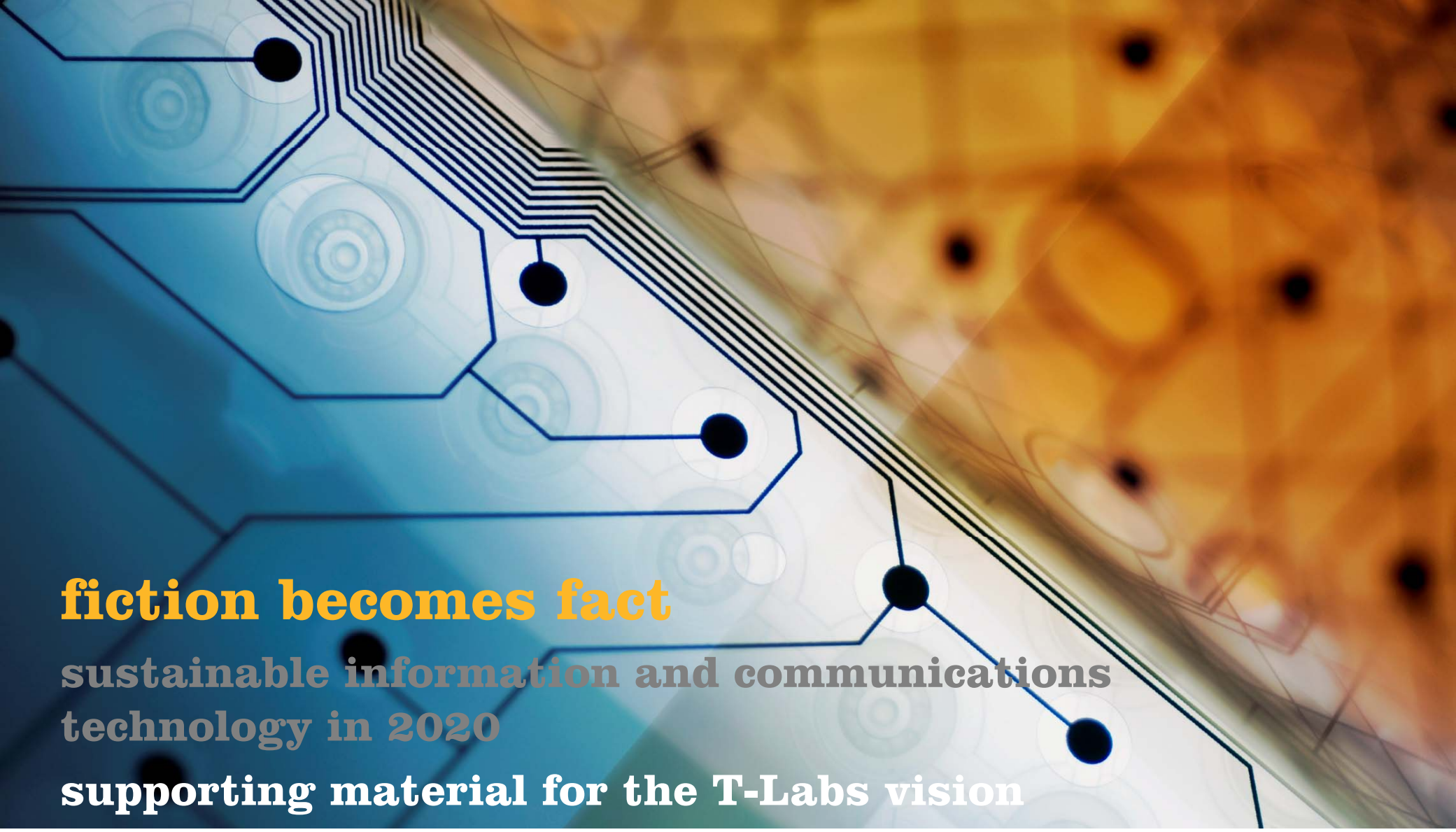


fiction becomes fact

sustainable information and communications technology in 2020

supporting material for the T-Labs vision

prepared by Forum for the Future

forum for the future
action for a sustainable world

Deutsche Telekom Laboratories

Background

Forum for the Future, the sustainable development NGO, works in partnership with leading businesses and public service providers, helping them devise more sustainable strategies and deliver new products and services which enhance people's lives and are better for the environment.

Deutsche Telekom Laboratories (T-Labs) is the research and development institute of Deutsche Telekom. As An-Institut of Technische Universität Berlin it combines industry and science to explore and develop sustainable innovation and open up new markets through new information and communication technologies. The results are sustainable innovative services, products and solutions for the customers of Deutsche Telekom.

Earlier this year T-Labs created its first set of scenarios, together with a set of themed think-pieces, known as "Vision 2020". Forum for the Future worked with T-Labs to develop the 'sustainability and information and communications technologies (ICT)' theme. This document contains research which supports the animation entitled: 'Our bright green vision: Life, ICT and sustainability in 2020'. It also outlines other technologies and trends of potential interest.

Overview

The document has three distinct sections:

1 Defining trends for 2020

This sets the broader context for 2020, outlining some key trends which will frame our lives.

2. Information and communications – what might we see in 2020

This outlines various technologies we may see in 2020, how and why people may be using them, and the contributions that they may make to sustainability. It draws heavily on T-Labs' document *'Telekom 2020: the shape of things to come'*, as well as a number of other sources.

In selecting the content for this section, we have made the assumptions that:

- the pace of technological change will not be constrained by physical laws
- there will be a combination of user-centred technological innovation with top-down product development,

i.e. a primary focus on the type of worlds described by the original scenarios *Bright Digital Future* and *Technocratic Corporatism*.

3. Emerging implications

This section outlines some emerging trends and implications suggested by the technologies outlined in the previous section. This is based on the project team's insights whilst conducting the research and is included here as a basis for further discussion.

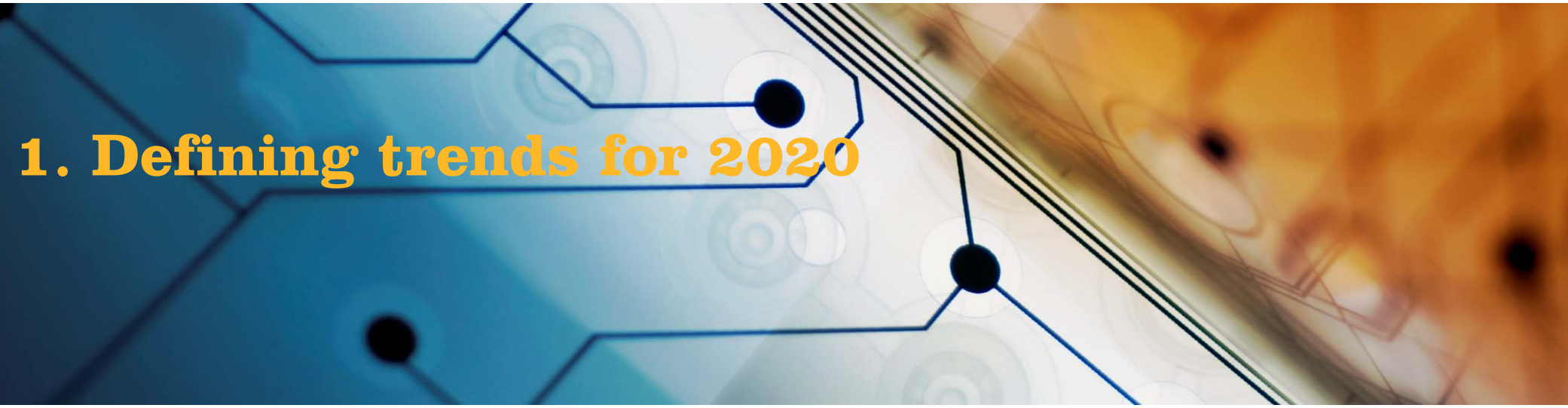
Contents

Defining trends for 2020..... 4

ICT in 2020

- Webware..... 12
- Augmented reality..... 13
- Machine-to-machine communication..... 15
- Near-field communication..... 17
- 3-D printing..... 19
- Smart-dust..... 21
- Individual carbon-use monitoring 23
- Telepresence..... 24
- Virtual office..... 26
- E-paper 28
- Smart grid 29
- Smart communities..... 31
- Smart transport..... .32
- Smart homes..... 34

Emerging themes..... 36



1. Defining trends for 2020

Defining trends for 2020

There is much we don’t know about 2020, but there are also some key trends that we know we need to prepare for, and ICT will play a vital part in this.

The following key trends are outlined:

- climate change
- energy supply uncertainty
- increasing demands on the natural world
- demographic change

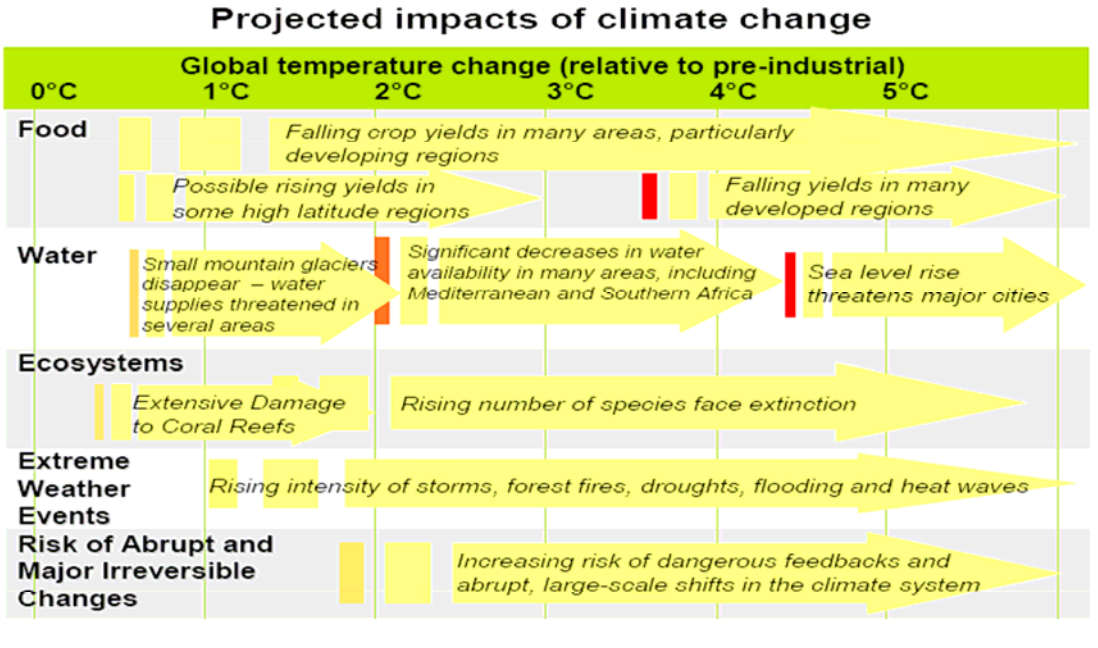
Climate Change

The climate impacts of 2020 are already ‘in the pipe’, determined by our historical emissions.

The IPCC’s mid-range estimate for the next twenty years is an average global warming of 0.4C.

The **frequency and intensity of storms** are likely to increase; there will be more areas affected by **drought**; there will be more and hotter **heat waves** in temperate zones; ecosystems, including agricultural crops, will be affected and biodiversity will be hit; certain diseases will become more common; **sea levels are likely to rise** [1].

Many climate change models are based on linear rates of change in natural systems. However, there is increasing **evidence of feedback loops in the climate system that could trigger non-linear change and abrupt, large-scale climate change much sooner than expected** [2]. For example, the significant loss of reflection from the Arctic ice-cap in the summer (‘polar albedo’), and increased emissions of atmospheric methane from tundras and wetlands may indicate we are already close to triggering such feedbacks, although the science on this remains unproven [3].



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Energy supply uncertainty

The next 20 years will be a period of transition for the global energy system due to uncertainty over existing energy supplies and the need to decarbonise, making the energy mix in 2020 very hard to predict.

Oil

Oil prices have become extremely volatile – spiking to a high of $147 in 2008, falling below $40 in early 2009 and increasing to over $80 in October 2009. The IEA assumes an average of $100/barrel during 2008 to 2015 and then $120/barrel average to 2030 (at 2007 values so a nominal future value of $200) [1]. And there is long-standing controversy over the **accuracy of estimates** of global oil reserves, due to the lack of reporting transparency by key OPEC producers such as Saudi Arabia and this has led to disagreement about when oil supplies will 'peak'. If early **peak oil** theories are correct – i.e. the supply of oil peaks by 2015 – then much higher prices and severe disruption to global economies and food supplies may occur by 2020. A late peak – around 2030 – gives more time to shift to an oil substitute (or different transport system).

Coal

Recently there have been indications that the extent of reported **coal reserves** may be unreliable. The US National Research Council recently stated that 'present estimates of coal reserves are based upon methods that have not been reviewed or revised since their inception in 1974… updated methods indicate that only a small fraction of previously estimated reserves are actually minable reserves'[2].

Renewables

Although they have vast untapped potential, there is much **uncertainty** about how fast, and which, renewable energy sources will be deployed.

Price of carbon

In addition to the rising cost of fossil fuels, regulation and trading systems may put an extremely **high price** on carbon as well.

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Increasing demands on the natural world

Availability of productive land

A **growing global population** and increasing personal wealth, means that an additional 120 million hectares – an area twice the size of France – will be needed for food production by 2030, mainly in developing countries. **Urbanisation** is projected to take up an additional 37 million hectares of cropland by 2030. Competition for land from non-food crops will also have a significant impact on the amount of cropland available for food production. **Unsustainable agricultural practices** may also decrease availability of productive land by soil erosion and depletion [1].

Ability of ecosystems to provide for our needs and regulate our impacts

60 per cent of nature's services are being **degraded or used unsustainably**, including 70 per cent of provisioning and regulating ecosystem services. The ability of our ecosystems to regulate our waste and pollution so that it does not adversely affect air, water and soil quality is decreasing, according to the Millennium Ecosystem Assessment [2].

Metals and minerals crunches

A small number of **minerals**, such as tantalum used in portable electronic devices or cobalt found only in restricted geographic locations, will continue to fill niche requirements in manufacturing, and will therefore be of **disproportionate significance**. As peaks become clear we will see concurrent price rises and likely searches for alternatives [3].

Water availability

World water demand is projected to rise by 30 per cent by 2030 [4].

Today, 800 million people live below UNEP's **'water stress**' threshold; by 2025 this number will rise to 3 billion [1].

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Demographic change

Population growth

The world population is projected to reach 7.7 billion by 2020 – **up** from 6.8 billion in 2008. Most of this increase is near-certain and will take place in developing countries, whose populations are currently predominately young.

In Western Europe in 2020 the population is projected to be 190.5 million with a **density** of 172 people/km – up from 180m & 159 people/km in 1990 [1].

Ageing population

By 2020, 28 per cent of the population in Western Europe will be **over 60** – and 6.5 per cent will be over 80 [1].

Urbanisation

More than half of the world's population is now living in urban areas. Almost 180,000 people are added to the urban population each day and by 2030, it is expected that this will **rise to just under 60 per cent** [2].

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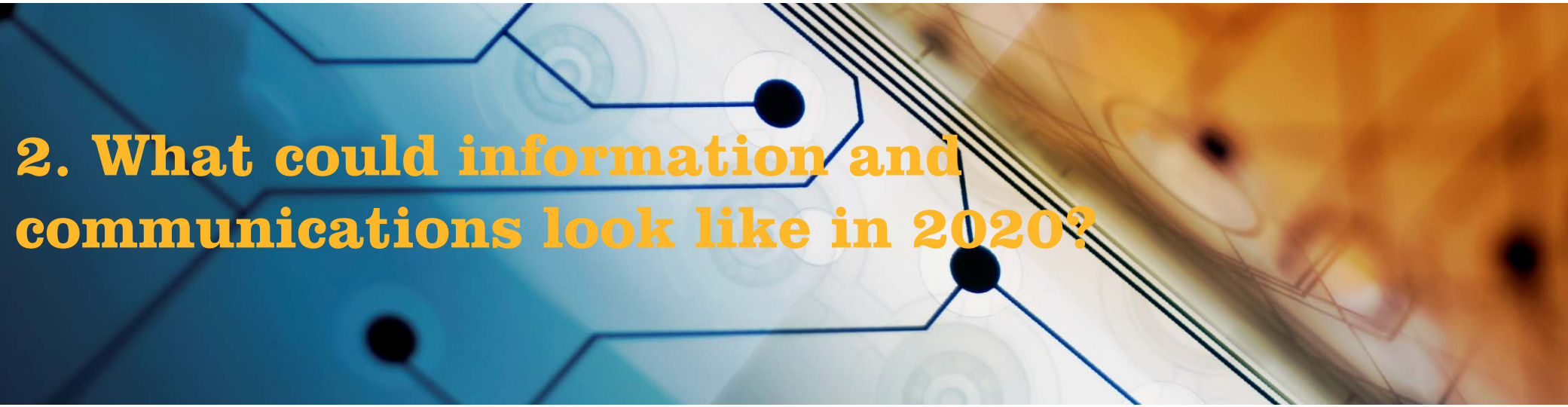

2. What could information and communications look like in 2020?

Webware

What is it and how will people use it?

'Webware' is agile browser-based software that doesn't require a local desktop application – such as Microsoft Word or Excel. This negates the need to own software, by making use of centralised storage capacity on the net, a set-up known as 'cloud computing'.

Why might we see this in 2020?

Webware will make the user's life easier – individuals will not be responsible for installations, updates or security patches. It will allow collaborative access from anywhere. Smaller mobile devices will be standard, probably with one mobile device for all applications: so no more laptops/netbooks, certainly no desktops for the general public. Projectors, head-up displays and virtual keyboards will make being tied to large, heavy, fragile infrastructure obsolete.

In late 2010 Google will launch Chrome OS – an open source, lightweight computer operating system. The aim is to move much of the user interface from the desktop environment to the World Wide Web and "cloud computing" is integral to its design.

What are the sustainability implications?

If you have access to the internet, you will have access to a whole range of applications, largely for free. This will mean huge potential empowerment – both in terms of business and personal agency – for people in sectors of society without the use of desktop-based and other highly specialised software. With barriers to entry removed, the technology could be a social leveller, providing universal access and opportunities for all the world.

The technology has the potential to save resources, reducing the need to upgrade devices such as mobiles or laptops as frequently, if, for instance, internal memory does not need to be increased. It is however likely to mean that operators' server power will need to be increased as more and more of what we do is carried out in the cloud. There could be problems of bandwidth and capacity to meet the vast additional demands, as well as network security issues to resolve.

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Augmented reality | 1

What is it and how will people use it?

The availability of high data rates from both wired and wireless infrastructure will enable innovative wireless applications like mobile ‘augmented reality’ (AR). This will be implemented using smart glasses or contact lenses or through mobile phone screens and will allow additional information regarding people or objects to be displayed. This could include: personal on-line community and contact information; brand/marketing information, cost and availability; or even virtual artwork, invisible to the naked eye.

Why might we see this in 2020?

AR will make the user’s life easier, providing instant information, without the need for additional research. Applications could be simple, such as providing more legible and informative 'name tags' at conferences or more complex – for example the targeted distribution of specific advertising to chosen audiences.

With the increasing urbanisation and growth of megacities, an ICT 'overlay' could help make these complex habitats manageable and navigable, allowing residents to cope with and make best use of enhanced information and rapid changes to the services they use and their social networks.

Research and development into this area is already well underway with an increasing number of smart phone applications and AR contact lens technologies advancing quickly.

Basic versions of AR are already in use in sports television, which uses graphic overlays to show the movement of players, balls etc and to add sponsors’ logos to playing fields.

Augmented reality | 2

What are the sustainability implications?

There will be potential opportunities to use this technology to inform people about the social and environmental impact of products or even modes of public transport.This may be particularly relevant in the future in a world where individual carbon limits are set.

However, this increases the risk of a digital divide. If augmented reality remains expensive there will be a large amount of information only available to some and it could increase dependence on technology.

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Machine-to-machine communication | 1

What is it and how will people use it?

'M2M' (or machine to machine) is the automated communication between remote machines and central management applications. It will provide real-time control and monitoring, without human intervention. Possible applications include sensor networks along the streets to help with the management of traffic, or within buildings to control and guide energy efficiency.

Devices/machines may integrate global positioning technology (GPS) with security information management (SIM), allowing them to co-ordinate with each other autonomously, as well being controlled externally from remote locations – for example in lawnmowers, cleaning, washing or communication robots.

Ultimately every car, energy meter, security alarm system, point-of-sale terminals, household appliances and gaming machines could have this technology – requiring a variety of personal networks and business networks to harness and manage the large amount of information generated. We will also need the development and widespread deployment of the new IP protocols (IPv6) to cope with the explosion in the demand for addresses.

Why might we see this in 2020?

This will reduce and balance resource use, increase efficiencies across a broad range of activities – such as transport and logistics – and automate many low-skill tasks. Basic M2M is already being developed for use in transport, logistics and smart energy meters. Environmental monitors could measure soil moisture and adjust irrigation accordingly, while alarm clocks could wake up households and activate the central heating, kettle or shower.

Machine-to-machine communication | 2

What are the sustainability implications?

M2M could improve the efficiency of machines used in everyday situations – reducing wasted time, money and resources. And this monitoring and control of energy use could have wider implications for the overall energy outputs of regions and countries – potentially representing an essential part of the 'smart grid' (see slide 29), through more efficient power management.

M2M could also be applied to environmental monitoring devices to manage, for example, water and electricity use according to weather conditions or to monitor and manage air pollution.

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Near field communication | 1

What is it and how will people use it?

A form of contactless technology, 'near-field communication' (NFC) uses short-range high-frequency wireless communication technology to allow the exchange of data between devices across a distance of approximately 10 cm. The technology has many potential applications: mobile ticketing – e.g. to access public transport systems; mobile payment – e.g. for card payments in shops and other outlets; physical access – e.g. to control entry to the home or office; logical access – e.g. to control use of a computer network; loyalty application – e.g. to award loyalty points at a supermarket or hotel, healthcare application – e.g. storage of medical information for use in emergencies; digital rights management – e.g. to control the exchange of purchased music or multi-media data; automotive application – e.g. to control access to a car; or smart-advertisement application – e.g. to access information from an equipped poster.

Why might we see this in 2020?

NFC will reduce the number of cards, keys and communication devices that people require and speed up payment and information gathering.

Prêt a Manger, Eat, Coffee Republic, the National Trust, Books Etc and Yo Sushi already accept contactless payment in the UK and Barclaycard has issued 4 million contactless credit cards since 2007. The O2 mobile network have done trials using NFC handsets in London: branded the 'O2 Wallet;' a Nokia phone can be used to make cash purchases up to £10 and travel the underground.The ultimate goal is to be able to use an O2 phone to get transport to the O2 venue in London, get access to the O2 concert, and then use the phone to buy whatever you need there – beers, food or merchandise. In order to work and get accepted however, it needs wide roll-out of the NFC reader technology, which is currently still limited.

Near field communication | 2

What are the sustainability implications?

In reducing the number of cards and electronic devices required, there will be savings in resource use.

There will be potential opportunities to provide sustainability information in advertisements or even on products themselves, such as carbon footprint or water use.

An opportunity may lie in integrated travel nationwide / Europe-wide, with one device meeting all public transport needs in a simple and secure way.

There are also privacy issues around the large amounts of information that could be gathered.

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3-D printing | 1

What is it and how will people use it?

A 3-D printer, sometimes called a ‘replication machine’ will use a digital plan to make real physical objects. This could allow a shift to more local, even desktop, production.

Why might we see this in 2020?

Right now, most 3-D printing is limited to single-material objects. On the near-horizon, however, are systems that will allow for multiple material inputs, and those that will allow the use of electroactive and electronic polymers. Although plastic electronics fall way behind traditional silicon processors when it comes to speed, they're moving into the "just good enough" category – raising the possibility of being able to print out basic electronic products such as sensors, radio frequency identification (RFID) tags, even simple communication devices, by the middle of the next decade.

3-D printing | 2

What are the sustainability implications?

3-D printing could have profound implications for the global economy. Instead of large companies mass-producing consumer goods and distributing them to shops, consumers could buy or share designs on the internet, manufacturing items on their own replication machines.

This may result in more disposable products, increasing resource consumption. Conversely, there could also be greater reparability for products, with consumers being able to print out and replace critical parts at home. This may improve the longevity of goods, possibly resulting in a shift to more basic and easily maintained goods with a longer life.

3-D printing may also enable more rapid product development and instant prototyping. This would remove the economies of scale – including energy efficiency associated with manufacturing in bulk, but also take out the transport impacts.

There could be intellectual property issues, and the potential for consumers to hack established designs to improve them (open source design).

Other fundamental sustainability questions include: what raw materials will 3-D printing machines be constructed from; what will happen to product control; will printers be priced so that they are accessible to all; will we see big corporations taking a stake in each community and providing a local manufacturing outlet for their goods?

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Smart dust | 1

What is it and how will people use it?

'Smart dust' is a hypothetical wireless network of tiny airborne nanotech devices, designed to measure a wide range of characteristics. The system is also known as motes or wireless sensing networks. Because of the small size of these nanotech devices, minute changes in the environment will perturb them. And that disturbance can be measured.

The potential sensitivity of the sensors means that they could measure bacteria, viruses, the chemical composition of molecules, sounds and moisture levels, helping users to monitor any aspect of the environment around them – be it natural or man made.

Why might we see this in 2020?

As the cost of computing continues to fall, as wireless broadband spreads, and as microchips get ever smaller, smart dust becomes more feasible. In our era of rapidly decaying global environment, smart dust could help us know with certainty how our world is changing, and help us make better-informed choices about how to respond.

In the short-term, the most obvious type of industry that this technology will appeal to is the chemical and energy sector. Networks of sensors could be deployed all over the chemical plant or oil refinery in the same way that a human body has nerves to collect information, providing real-time information about the system. So, if a bearing on a pump begins to wear, the management system will be aware of the problem long before it actually fails. The smart dust will convey what is happening and failures may be predicted before they occur and be fixed during routine maintenance.

Other potentially useful applications include the use of smart dust to monitor a high-rise building's structure, or the steel in a ship's hull or a train track.

Smart dust | 2

What are the sustainability implications?

Smart dust will give us lots more real-time information about what is happening, and – by making the invisible visible – could increase pressure for change. It could make sustainable choices easier. Using public transport could be simpler if we are all equipped with GPS, constantly updating both ourselves and the transport provider on where we are in relation to any part of the network.

Perhaps the greatest potential is to increase the efficiency with which we use resources. Energy use would be finely calibrated. Companies could monitor performance in real time and make micro-adjustments to maximise efficiency.

However, smart dust might end up polluting our ecosystems; privacy could be threatened because everyone and everything is monitored. And because so much will be known about our wants and desires, businesses may become ever more skilled at fulfilling them – fuelling more consumerism.

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Individual carbon-use monitoring

What is it and how will people use it?

'Individual carbon-use monitoring' involves using software to consolidate travel and consumption patterns gathered from, for example, GPS mobile devices and payment transactions. This analysis of carbon-related data could be used to recommend the most effective measures to reduce carbon emissions for the individual user and to manage and buy or sell individual carbon allowances.

Why might we see this in 2020?

There is likely to be an increased interest in carbon reduction due to concern over climate change and energy/resource security. With this in mind, there will also likely be increasingly stringent local and international legislation to reduce carbon use (along the lines of the CRC in the UK and ETS in Europe).

Google has a mobile device for monitoring home energy use and Carbon Diem have developed software to establish accurately carbon use associated with travel. There are, however, significant logistical, economic and political hurdles to clear before personal carbon trading is likely to happen.

What are the sustainability implications?

There are clear environmental and economic benefits to reducing our reliance on carbon-intensive resources and fossil fuels. But there are also potential social benefits as effective measurement will empower consumers to control and reduce their carbon costs. Wealthier households tend to be higher carbon users and would, therefore, be penalised more heavily than low-income households, which seems a reasonable way to help the largest emitters engage with the issue.

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Project GreenIT@Labs, Contact Thomas Scheerbarth Deutsche Telekom Laboratories

Telepresence | 1

What is it and how will people use it?

Hugely expanded bandwidths – 50 megabits per second – enabled through the use of fibre optic cables, along with declining prices of surround-screen large displays, mean that connecting with friends, family and business associates on the other side of the world visually as well as aurally, using 'telepresence', could soon be as easy as making a phone call is in 2009.

'Virtual communication environments' involving 3D goggles and fully interactive high-definition internet protocol television could allow instant virtual participation to inaccessible activities and experiences – such as viewing endangered wildlife up close.. This could also enable professionals in the social care field to undertake consultations with patients in remote areas.

Why might we see this in 2020?

The International Energy Agency conservatively projects oil to be at $100 per barrel in 2020 and this rise will increase the cost of transport and increase the drive for video and telecommunication. And social and legislative pressure around carbon use is also likely to persuade individuals and companies to reduce their emissions from transport. Telepresence would allow people to connect with issues and places in the world that they might not otherwise have access to, minimising negative environmental impacts and potentially inspiring people to positive social action – e.g. experiencing 'first hand' life in megacity slums.

Telepresence | 2

What are the sustainability implications?

Telepresence can build social capital by allowing people to stay connected with others in a more full and engaging way. The potential for carbon emissions reductions by avoiding unnecessary travel is huge. Telepresence could connect people with limited access to health-care or other advice, for example in third-world countries, with professionals in the developed world.

It has been estimated that videoconferencing could save 80 MtCO2 per year by 2020 in business alone, more if you include the savings from people's personal lives.

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Products of Deutsche Telekom, http://bit.ly/cef6xH

The virtual office | 1

What is it and how will people use it?

Wireless telecommunications products – such as mobile email, secure access to applications via mobile phones, mobile broadband cards or USB dongles – will be used together to create a 'virtual office', enabling work from home or from local hubs where office infrastructure can be shared.

Why might we see this in 2020?

The benefits for the organisation will include:

- reduced office space and energy requirements
- reduced wired landline infrastructure requirements
- decreased time as well as costs from business travel

The benefits for the staff include:

- decreased time as well as costs from commuting

In the US, for example, around 11 per cent of the total workforce already telecommutes at least one day a month. Rural communities hubs could help to reduce congestion in and out of cities.

The virtual office | 2

What are the sustainability implications?

By enabling remote and home working (or 'telecommuting'), the virtual office cuts emissions and costs from commuting to a physical office location. This could also lead to a more efficient use of space, reducing the use of office buildings for only 12 out of every 24 hours, for example.

The virtual office could also enhance a sense of community in residential areas that have a 'neighbourhood hub'.

It has been estimated that telecommuting could save 260 MtCO2 per year by 2020.

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E-paper

What is it and how will people use it?

The term ‘e-paper’ is applied to a new generation of computer displays which have been designed to mimic as closely as possible the visual properties of paper.

Why might we see this in 2020?

Unlike competing electronic displays such as LCDs, E-paper requires no backlight. In addition, it only needs power when the image changes. Once an image has been produced it will remain visible even with the power switched off. Functionality is improving, E Ink Corporation of Cambridge, Massachusetts, says products based on its colour e-paper will be on the market by the end of 2010.

What are the sustainability implications?

Depending on use, e-paper may have lower emissions than printed paper.

For more information

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New e-readers will end black and white era, New Scientist, May 2009

Smart grid | 1

What is it and how will people use it?

'Smart grids' actively monitor and manage power use, to improve the efficiency of decentralised power networks. The current energy generation and distribution system where a a few, rigidly managed, mega-powerful stations supply most of the market could be replaced by a multitude of relatively weak local energy sources such as micro-generators, owned or managed by individuals and small communities, who become both producers and consumers of power. If this shift occurs there is likely to be an increased volatility of supply which will need careful management by ICT services such as smart grids.

For transport, the new grids could manage the efficient distribution of power to next-generation electric or hydrogen vehicles when they most need it. For example, channelling power between homes, work places or supermarkets, when the vehicles are inactive, in anticipation of use.

Smart meters are an important part of smart grid enablement – for example, to support the sale of energy to utility companies for local distribution or encourage end-users to adjust daily electricity use and avoid destabilising peaks of demand. M2M communication will also have a role here with central power generator control of appliances and timings of operation (washing machines, defrost cycles in fridges, etc.)

Why might we see this in 2020?

Current centralised energy distribution networks are often huge, inefficient grids that lose power in transmission, require an overcapacity of generating capability to cope with unexpected surges in energy use and allow one-way communication only – from provider to customer.

Smart grid | 2

Wireless telecommunications providers are well-positioned to provide the M2M communications and energy consumption mobile networks required for smart grids, with extensive cellular General Packet Radio Service (GPRS) network coverage.

There isn't enough power to go around: businesses and communities recognise that they need to get "off-grid" to support their livelihoods/populous. Smart grids will allow more personal control of energy use – and enable energy independence.

However, the smart grid only makes sense on a pan-European level and needs a critical mass (in a systemic sense) in order to ignite. The shift required is less about technology and more about intelligent organization and orchestration. There could also be difficulties in persuading consumers to modify energy consumption practices for the benefit of the overall systems, which may need the sweetener of add-on services or functionality to make happen.

What are the sustainability implications?

Smart grids reduce the need for generating capacity, and enable more micro-generation.

Consumers will have much more awareness and control over their own energy use.

The potential for ICT to reduce carbon emissions through smart grid technology could be substantial – some 2,030 MtCO2e annually by 2020,

For more information

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Smart communities

What is it and how will people use it?

Networked 'smart communities' will harness digital networks to share goods, services and power.

- Goods – by 2020 every new product could have an internet address of its own (Web 3.0). This would make inanimate objects easily searchable on the internet. Owners who want their possessions to be searchable in this way will need only to tick a permissions box online at a website, and other community members will be able to book to borrow their items.
- Services – remote monitoring of utilities such as water could improve planning, reduce losses and optimise maintenance. New York, Syracuse, Santa Barbara and St. Louis are already using data analytics, wireless and video surveillance capabilities to strengthen crime fighting and the coordination of emergency response units.
- Power – smart grids and individual carbon use-monitoring will enable individuals and communities to share and apply power when and where it is needed, to avoid waste and periods of extraordinary demand.

Why might we see this in 2020?

Increased urbanisation will mean more people living in close proximity, creating the potential and need for sharing products and services. And as resource constraints are increasingly felt and the cost of manufacturing and purchasing goods becomes more expensive, the short-term renting of products will become much more attractive. Society may become more frugal.

What are the sustainability implications?

Smart monitoring of service provision, and tech-enabled community sharing of goods could significantly reduce a community's ecological footprint, ensuring that it only consumes what it needs.

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Smart transport | 1

What is it and how will people use it?

• Intelligent transport: using street architecture – lights, signage and flexible one-way streets – to improve traffic management in cities.

• Personal transport: peer-to-peer updating will inform other drivers of problems further up the road, perhaps through automatic updating of a central transport computer from in-car telemetry, or using a function which combines real-time updates from drivers – through the future version of Twitter, for instance.

•Vehicle safety improvements such as impact prevention will use, for example, GPS, white line sensors and proximity sensors

• Public transport: peer-to-peer updating will improve desirability and operability:

- using travellers' GPS data to manage bus routes etc. in real time;
- using GPS bus/train info to inform travellers where their nearest bus stop is, where the bus is, how long they've got to get it and how it connects with the train they need to catch.

• We will see smart logistics and enhanced fleet management systems such as centralised tracking or vehicle to vehicle communication.

Why might we see this in 2020?

Congestion is likely to be a major issue and safety is an increasing concern (car traffic has increased by 1.3 per cent over the past year, 12 per cent since 1996 and 851 per cent since 1955). By 2020, 28 per cent of the population in Western Europe will be over 60 – and 6.5 per cent will be over 80 and an ageing society will require improved safety. Increasing energy and fuel costs will need to be addressed.

Smart transport | 2

What are the sustainability implications?

Transport would become more efficient and safer. Reduced congestion would lower carbon emissions in urban areas and improve local air quality. On a personal level mobility would be improved with reduced commuting times.

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Smart homes

What is it and how will people use it?

'Smart homes' can have their energy use controlled in real time and remotely through mobile devices if desired. The next generation of 'smart meters' will be able to monitor all of the energy use and production in the home, link up all home appliances wirelessly, giving the homeowner much more knowledge of – and control over – energy usage.

Personalised environmental controls will change the ambience of indoor and outdoor spaces with lighting, temperature and even decor controllable from a mobile device or personal RFID (radio frequency identification) tag.

Why might we see this in 2020?

Globally, smart buildings technology could potentially reduce emissions by 1.68 GtCO2e and be worth €187 billion ($295 billion) of energy savings and €29 billion ($45.7 billion) in carbon costs.

A host of building management systems already exist and as ICT applications become more sophisticated, the range of functions will expand.

What are the sustainability implications?

More efficient homes could reduce energy use and the associated emissions. The built environment currently accounts for around 20 per cent of UK carbon emissions. Smart buildings could save up to 1,680 MtCO2e by 2020.

References

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3. Emerging implications

Emerging implications | 1

Global vs. local?

Information and communications technologies may allow us to be connected with people across the world, and simultaneously afford more effective communication and decision-making on a local level. It's not clear whether the combination of pressures the world will face in the future – energy supply uncertainty, climate change and resource constraints – will move us towards a more global world, where coordination is key, or a hyper-local one, where interests are managed at the community level. It could be that both play a simultaneous role.

Where choice lies

The efficiency of information transfer, including machine-to-machine communication, has the potential to remove a lot of consumer choice, as well as to produce more informed consumers. There is a limit to how much information people can individually process. Will regulation and 'behind the scenes' information analysis put less power into the hands of the individual, or will people demand ICT-enabled transparency and decision-making powers? Will we have a 'concierge app' that deals with the complicated world on our behalf?

Services not products

The music industry has already felt the effect of digital technologies in highly disruptive business models like iTunes and Spotify. People will accept the service of having convenient access, rather than feeling they actually have to own a physical product – the CD, the car, and so on – outright. The shift from products to services will help us address resource constraints with large concurrent business opportunities.

Privacy

With increasing personal information being available and being shared, notions of privacy will evolve. There will be more ways that our current version of personal privacy can be breached. It will become more and more difficult for individuals to control what information exists about them and who has access to it. There are questions over whether privacy law will be able to adapt fast enough and what role organisations should play. However, people – especially younger generations who grow up in the context of an always-on world – will draw their boundaries between the 'completely personal' and the 'completely public' differently.

Emerging implications | 2

Information for decision-making

In combination with increased real-time information updates via ICT, advances in social science, behavioural science and mathematical modelling may combine, leading to more informed decision-making in both policy and strategy.

Massive information processing & decreasing transaction costs

Near-field communication is already enabling a decrease in the cost of an individual transaction. At the same time personal ICT devices are 'smart' enough to learn their owners' preferences. This may have far-reaching implications for how individuals interact with their environment, and for future business models – will we be buying infinitesimal components of our lives as we go about our business, perhaps even unconsciously?

Tracking and tracing

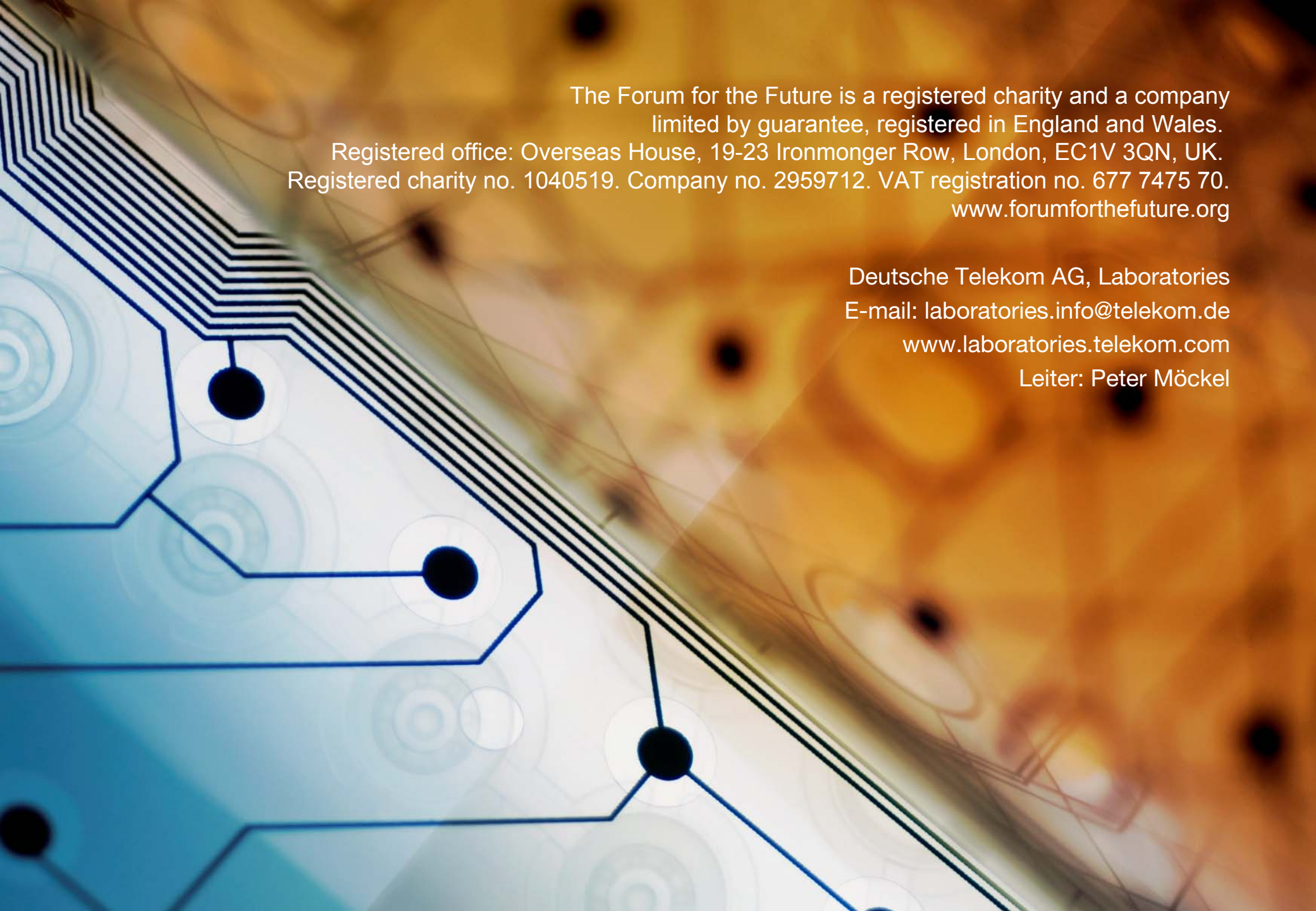
Advances in monitoring technology point towards a future 'internet of things' – where every manufactured or processed product is trackable & traceable in real-time, and detailed environmental monitoring (of cities, farms, forests and marine ecosystems) is ubiquitous.

Faster, faster

Technologies like M2M and telepresence shorten the time taken for information to be transferred from place to place and acted on – either because the process becomes automated or waiting time (like travelling to and from a meeting) is eliminated. The pace of activity in the economy and in people's interactions is likely to get faster and faster.

'Outsourcing' our memories and other cognitive functions

With our always-on devices we will be able to use the entire internet plus the apps on the phone as extensions of our own cognitive functions. There will be less need to remember things when they can be looked up easily and instantly. The key cognitive skill will not be remembering things, but being able to formulate searches for them.



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www.forumforthefuture.org

Deutsche Telekom AG, Laboratories
E-mail: laboratories.info@telekom.de
www.laboratories.telekom.com
Leiter: Peter Möckel