities - no more communication on the number of connections or the size of the market. Organisations in this space should build strong narratives and prototypes that demonstrate the potential to meet real needs, inspire people and suspend disbelief about what might be possible.
- Start with smart cities as a place to do it right - given the excitement and activity in this space, smart cities should be the crucible for experimenting with different approaches that bring people front and centre. As pointed out by Anthony Townsend we have been here before with big plans for urban revitalisation, but this time we have the opportunity to do it better. As early as the beginning of the 20th century the Scotsman Patrick Geddes - an evolutionary biologist turned sociologist - said that urban renewal was only going

work if the entire citizenry took part. Townsend says that for smart cities to succeed they need a new civic code “a toolkit citizens and planners alike could use to understand and rehabilitate the metropolis.”

- Work with the shift in power rather than trying to hold onto it - one of the amazing characteristics of this technology is its potential to shift power and information flows away from the few and on to the many. This is revolutionary and uncomfortable territory for many in the establishment, but it will happen nonetheless, the benefits available to all will be greater, and working with this shift will yield far more powerful results.

Finally

- Stop talking about the IOT as if it is the goal - As Mark Weiser, the father of ubiquitous computing, said in 1991 “*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it*” . Talk about the dream, not the features.

**‘To be everywhere is to
be nowhere’**

Seneca

Appendix 1: Contributors and Interviewees

We would like to thank everyone who contributed to this report or helped shape our thinking, either through interviews, informal chats or workshops:

- Stacey Goldsmith, Cisco
- Usman Haque, Umbrellium
- Neil Harris, Cisco
- Jon Arden, Superflux
- Tomas Diez, Smart Citizen Kit
- Paul Tanner, Virtual Technologies

Appendix 2: Further reading

The vast majority of our reading consisted of articles that are already linked into the document. There are a couple of reports that may be of interest:

Machine-to-Machine Technologies: Unlocking the Potential of a \$1 Trillion Industry from Carbon War Room (http://www.grahampeacedesignmail.com/cwr/cwr_m2m_down_singles.pdf)

What the Internet of Things means for cleantech (Requires Subscription) <http://gigaom.com/2013/09/17/what-the-internet-of-things-means-for-cleantech-2/>

Smart Cities: Big data, Civic Hackers and the quest for a new utopia (Anthony Townsend) www.smartcitiesbook.com

Connect, Collaborate Change: Opportunities for Information and Communication Technologies (ICT) to support a new movement for a sustainable society <http://europe.nxtbook.com/nxteu/o2/connectcollaboratechange/index.php>

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