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Ethical and societal challenges of the approaching technological storm

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Supported by the arrival of 5G and, soon 6G, digital technologies are evolving towards an artificial intelligence-driven internet of robotic and bionano things. The merging of artificial intelligence (AI) with other technologies such as the internet of things (IoT) gives rise to acronyms such as 'AIoT', 'IoRT' (IoT and robotics) and 'IoBNT' (IoT and bionano technology). Blockchain, augmented reality and virtual reality add even more technological options to the mix. Smart bodies, smart homes, smart industries, smart cities and smart governments lie ahead, with the promise of many benefits and opportunities. However, unprecedented amounts of personal data will be collected, and digital technologies will affect the most intimate aspects of our life more than ever, including in the realms of love and friendship. This STOA study offers a bird's eye perspective of the key societal and ethical challenges we can expect as a result of this convergence, and policy options that can be considered to address them effectively.

1. Features, opportunities and challenges of converging technologies

Ethical discussion about digital technologies in the past few years has frequently focused on AI. It is therefore important to note that the challenges extend well beyond those that are typically or usually discussed in the AI ethics literature. The convergence of digital technologies will lead to new technological applications, but will also contribute to the creation of new sociotechnical systems and systems of systems, which may raise their own challenges. The convergence will therefore most likely result in technological possibilities and features that extend beyond those of individual enabling technologies like AI, IoT and blockchain. To address these challenges, we need to look for policy options and regulation that extend beyond the realm of AI and the concerns it has raised.

Many, if not all, new applications and socio-technical systems will display one or more of the following features: interactive, long-distance, distributed, autonomous, intelligent, adaptive, reconfigurable, hybrid, fully connected, invisible, fast, precise in location, intimate, immersive, persuasive, and commercially exploitable. These features partly stem from the individual technologies that go 'in the mix'. For example, features like interactivity, autonomy, intelligence and autonomy are typical characteristics of AI systems. However, some features also emerge due to new combinations of technologies. Moreover, it is often the combination of the features that creates new challenges for society, policy-making and regulation. Based on these features and inspired by interviews with a number of experts, the study identifies (and explains in more detail) nine key opportunities and challenges:

1. Digital sovereignty and new economic and social opportunities.
2. The blurring of historically distinct social and economic areas (such as the family and work).
3. An increased impact on people's intimate life.
4. Opacity and cognitive overload.
5. Energy use and sustainability.
6. Increased cybersecurity risks and new cyber-physical risks.

7. Disruptive effects.
8. The concentration of techno-economic power.
9. Fundamental unpredictability.

2. Methodology

This analysis was performed using responsible research and innovation (RRI) as the overarching framework for developing policy options. RRI has four dimensions (Stilgoe, Owen & Macnaghten, 2013):

- Inclusiveness: relevant stakeholders, and their values and needs, should be included in the process of technological innovation from the start.
- Anticipation: impacts, benefits and risks of the technology should be anticipated and these anticipations should be fed back into the process of technological innovation.
- Reflexivity: the underlying purposes, motivations, and values for technological innovations should be reflected upon and should guide the process of technological innovation.
- Responsiveness: technological developments should be responsive to the values and needs of society and to new insights and developments that appear along the way.

3. Policy options and assessment

Inspired by these dimensions, this study puts forward the following policy options in response to the challenges identified.

3.1 Digital innovation for societal challenges

Concrete measures could include: (1) giving digital innovation a clearer place in the EU missions[1] in the Horizon Europe research funding scheme, particularly in mission-oriented research; (2) stimulating the creation of European industrial consortia and public-private partnerships that can contribute to digital innovation for societal challenges and increasing digital sovereignty; and (3) paying particular attention to how small and medium-sized enterprises (SMEs) and start-ups may contribute to digital innovation for societal challenges, e.g. through incubators and subsidy schemes.

3.2 The IoT as a digital common

As infrastructure technology and an enabler of systems connecting many applications, IoT is a key public good, one which allows the production of other goods; it is also a key enabler for ensuring that important social and moral values (like democracy, autonomy, justice and fairness, privacy, sustainability) are respected by specific applications. Safeguarding this role of IoT as a public good and enabler of public values requires managing IoT (and other digital infrastructure) as a common good. This would minimally require a set of public rules for its development, maintenance and use, aimed at guaranteeing equal, non-discriminatory access for everyone, and safeguarding public values. This may be achieved through public ownership, e.g. by governments, of the basic digital infrastructure, but other ownership and institutional structures may also allow the IoT to be managed as a digital common.

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1   The EU missions included in the Horizon Europe research and innovation programme for 2021-2027 are a new feature set in place to support specific priorities of the European Commission.

3.3 EU Observatory for converging digital technologies

The new ethical and social issues raised by the technological storm are partly unpredictable. Yet some of their effects may be disruptive and be irreversible, and require institutional, regulatory or even conceptual changes to properly deal with them. There is therefore a need for an organisation playing an early warning or early detection function when it comes to new challenges and potential disruptions brought about by the approaching technological storm. This could be achieved by establishing an EU observatory of converging digital technologies. Such an observatory would be tasked with monitoring relevant developments, and carrying out interdisciplinary ethical, legal and social issues (ELSI) research on converging technologies, with the aim to discover early new issues and challenges and to translate these either into new technological research and innovation, or into new policy, governance or regulatory measures.

3.4 Increasing digital literacy

Digital literacy is important in making digital innovation more inclusive, as inclusiveness would require citizens who are sufficiently well-informed to contribute to a societal dialogue. It will also be helpful in addressing some of the more specific challenges. For example, dealing with opacity and cognitive overload will also require citizens that have a better understanding of digital technologies, including their limitations and threats. Similarly, better awareness will help citizens to play their part in addressing challenges like increased and new cybersecurity risks, energy use and sustainability, and the impact on people's intimate life.

3.5 Institutionalisation of design for values

The design for values approach aims at systematically designing digital technologies for a range of moral and social values. Privacy-by-design and ethics-by-design are already part of the General Data Protection Regulation (GDPR) and of the new EU AI regulation. However, the approach needs to be extended to other values, like democracy and transparency. Concrete measures could include: (1) stimulating the creation of training programmes on design for values, for example through the Horizon Europe research funding scheme; (2) Making reporting on design for values obligatory for large tech companies in the EU as part of the obligatory CSR (corporate social responsibility) reporting; (3) Ensuring that design for values is taken up in standardisation and certification.

3.6 Energy label for digital technologies and services

Sustainability has so far received little attention in ethical and legal frameworks for AI. But with the advance of technologies like 5G/6G and blockchain, energy consumption is becoming a challenge that urgently needs addressing. Energy labels would make consumers (and the public at large) more aware that some digital technologies and services consume considerable amounts of energy and help them to make more deliberate choices in this respect. Energy labels also create an incentive for the industry to reduce the energy consumption of digital devices and services, and may spur innovation towards lower energy consumption (with similar performance).

3.7 From privacy and digital rights to social justice and human capabilities

Privacy is a key concern with the technologies addressed in this report. However, the invasiveness of these new technologies in people's intimate life means that we may need to move beyond traditional ways of thinking about and responding to privacy issues. The dominant ethical and legal paradigm is informational privacy, often operationalised as informed consent. However, some of the new challenges raised extend well beyond informational privacy; an example of this is the blurring of social areas. It is necessary to pay attention to wellbeing and human capabilities, to deal with the challenge

of an increased impact on people's intimate life. Both may require legal or regulatory frameworks that extend beyond the current emphasis on privacy and (digital) right and also emphasise social justice and human capabilities.

Opportunities & challenges	Digital innovation for societal challenges (X)	IoT infrastructure as digital common (X I A)	EU Observatory for converging digital technologies (R A)	Increasing digital literacy (I)	Stimulating the design for values approach (X)	Energy label for digital products & services (A)	From privacy & rights to justice & capabilities (I A)
Digital sovereignty, economic prosperity & social benefits	●						
The blurring of social spheres		●	●	●	●		●
Impacts on people's intimate life		●	●	●	●		●
Opacity & cognitive overload		●		●	●		
Energy use & sustainability	●			●	●	●	
Increased cybersecurity risks & new cyber-physical risks	●	●		●	●		
Disruptive effects		●	●				
Concentration of techno-economic power		●					
Uncertainty & fundamental unpredictability			●				

Dimensions of responsible research & innovation (RRI):
(R) Responsiveness (A) Anticipation
(I) Inclusiveness (X) Reflexivity

Proposed policy options and their correspondence with identified opportunities and challenges, as explained in more detail in the accompanying study.

This document is based on the STOA study ['Ethical and societal challenges of the approaching technological storm'](). The study was written by Ibo van de Poel, Tristan de Wildt, Ilse Oosterlaken, and Jeroen van den Hoven of Delft University of Technology (TU Delft) at the request of the Panel for the Future of Science and Technology (STOA), and managed by the Scientific Foresight Unit, within the Directorate-General for Parliamentary Research Services (EPRS), European Parliament. STOA administrator supervising the study: Andrés García Higuera. STOA administrator responsible: Vasco Guedes Ferreira.

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