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on the Mid-Term Review on the implementation of the Digital Single Market Strategy

A Connected Digital Single Market for All

{COM(2017) 228 final}

Contents

1. Introduction 4
1.1. Policy Context 4
1.2. Reactions to the DSM Strategy 5
2. A call for timely delivery and effective implementation 6
2.1. Agreements already reached 6
2.1.1. Wholesale Roaming and Fair Use Policy Implementing Act 6
2.1.2. Spectrum – UHF band (including 700MHz band) 7
2.1.3. Cross-border portability of digital content 8
2.2. Proposals adopted by the Commission, awaiting co-legislature 8
2.2.1. Geo-blocking 8
2.2.2. Digital Contracts (online content & distance sales of goods) 9
2.2.3. Value Added Tax (VAT) for eCommerce 10
2.2.4. Copyright 10
2.2.5. Parcel delivery 12
2.2.6. Consumer rights enforcement / Unfair Commercial Practices Directive 13
2.2.7. Audio-visual Media Services 14
2.2.8. European Electronic Communications Code, BEREC & WiFi4EU 15
2.2.9. ePrivacy 17
2.2.10. Enforcement of intellectual property rights 18
2.2.11. E-commerce sector inquiry 20
3. Ensuring a fair, open and secure digital environment 21
3.1. Promoting Online Platforms as responsible players of a fair internet ecosystem 21
3.2. Developing the European Data Economy 31
3.3. Fostering a trustworthy cyber ecosystem: Tackling cybersecurity challenges together 36
4. Managing the digital transformation of our society and economy 40
4.1. Digital skills and opportunities for all 41
4.2. Startups and digitisation of industry and service sectors 44
4.3. Digital innovation for modernising the public services 57
4.4. Stepping up investments in digital technologies and infrastructures 67
4.4.1. Towards a Gigabit society 68
4.4.2. Developing a European Open Science Cloud, High Performance Computing and European Data Infrastructure 70
4.4.3. Building artificial intelligence capacities 72
4.4.4. 5G 75
5. The Digital Single Market: Europe's main asset in the global digital economy and society 77

Annex: Indicative table of EU funding and financing to digital infrastructure and services, as well as skills, 2014-2020 82

1. INTRODUCTION

1.1. Policy Context

The EU economy and European society are in the process of radical economic and social transformation. Digital technologies and the amount of data they create trigger new innovations, products, services, business models, as well as new ways of interaction between people and machines. These technologies change the way citizens and business live, work, communicate, travel and consume.

These technologies are already delivering concrete benefits: personalised medicine; wider access to education and culture, by using online services; better digital public services; and allowing consumers to manage how they consume, and even produce energy, with the help of smart grids and smart meters. These are just a few demonstrations of the growing number of tangible benefits these technologies can provide. Beyond these, digital technologies can help to re-industrialise Europe and assist existing industries to modernise their operations and profit from the scale of the internal market. Indeed, new business models using new technologies such as three dimensional (3D) printing, Artificial Intelligence, cloud and the Internet of Things could facilitate the return of manufacturing to Europe that was previously outsourced. They also allow a more resource efficient production and delivery of goods and services that are tailored to individual needs and expectations (e.g. personalised health-care, tailored personal education).

The digital revolution, if well managed, offers the opportunity to strengthen Europe's economy and society which have suffered from a decade of low growth, a weakening of the social fabric and unsustainable development. It is also an opportunity for the EU to demonstrate global leadership in innovation and technologies.

Maximising the positive impacts of this digital revolution on people's lives and European business activity is the principal aim of the Digital Single Market (DSM) strategy adopted on May 2015. As part of its 10 priorities, the Juncker Commission has thus decided to provide a strong focus on digital through the Digital Single Market strategy, combined with fresh investment in new technologies and fostering of capital availability thanks to the building of a Capital Markets Union.

In the 18 months following the adoption of the Strategy, the European Commission consulted widely and delivered the necessary proposals under the 16 actions of the Strategy. The proposals will bring down barriers, reduce costs of doing business across borders, improve access to goods and services for all citizens, and create the necessary conditions for investment and growth in digital infrastructure and services and all those sectors that rely on them. The final shape of many of the legislative proposals now rests in the hands of the Council and the European Parliament. Other actions are being implemented through various non-legislative measures. Those range from financing key digital technologies and stimulating digitisation to modernising public services through the digital transformation of government.

This Staff Working Document takes stock of the considerable distance that the Commission has covered since May 2015. It also highlights new issues that have emerged more clearly since then: the need to better capture the impact of the digital transformation on societies, the growing role of data, the European cloud, digital skills, artificial intelligence and internet platforms, the potential that digital has for health and health care and the mapping out of cybersecurity risks.

This Staff Working Document provides an overview of the implementation of the DSM strategy and shows how the Commission manages the digital transformation and keeps up with digital developments.

Chapter 2 highlights the rationale of the DSM legislative proposals (including better enforcement actions) and overviews the progress made since the adoption of the Strategy.

Chapter 3 provides an overview of emerging trends in digital ecosystems that may require additional actions. This covers online platforms, the data economy and cybersecurity.

Chapter 4 focusses on digital policies aimed at successfully managing the digital transformation of our economy and society. It summarises the Commission's activities in this field: to boost Europeans' digital skills, foster the digitalisation of industry and service sectors, modernise the public sector and step up investments in connectivity and digital technologies.

Chapter 5 looks at the EU's position on the global digital stage.

1.2. Reactions to the DSM Strategy

The European Council and *The European Parliament* supported and welcomed the strategy. The European Council stated that the strategy should be used to promote inclusive growth in all EU regions[1]. The European Parliament considered that achieving a digital single market through a horizontal approach, strengthened in its implementation, creates jobs and growth, a more inclusive society, and new opportunities for citizens and businesses.[2]

The European Parliament has since commented on several aspects of the strategy and has called on Member States to fully cooperate in implementing the DSM to stimulate growth, create quality jobs, promote necessary innovation in the EU market, keep the European economy globally competitive and bring benefits to both businesses and consumers.[3]

The European Council has since committed itself to the adoption and implementation of DSM files by June 2018[4]. In the Bratislava declaration[5], it repeated the importance of delivering concrete benefits for citizens.

The European Economic and Social Committee supported the Commission in its determination to put an end to the fragmentation of European digital policy and pointed to closing the skills gap as a priority.[6] *The European Committee of the Regions* has been favourable towards the strategy in its opinions, emphasising the importance of deploying digital infrastructure across Europe.[7]

National Parliaments also engaged,putting forward opinions[8] on both the strategy and its specific action points.

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1 http://www.consilium.europa.eu/en/policies/digital-single-market-strategy/

2 REPORT on Towards a Digital Single Market Act (2015/2147(INI))

3 Report on the Annual Report on the Single Market Governance within the European Semester 2017 (2016/2248(INI)) Committee on the Internal Market and Consumer Protection

4 http://www.consilium.europa.eu/en/press/press-releases/2016/06/28-euco-conclusions/

5 http://www.consilium.europa.eu/en/press/press-releases/2016/09/16-bratislava-declaration-and-roadmap/

6 OPINION of the European Economic and Social Committee on the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Digital Single Market Strategy for Europe COM(2015) 192

7 SEDEC-VI/005 114th plenary session, 12-14 October 2015 OPINION Digital Single Market

8 The Commission received opinions from the National Parliaments in Austria, Czech Republic, Germany, UK, Italy, Portugal and Romania on the DSM Strategy, and from Germany and Romania on online platforms.

Member States have supported and pushed the strategy forward through different contributions, the adoption of new or amended national strategies, and processes like the digital republic law in France[9], and the Foundation Autonomous-project in Denmark[10].

Today, National Digital Agendas are in place in all Member States and reflect the strategies put forward by the European Commission. This has led to a higher priority and awareness of digital policies throughout Europe. Some Member States seem to go beyond having one National Digital Strategy by formulating and implementing more specific strategies on the various core issues of the Digital Single Market such as eGovernment[11], Industry 4.0[12] and eSkills[13]. The strategy has provided Member States with a common framework and has united Europe in its development of digital policies necessary both in the internal market and the global economy.

2. A CALL FOR TIMELY DELIVERY AND EFFECTIVE IMPLEMENTATION

This section presents the progress on policy files categorised by agreements already reached between co-legislators, legislative proposals under negotiation, enforcement activities related to the DSM and reactions after the adoption of the DSM Strategy by Member States and various European Institutions.

2.1. Agreements already reached

2.1.1. Wholesale Roaming and Fair Use Policy Implementing Act

Challenges addressed through the actions announced in the DSM Communication

The Commission has been working for a decade to reduce and ultimately remove the surcharges citizens face each time they cross a border while using their mobile device. The Digital Single Market will not happen if people are hesitant to go online, text or call every time they cross a border. 34 % of Europeans travel abroad within the EU every year.[14]

Since 2007, roaming prices have decreased by more than 90 %. Prices last fell in April 2016, to 5 cents per minute of voice call received, 2 cents per SMS sent, and 5 cents per MB of data on top of national rates.[15] In 2015, based on a proposal by the European Commission, the European Parliament and the Council agreed to end roaming charges for people travelling periodically in the EU.

To this end, it was also necessary to reduce the maximum prices operators can charge each other, when their customers use other networks when roaming in the EU. That is why the European Parliament and the Council mandated the Commission to review the markets where operators purchase roaming services for their customers ('wholesale roaming markets') and make appropriate proposals by 15 June 2016, to enable the abolition of retail roaming charges from 15 June 2017.[16]

What has been delivered?

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9 http://www.republique-numerique.fr/pages/in-english
10 https://autonomous.dk/en/
11 E.g. Bulgaria, Cyprus, Denmark, Greece, Italy, Slovakia and Spain (EDPR 2017).
12 E.g. Czech Republic, France, Italy and Slovakia (EDPR 2017).
13 E.g. Hungary Ireland, Luxembourg, the Netherlands and Portugal (EDPR 2017).
14 Special Eurobarometer 414 (2014)
15 https://ec.europa.eu/digital-single-market/en/roaming-tariffs
16 Regulation (EU) No 2015/2120

Following an in-depth review of the wholesale roaming markets, the Commission adopted its proposal on 15 June 2016.[17]

The European Parliament and the Council adopted the new rules in April 2017. All measures will be in place to abolish retail roaming charges from 15 June 2017.

On 15 December 2016, the Commission adopted an implementing act with detailed rules on 'fair use' measures that operators can take to prevent abuse of the roaming services, and on a derogation that operators can apply for when the provision of regulated roaming services at domestic prices threatens the sustainability of their domestic charging model. National regulators, authorising such derogations, can only grant them exceptionally, on the basis of the methodology included in the implementing act.

The European Parliament and the Council adopted the new rules in April 2017. All measures will be in place to abolish retail roaming charges from 15 June 2017.

	1 July 2014	**30 April 2016**	**15 June 2017**
Outgoing voice calls (per minute)	EUR 0.19	Domestic price + up to EUR 0.05	Roam like at home – **no extra fee**, same as domestic price when travelling in the EU
Incoming voice calls (per minute)	EUR 0.05	EUR 0.0108	
Outgoing texts (per SMS message)	EUR 0.06	Domestic price + up to EUR 0.02	
Online (data, download, per MB)	EUR 0.20	Domestic price + up to EUR 0.05	

2.1.2. Spectrum – UHF band (including 700MHz band)

Challenges addressed through the actions announced in the DSM Communication

Radio spectrum is an essential resource for wireless communications. Smart phones and tablets, for example, depend on wireless connectivity, but it will also become relevant for traditional sectors that will use the next generation of connectivity (5G) to deliver new wireless services, such as connected cars, or new mobile health applications. However, radio spectrum is a finite resource and the devices that use it can easily cross borders. Therefore, logically, Europe needs to ensure sufficient spectrum is available in time to support these new services, and that EU-level coordination is effective and efficient.[18]

What has been delivered?

The Commission adopted its proposal for a Decision of the European Parliament and of the Council on the use of the 470-790 MHz frequency band in the Union on 2 February 2016.[19]

The proposal intended to contribute to the availability of high-speed wireless broadband for all EU citizens by 2020 and facilitate the development of next generation connectivity services through harmonised use of the 700 MHz band. The coordinated release of the 700 MHz band will enhance rural and ubiquitous machine-type wireless connectivity of up to 100

[17] COM(2016) 399

[18] According to a recent study from the Commission (SMART 2016/0019), 5G applications would require up to an additional 56GHz of spectrum, depending on the usage scenario.

[19] COM(2016) 43

Mb/s and enable leading 5G deployment in Europe by 2020, due to its ability to deliver cost-efficient wireless connectivity with both indoor and outdoor coverage[20]. It can also be combined with other sub-1GHz bands, such as 800 MHz and 900 MHz, to boost capacity and provide wide coverage. At the same time, the lower part of the spectrum band will be reserved for the distribution of audio-visual media services to the public, while allowing technology and service neutrality for flexible spectrum use on a national basis in accordance with broadcasting needs.

On 14 December 2016, the co-legislators reached a general political agreement on the proposal. On 15 March 2017 the finalised proposal was approved by the European Parliament.

In conjunction with the proposal, the Commission adopted in April 2016 an Implementing Decision[21], which harmonises the technical conditions for use of, the 694-790 MHz (700 MHz) frequency band for wireless broadband and facilitates flexible use for specific national needs.

2.1.3. Cross-border portability of digital content

Challenges addressed through the actions announced in the DSM Communication

There are significant barriers limiting cross-border portability of online content services (e.g. audio-visual services including online transmission of sporting events) in the EU. The reasons behind these barriers are related to the licensing practices of right holders and the commercial practices of service providers. These aspects had to be addressed to ensure that Europeans travelling in any EU Member State are able to access the online content services (films, sporting broadcasts, music, e-books or games) to which they have subscribed in their home country.

What has been delivered?

In December 2015, the Commission proposed a new Regulation[22] ensuring the cross-border portability of online content services to which a consumer subscribed in their Member State of residence. That means consumers can continue using online content services such as watching films or sporting events, listening to music, reading e-books or playing games when temporarily traveling in other Member States, e.g. on holidays or business. Based on a 2015 estimate, over 29 million people would have used this feature then and as many as 72 million would do so in 2020.[23] The European Parliament and the Council reached a political agreement on the proposed Regulation on 7 February 2017. The Regulation will become applicable in the beginning of 2018 following its formal imminent adoption and a 9-month period provided to prepare for the application of the new rules.

2.2. Proposals adopted by the Commission, awaiting co-legislature

2.2.1. Geo-blocking

Challenges addressed through the actions announced in the DSM Communication

[20] Opinion of the Radio Spectrum Policy Group, document RSPG16-032 final
[21] Commission Implementing Decision (EU) 2016/687
[22] COM (2015) 627 final
[23] Impact Assessment report accompanying the proposal for a Regulation of the European Parliament and of the Council on ensuring the cross-border portability of online content services in the internal market; p. 12 and p. 17; SWD(2015) 271, SEC(2015) 484

Geo-blocking refers to practices used by traders that result in discrimination against customers on the basis of their nationality, place of residence or of establishment. This can entail denial of access to websites from other Member States, or to situations, where the customer from another Member State is discriminated against or prevented from accessing the product or service or can only pay with a debit or credit card from a certain country. Sometimes such restrictions can be justified, for instance where the seller needs to comply with specific legal obligations. But in many cases they cannot. Despite the implementation of the non-discrimination principle in the Services Directive[24], there is uncertainty over what constitutes objective criteria that justify differences in the way traders treat customers.

By limiting consumer opportunities and choice, geo-blocking is a significant cause of consumer dissatisfaction and of fragmentation of the Internal Market. A Commission mystery shopping survey found that in only 37 % of all websites assessed were shoppers successful in reaching the last stage of the online shopping process, where they successfully entered their payment details in order to complete their cross-border purchase.[25] Removing geo-blocking barriers could lead to an aggregated consumer gain of EUR 500 million and an aggregated firms' profit increase of EUR 283 million from new trade opportunities.[26]

What has been delivered?

In May 2016 the Commission adopted its proposal for a regulation on addressing geo-blocking and other forms of discrimination based on customers' nationality, place of residence or place of establishment.[27]

The proposal defines specific situations when there can be no justified reasons for geo-blocking or other discriminations based on nationality, residence or location. Furthermore, the proposal bans blocking of access to websites and the use of automatic re-routing if the customer has not given prior consent. The proposal also provides for a non-discrimination rule in payments.

2.2.2. Digital Contracts (online content & distance sales of goods)

Challenges addressed through actions announced in the DSM Communication

Despite the rapid growth of e-commerce, most European businesses do not yet make the most of the DSM. European consumers also miss out on a potentially broader choice of products and better prices. Legal gaps and differences between the relevant contracts laws of the Member States are among the obstacles still preventing this.

For defective digital content there are no rules at EU level offering remedies. Some Member States have started designing their own laws in this area. For online sales of goods, the EU still works with 28 partially different consumer contract laws. This situation causes legal uncertainty and results in a fragmented environment for businesses and less competitive offers for consumers.

What has been delivered?

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[24] Article 20(2) of Directive 20016/123/EC

[25] GfK Belgium, Mystery Shopping Survey on Territorial Restrictions and Geo-Blocking in the European Digital Single Market, May 2016

[26] Néstor Duch-Brown, Bertin Martens, *The Economic Impact of Removing Geo-blocking Restrictions in the EU Digital Single Market*, JRC Technical Report, 2016, p. 18

[27] COM(2016) 289

(i) Proposal for a Directive on certain aspects of contracts for the supply of digital content

The proposal for a Directive[28] advocates for full harmonisation of key contract rules for the supply of digital content. It covers business-to-consumer transactions.

(ii) Proposal for a Directive on certain aspects of contracts for the online and other distance sales of goods

The proposal for a Directive[29] advocates for full harmonisation of key contract rules for the online and other distance sales of goods. This proposal too, covers business-to-consumer transactions.

2.2.3. Value Added Tax (VAT) for eCommerce

Challenges addressed through the actions announced in the DSM Communication

Companies, especially smaller ones, find it difficult and costly to comply with many different national systems for value-added tax (VAT). The current rules impose a high cost of doing business cross-border (companies that sell goods online pay around EUR 8 000 in VAT compliance costs for every EU country into which they sell); they do not provide a level playing field. Companies based outside the EU can fraudulently mark expensive goods such as mobile phones and tablets as costing less than EUR 22, meaning that no VAT is paid. This puts European businesses at a clear disadvantage vis-à-vis non-European ones and leads to revenue losses for Member States. It is estimated that EUR 5 billion of VAT is lost each year in the EU due to non-compliance on cross-border online sales.

What has been delivered?

The Commission adopted a package of three proposals on 1 December 2016.[30] This included:

1) new rules allowing companies that sell goods online to take care of all their VAT obligations in the EU through a digital online portal, hosted by their own tax administration and in their own language;
2) support to startups and micro-businesses, via the introduction of a yearly VAT threshold of EUR 10,000 under which cross-border sales for online companies are treated as domestic sales, with VAT paid to their own tax administration
3) the removal of the current exemption from VAT for imports of small consignments from outside the EU, which leads to unfair competition and distortion for EU companies;
4) a change to existing VAT rules to enable Member States to apply the same VAT rate to e-publications like e-books and online newspapers, as they apply to their printed equivalents.

The new rules will have a major effect for companies selling goods and services online that will now be able to benefit from fairer rules, lower compliance costs and reduced administrative burdens. Member States and citizens will benefit from additional VAT revenues of EUR 7 billion annually and a more competitive EU market.

2.2.4. Copyright

Challenges addressed through the actions announced in the DSM Communication

[28] COM(2015) 634 final.
[29] COM(2015) 635 final..
[30] COM(2016)755, COM(2016)756, COM(2016)757.

Users often face barriers when accessing copyright-protected content across borders due to legal and/or contractual restrictions applied by the right holders and/or the service providers. Additionally, the clearance of rights is particularly difficult in some cross-border situations, e.g. in the case of certain online transmissions of broadcasters or the digitisation and dissemination of out-of-commerce works by cultural heritage institutions.

Copyright exceptions currently allow for specific purposes and under specific conditions, the use of protected works without the authorisation of right holders - but most of the exceptions in EU law are optional, do not have cross-border effect or do not always cover digital uses. This inhibits new ways of using digital materials for education, research, preservation of cultural heritage and access to knowledge.

Copyright-intensive industries account directly for 3.2 % of employment in the EU with around 7.05 million jobs (average between 2008-2010). Overall, 4.2 % of the EU's GDP is generated in copyright-intensive sectors. Copyright-intensive industries account for 4.2 % of EU's exports, with net exports of around EUR 15 billion in 2010[31].

In recent years, the internet has become the main marketplace for accessing and disseminating copyright-protected content but authors and other right holders face difficulties getting a fair share of the value generated by some forms of online content distribution.

What has been delivered?

In September 2016, following the first legislative initiative on cross-border portability of online content services (see 2.1.3), the Commission proposed a further package of legislative measures.[32]

1) To ensure wider online access to content in the EU, the Commission proposed rules[33] to make it simpler and faster to clear the copyright and related rights that are needed for certain broadcaster' online services (such as simulcasting and catch-up TV/radio), and for re-transmission services via means such as IPTV. As a result, users will have access to a wider variety of broadcasters' TV and radio programmes from other Member States. Also, the Commission proposed to enhance the availability of audio-visual content on video on demand platforms through the introduction of a negotiation mechanism facilitating the conclusion of licences for audio-visual works[34]. Finally, works that are out-of-commerce but hold great cultural value will become more easily available through the solutions that have been proposed to facilitate licensing of rights by cultural heritage institutions.
2) To adapt certain exceptions to the digital and cross-border environment, the Commission proposed new mandatory exceptions in the areas of education, text and data-mining, and preservation of cultural heritage.

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[31] *Intellectual property rights intensive industries: contribution to economic performance and employment in the European Union. Industry-Level Analysis Report*. A joint project between the European Patent Office and the Office for Harmonization in the Internal Market, September 2013.

[32] For an overview, see COM (2016) 0592 final

[33] COM(2016) 594

[34] COM(2016) 593 final

3) To foster a well-functioning copyright marketplace, the Commission proposed that press publishers will be provided with a new related right for the exploitation of their publications in the digital environment. Other measures strengthen the position of right holders to negotiate the exploitation of their copyright protected content by online services storing and giving access to a large amount of content uploaded by their users. Right holders should be in a better position to decide on the use and possible remuneration for the use of their content by such online services. Finally, authors and performers will benefit from increased transparency with their contractual partners on the exploitation of their works and performances, which should help them to receive appropriate remuneration when the contractually agreed remuneration is disproportionately low compared to the success of their work (best-seller clause). The Commission is committed to ensuring the coherence and efficiency of results in view of the sector specific discussions that are required for implementation.

In parallel, two legislative proposals[35] were adopted for the implementation in EU law of the Marrakesh Treaty[36] which requires the contracting parties to introduce exceptions for the benefit of people with visual disabilities to access books and other print material in formats that are accessible to them as well as to ensure the cross-border exchange of such formats. As a result, blind and other print-disabled persons will have better access to special format copies of books from the EU and from other parts of the world.

2.2.5. Parcel delivery

Challenges addressed through the actions announced in the DSM Communication

Consumers and small businesses complain that problems with parcel delivery, particularly high delivery charges for cross-border services, prevent them from selling and buying more across the EU. Prices charged by postal universal service providers to deliver a small parcel to another Member State are on average three to five times higher than domestic prices, without a clear correlation to the actual costs.

What has been delivered?

The Commission adopted its proposal for a Regulation on cross-border parcels delivery[37] on 25 May 2016, as part of the DSM e-commerce package, together with the proposal addressing unjustified geo-blocking and the revision of the Consumer Protection Cooperation Regulation. This is a package of complementary measures that will allow consumers and companies to buy and sell products and services online more easily and confidently across the EU. The proposed Regulation on cross-border parcel delivery complements existing non-legislative initiatives, including greater interoperability between postal operators, trust marks and new standards in the parcel sector. It should:

1) make regulatory oversight more effective because all parcel delivery service providers will have to provide regulators with basic information about their services;

2) require the prices of universal service providers to be assessed for affordability and name those who are not fulfilling their obligation to provide affordable cross-border delivery services for consumers and small businesses;

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[35] COM(2016) 596, COM(2016) 595

[36] The Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired or Otherwise Print Disabled, signed on behalf of the EU on 30 April 2014.

[37] COM(2016)285

3) give customers more choice of cross-border parcel services by requiring universal service providers to offer access to their cross-border networks in order to encourage new market entrants.

2.2.6. Consumer rights enforcement / Unfair Commercial Practices Directive

Challenges addressed through actions announced in the DSM Communication

The Digital Single Market Strategy identified a problem with the enforcement of consumer rights in the digital environment. EU-wide enforcement cooperation among public authorities is often slow or ineffective. It needs to be strengthened to prevent non-compliant traders from exploiting gaps and territorial and other limitations in Member States' enforcement capacity.

A key piece of legislation to boost fairness in e-commerce transactions is **the Unfair Commercial Practices Directive** (UCPD)[38]. But EU consumers often do not know their rights, and businesses, especially new digital and collaborative business models, may not comply as they are unsure which rules apply to them.

What has been delivered?

Consumer Protection Cooperation (CPC) Regulation

In May 2016, the Commission proposed a reform of the Consumer Protection Cooperation (CPC) Regulation[39] that would:

1) ensure a strengthened and more efficient enforcement cooperation framework that will increase legal certainty, particularly for traders and consumers active across borders;
2) enable authorities, by means of additional powers, to (jointly) act faster to stop widespread online infringements (e.g. interim measures to block infringing websites);
3) provide a single procedure, launched and coordinated by the Commission, for EU-wide problems.

The EU-wide online dispute resolution platform

In the beginning of 2016, the Commission opened its online dispute resolution platform to alternative dispute resolution (ADR) bodies and consumers. It helps consumers and traders to solve online disputes over a purchase made online (both domestic and cross-border), without going to court. In its first year of operation, the platform attracted more than 24,000 consumer complaints. More than one third of the complaints concerned cross-border purchases within the EU.

Updated Guidance on the application of the Unfair Commercial Practices Directive

In May 2016, as part of the e-commerce package the Commission adopted a staff working document[40] with updated guidance on the application of the Unfair Commercial Practices

[38] Directive 2005/29/EC.
[39] COM(2016) 283 final.
[40] SWD(2016) 163..

Directive. It contains a specific part explaining its application to the online sector, such as online platforms, search engines, comparison tools[41] and the collaborative economy.

2.2.7. Audio-visual Media Services

Challenges addressed through actions announced in the DSM Communication

Viewers, particularly minors, are moving from traditional TV to the online world. While TV broadcasting services are strictly regulated, on-demand services (Netflix, MUBI) are subject to a lighter regulatory regime and video-sharing platforms (YouTube, Dailymotion) are generally outside the rules' scope altogether. These discrepancies are especially found in the area of:

1) advertising rules, which allow TV broadcasters little flexibility, in an environment where consumers can easily switch to online ad-free offerings;
2) the promotion of European works. Whereas European TV broadcasters invest around 20 % of revenues in original content, on-demand providers invest less than 1 %;
3) consumer protection provisions (especially for minors). Rules protecting minors from harmful content (pornography, violence) and protecting all citizens from incitement to hatred do not cover video-sharing platforms.

What has been delivered?

The Commission proposed a revision of the Audiovisual Media Services Directive (AVMSD) in May 2016[42]. The proposal introduces flexibility when restrictions applicable to TV are no longer justified, whilst ensuring consumers will be protected in the on-demand and internet world.

The proposal strengthens requirements on the promotion of European works for on-demand services (20 % quota of European Works in their catalogues, good visibility of such works in their offers). In some Member States this would result in an increase in consumer choice by up to 450 EU films.[43]

If the proposed Directive is adopted, video-sharing platforms will have to take measures to protect minors from harmful content and to protect all citizens from incitement to hatred, based on new EU-specific terms. This would be done while respecting the lack of editorial control over the content they host and building on existing efforts by the industry.

On the other hand, it is proposed to provide more flexibility to TV broadcasters on advertising rules, product placement and sponsoring. Having simplified rules on product placement and sponsorship could generate additional revenue of respectively EUR 1.2 billion and EUR 441 million for broadcasters and on-demand services in the EU.[44] An increase in advertising revenues would increase their capacity to invest in audio-visual content, which will benefit both the competitiveness of the EU audiovisual industry and consumers.

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[41] The Commission launched a Multi-stakeholder Group on Comparison Tools, which in 2016 agreed on Key Principles for Comparison Tools,, http://ec.europa.eu/consumers/consumer_rights/unfair-trade/comparison-tools/index_en.htm

[42] COM(2016) 287 final

[43] European Audio-visual Observatory, *Origin of films and TV content in VOD catalogues in the EU and Visibility of films on VOD services* Study –(https://ec.europa.eu/digital-single-market/en/news/demand-audiovisual-markets-european-union-2016)

[44] Study on defining a new framework for the monitoring of advertising rules under the Audiovisual Media Services Directive (SMART 2014/0052)

Additionally, the proposal seeks to simplify the rules on jurisdiction and clarify cooperation procedures that govern limitations to the country of origin principle.

The proposal provides that Audio-visual Regulators have to be independent, and gives the European Regulators Group for Audio-visual Media Services a bigger role in preserving the internal market (assessing EU co-regulatory codes, derogations to country of origin principle).

2.2.8. European Electronic Communications Code, BEREC & WiFi4EU

Challenges addressed through the actions announced in the DSM Communication

The electronic communications sector is undergoing structural change and suffers from isolated national markets, a lack of regulatory consistency and predictability across the EU (particularly for radio spectrum), and a lack of sufficient investment, notably in rural areas. Rural areas suffer from an undersupply of fast broadband: in 2016, despite substantial improvement only 40 % of rural areas were covered by the Next Generation Access (NGA) networks, compared to 76 % EU wide.[45]

The regulatory framework has successfully promoted and fostered retail competition in the telecom sector, but not enough 'infrastructure' competition has emerged in fixed-line networks, except in very densely populated areas, where cable networks were already present, or where local authorities have been active. Therefore the regulatory framework for electronic communications needs to encourage the deployment of very high capacity networks while maintaining effective competition and adequate returns relative to risks.

The changing market and technological environment calls for strengthening the institutional framework. Enhancing the role of bodies in which the Member States' authorities are themselves represented – such as the Body of European Regulators for Electronic Communications (BEREC) or the Radio Spectrum Policy Group – is also required.

Telecoms operators compete with services that are increasingly used by end-users as substitutes for traditional electronic communications services such as voice telephony, but are not subject to the same regulatory regime.

What has been delivered?

As part of its Connectivity Package, in September 2016 the Commission adopted a proposal for a Directive establishing the European Electronic Communications Code (Recast)[46] and a proposal for a Regulation establishing the Body of European Regulators for Electronic Communications[47], as well as the proposed WiFi4EU initiative[48].

The proposed Code aims to modernise and simplify the telecoms regulatory framework so as to reflect technological and market developments (in particular the growth of internet-based services) and to incentivise investments in very high capacity networks. Results in the Digital Economy and Society Index[49] show a clear correlation in Member States between performance in terms of connectivity and overall digital performance.

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[45] Broadband coverage in Europe in 2016, study for the EC by IHS and Point Topic, SMART 2016/0045.
[46] COM (2016) 0590
[47] COM(2016)591
[48] COM(2016)589
[49] https://ec.europa.eu/digital-single-market/desi

The proposed BEREC Regulation aims to enhance the powers and functions of BEREC in order to contribute to a more consistent application of the telecom rules throughout the EU. The proposal also aligns BEREC's structure, governance, operation, programming and accountability with the 'common approach' on decentralised agencies of July 2012.

The Commission is conducting an evaluation study to assess the impact of the Broadband Cost Reduction Directive[50] on the cost of EU-funded broadband projects, by July 2018.

Accompanying measures to support internet connectivity

The Commission, in addition to proposing regulatory incentives for private investment, is working on making the use of public funding smarter and more efficient. The WiFi4EU initiative aims to make financial incentives available to public entities who want to provide free, high capacity local wireless connectivity in public spaces within their jurisdiction or at their sites of service. Moreover, in December 2016 the Commission and the European Investment Bank announced the launch of a fund for broadband infrastructure – the Connecting Europe Broadband Fund - open to participation of National Promotional Banks and Institutions and private investors, which is capitalising on a EUR 100 million Connecting Europe Facility contribution. On the basis of EUR 500 million from public and private sources, it is expected to trigger additional investments in broadband deployment in less densely populated areas amounting to between EUR 1 billion and EUR 1.7 billion between 2017 and 2021. Additional support is provided by the European Fund for Strategic investment, the Connecting Europe Facility and EIB lending activity.[51] About EUR 1 billion has been approved under the European Fund for Strategic Investments (EFSI) triggering around EUR 3.2 billion of total EFSI related investments for broadband-related projects by April 2017.[52]

Additionally, under the current financial framework, around EUR 6 billion of European Structural and Investment Funds (ESIF) and European Agricultural Fund for Rural Development (EAFRD) funds are supporting broadband roll out in under-served areas, including the infrastructure needed for the adoption of digital services for a smart rural economy..

An element to ensure complementarity between funds is the network of Broadband Competence Offices[53] supported by a Brussels-based support facility, which among other activities helps local project managers to find the most appropriate funding sources available for their type of broadband infrastructure projects. The official launch of this Broadband Competence network is planned for November 2017. In addition, the European Investment

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[50] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks

[51] For example, in Italy the project "TI – Accelerated High Speed Broadband Rollout" aims at increasing ultra-high-speed broadband network reach by about 7 million households and increasing the population coverage by 32% to 60% of all Italian households. The EIB financing amounts to EUR 500m for a total cost of EUR 1808m.
http://www.eib.europa.eu/projects/pipelines/pipeline/20150189.
For projects submitted to the EIB for financing purposes see http://www.eib.europa.eu/projects/pipelines/index.htm.
For more information on EFSi projects see http://www.eib.europa.eu/efsi/efsi-projects/index.htm?c=&se=4.

[52] The list of projects is available on http://www.eib.org/efsi/efsi-projects/index.htm?c=&se=4.

[53] https://ec.europa.eu/digital-single-market/en/broadband-competence-offices.

Advisory Hub[54] provides a single access point to advisory and technical assistance services on investment.

Meeting Europe's internet connectivity objectives will also require pro-active national or regional policies. The Commission has called on Member States to review progress in their National Broadband Plans (NBPs) and update them by the end of 2017 for a time horizon of 2025. The Commission has reported on the development of National Broadband Plans in its Digital Progress Reports. In addition, an independent study on Member States' NBPs, financed by the Commission, provided a comparative assessment of these plans[55]. A "Connectivity/5G Working Group" is being set up to address the revision of NBPs and ensure the inclusion of the 5G roadmaps – actions that Member States are expected to complete by the end of 2017. This work will inform the development of voluntary 'guidelines' on the aspects to be covered by the update of NBPs with a time horizon of 2025 and ensure alignment with the new strategic objectives. It should also help identify Member States' best practice on administrative conditions and time frames to facilitate comprehensive coverage.

The Commission and the Committee of the Regions have announced[56] the setting-up of a joint Participatory Broadband Platform involving local and regional decision-makers in the discussion of connectivity policies.

The Commission's State Aid broadband guidelines furthermore inform Member States on how their intended subsidies can be channelled in a pro-competitive manner. As announced in the DSM Communication, in the assessment of compatibility with the State Aid Framework of public support to future broadband projects, the Commission will take into account the foreseeable evolution of long-term demand when applying the "step change" approach of the Broadband State Aid Guidelines in conjunction with the strategic objectives set in the Communication. The Commission will also consider efficient blended financing that contributes to lower the aid intensity and to reduce risks of distorting competition, as part of its assessment of State aid interventions.

2.2.9. ePrivacy

Challenges addressed through the actions announced in the DSM Communication

The General Data Protection Regulation (GDPR)[57] will protect individuals in respect of processing of personal data. Special rules on data protection apply in the electronic communications sector (ePrivacy Directive)[58].

The efficacy of the ePrivacy rules protecting the confidentiality of communications has been eroded over time by technological changes. Services that are functionally equivalent to electronic communications services (ECS), such as the over-the top (OTT) services (e.g. Skype, WhatsApp or Viber) are not subject to most of the current ePrivacy Directive provisions.

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54 http://www.eib.org/eiah/

55 https://ec.europa.eu/digital-single-market/en/news/study-national-broadband-plans-eu-28-connectivity-targets-and-measures

56 http://cor.europa.eu/en/news/Pages/european-commission-and-the-european-committee-of-the-regions-announce-a-new-broadband-platform-to-boost-connectivity-in-eu.aspx

57 Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

58 Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector

In respect of the confidentiality of terminal equipment, which applies e.g. to cookies, the consent requirement has a number of problems: users do not read long and complex privacy statements and find it difficult to understand what consent implies. Moreover, the rule is not well adapted to more recent technology: it also applies to non-intrusive practices but it does not address new tracking techniques (e.g. device fingerprinting).

Diverging implementation, interpretations and inconsistent enforcement of several key provisions also create problems. This is linked to the current system of enforcement, where Member States are free to choose which authorities are competent.

What has been delivered?

In 2016 the Commission undertook a REFIT evaluation of the ePrivacy Directive which assessed the functioning of the applicable legal framework and the objectives of the Directive.

The Commission adopted its proposal for an ePrivacy Regulation[59] in January 2017 which complements and particularises the GDPR regarding the protection of personal data and implements in secondary Union law the right to the respect of private life, with regard to communications (Article 7 of the EU Charter of Fundamental Rights), in addition to the right to the protection of personal data (Article 8 of the Charter). As to its main content:

1) It protects the confidentiality of electronic communications (content and related traffic and location data – metadata) via publicly available electronic communications services. Electronic communications service providers can normally only process electronic communications data based on the users' consent. Without consent the processing can only take place for specific purposes, such as the technical storage for transmission, billing or ensuring the quality of the service. The new ePrivacy proposal is technology-neutral. It will apply to both traditional telecoms operators (ECS) and the "over-the-top" service providers as long as they provide electronic communications services.
2) As regards online tracking, to minimise the number of cookie banners on websites, the users will be required to choose a specific privacy setting when they install their browser. They will also be able to modify their privacy setting easily and at any point in time.
3) 92 % of survey respondents say it is important that personal information on their computer or smartphone can only be accessed with their permission and that the confidentiality of their e-mails and instant messaging is guaranteed.[60]
4) The proposal also contains rules on calling line identification, incoming call blocking, unsolicited marketing communications (spam).
5) The enforcement of the ePrivacy Regulation, including the choice of national competent authorities, is brought in line with the GDPR.

2.2.10. Enforcement of intellectual property rights

Challenges addressed through the actions announced in the DSM Communication

Respect for intellectual property rights is essential to promote creativity and innovation and create trust in the market place. Rights that cannot be effectively enforced have little economic value, particularly when infringements occur on a commercial scale that free-rides on the work and investment of creators, the industry and legal distribution services. Such

[59] COM(2017) 10
[60] Flash Eurobarometer survey on ePrivacy (2016).

commercial-scale infringements are currently very frequent and harmful, not only to right holders but also to the EU economy as a whole. An effective and balanced civil enforcement system, which takes full account of fundamental rights, is required to reduce the costs of fighting infringements, particularly for small businesses, and keep up with their increasing cross-border nature.

The Commission is exploring whether the current legal framework, in particular the Directive on the enforcement of intellectual property rights (IPRED)[61], is fully fit for the challenges of the Digital Single Market. This is being assessed, in particular through a REFIT evaluation that the Commission began in 2016.

What has been delivered?

Voluntary cooperation agreements between right holders and intermediary service providers can include a set of principles and rules aimed at identifying and disrupting the revenue stream for commercial scale infringements of intellectual property rights. The first Memorandum of Understanding brokered by the Commission in 2011 on the sale of counterfeit goods via the internet[62] was reviewed in June 2016 to include Key Performance Indicators that will allow for the impact of the Memorandum of Understanding to be objectively quantified. A new agreement between the advertising industry, right holders and advertisers is expected to be signed by the summer of 2017.

The preliminary findings of the above-mentioned REFIT evaluation lead to the conclusion that the existing rules have helped effectively in protecting intellectual property rights (IPR) and preventing infringements by creating a broadly common legal European framework. However, the evaluation has also shown that there are differences in the way some measures, procedures and remedies of the IPRED are applied across the Member States.

For example, Member States offer different levels of protection to right holders when awarding damages for IPR infringements. The data currently available show a great variation in terms of damages requested as well as awarded. Between 2010 and 2015 the average award for design right infringements for example was as high as EUR 600,000 in Italy or EUR 500,000 in Spain, while German courts awarded on average EUR 300,000 for design cases. In the UK and France, average awards were about EUR 100,000. For patents-related litigation, the average amount of damages awarded was EUR 1.3 million in Spain, whereas German courts awarded on average EUR 600,000, Italian and the UK courts around EUR 400,000, and in France EUR 200,000.

The REFIT evaluation findings point at some other problems as well: for example, the use and presentation of digital evidence and the access to digital information is not explicitly regulated by IPRED which may reduce its effectiveness in combating infringements on the internet.

Moreover, while intermediaries can play an important role in the protection of IPR there are differences in the EU as regards the use of the right of information and of interlocutory and permanent injunctions. For example, under the IPRED, permanent injunctions, which can permanently prohibit the continuation of an infringement, must be available also against intermediaries whose services are used by third parties to infringe IP rights. Yet the REFIT

[61] Directive 2004/48/EC, OJ L 157, 30.4.2004

[62] http://ec.europa.eu/internal_market/iprenforcement/docs/memorandum_04052011_en.pdf

evaluation shows that significant disparities remain in the EU in the scope and criteria under which such injunctions are available against intermediaries.

2.2.11. E-commerce sector inquiry

Challenges addressed through the actions announced in the DSM Communication

The Commission launched an antitrust competition inquiry into the e-commerce sector in the EU. The inquiry particularly focused on potential barriers erected by companies to cross-border online trade in categories of consumer goods where e-commerce is most widespread such as electronics, clothing and shoes, as well as in the provision of digital content, in particular the online provision of audio-visual and music products. The objective of the sector inquiry was to understand the prevalence of certain business practices and their underlying rationale, to allow the Commission to identify possible competition concerns in European e-commerce markets and to identify priorities for the enforcement of EU competition rules.

During the inquiry, the Commission has gathered evidence from nearly 1 800 companies operating in e-commerce of consumer goods and digital content and has analysed more than 8 000 distribution contracts.

What has been delivered?

In March 2016, the Commission published initial findings on geo-blocking in an issues paper.[63]

In September 2016, the Commission published a Preliminary Report on the e-commerce sector inquiry[64] setting out its initial findings. The publication of the Preliminary Report was followed by a public consultation open to all interested stakeholders. The public consultation ended on 18 November 2016. Altogether 66 submissions were made in relation to consumer goods and digital content.

The Commission published the Final Report on the E-commerce Sector Inquiry[65]. The Report confirms that e-commerce is an important driver of price transparency and price competition, increasing consumers' choice and their ability to find the best deals. This transparency also impacts the supply side: the report finds that manufacturers have responded to the growth of e-commerce by adopting a number of practices to better control the distribution of their products and the positioning of their brands.

(i) To reap the benefits of online sales and better control distribution, manufacturers increasingly sell their products online directly to consumers. Selective distribution systems are also used more widely, allowing the manufacturers to set the criteria that online and offline retailers must meet to become part of the distribution network.

The report also points to an increased recourse to restrictive business practices that may limit online competition. Depending on the business model and strategy, restraints may take various forms, such as resale price restrictions, contractual restrictions on selling on online marketplaces (platform bans) or on submitting offers to price comparison websites (price comparison tool bans), the exclusion of pure online players from distribution networks, as well as contractual restrictions on cross-border sales, which are often implemented by means

[63] SWD (2016) 70 final.
[64] SWD (2016) 312 final.
[65] COM(2017) 229.

of geo-blocking. The results of the sector inquiry show that the majority of geo-blocking measures in relation to consumer goods result from unilateral business decisions of retailers not to sell cross-border. These contractual sales restrictions may, under certain circumstances, make cross-border shopping or online shopping more difficult and ultimately harm consumers by preventing them from benefiting from greater choice and lower prices.

(ii) Digital content: The Report finds that the way copyright licensing agreements are structured has a major impact on competition. The license agreements determine what territories, technologies and release windows digital content providers can use. The Report found that more than 60 % of the licence agreements submitted by rights holders are limited to the territory of a single Member State. Almost 60 % of responding digital content providers have contractually agreed with right holders to geo-block. There are however stark differences as regards Member States and content sectors when it comes to the prevalence of geo-blocking. The results of the e-commerce sector inquiry raise the question of whether certain licensing practices may make it more difficult for new online business models and services to emerge and for new or smaller players to enter existing markets or to grow and expand their activities into other markets or whether these licensing practices are justified[66].

In the light of the findings of the sector inquiry the Commission has already opened three investigations into alleged anti-competitive practices for consumer electronics, video games and hotel accommodation.

3. ENSURING A FAIR, OPEN AND SECURE DIGITAL ENVIRONMENT

The DSM Strategy provided a comprehensive analysis and action plan to achieve a connected Digital Single Market. Its pillars focused on better online access for consumers and businesses across Europe, creating the right conditions and a level playing field for advances digital networks and innovative services as well as maximising the growth potential of the digital economy.

While working on the implementation, over the last 2 years the digital society and economy has been evolving. Section 3 addresses the digital developments, such as the regulatory environment for online platforms, innovative solutions with the help of data and tackling cybersecurity challenges in the future.

3.1. Promoting Online Platforms as responsible players of a fair internet ecosystem

Policy Context

Online platforms play a central role in social and economic life; they revolutionised the digital economy and access to information and content in an increasingly cross-border context. A comprehensive analysis of the role of online platforms in the market, including in the fight against illegal content on the internet, is a key component of the DSM Strategy. Some important findings include:

[66] Any assessment of certain licensing practices under EU competition rules would have to take into account the characteristics of the content industry, the legal and economic context of the licensing practice and/or the characteristics of the relevant product and geographic markets.

1) At the end of 2015, the largest 178 online platform enterprises alone accounted for 25 % of global web-based internet traffic - excluding app-based traffic.[67]
2) 39 % of all European businesses used online social media in 2015, with social networks being the dominant outlet.[68] At the same time, six in ten EU internet users that responded to a recent Eurobarometer survey declared using online social media at least once a week.[69]
3) 82 % of SME respondents to a recent Eurobarometer on online platforms[70] rely on search engines to sell products and/or services online, with 66 % indicating that their position in the search results has a significant impact on their sales.
4) 42 % of those SME respondents use online market places to sell their products and services, with 52 % stating that their company's reviews on online platforms have a significant impact on their sales.
5) 90 % of respondents to the Commission's Business-to-Business (B2B) business panel survey use online social media platforms for business purposes, with 72 % of respondents using one and the same firm.[71]
6) 56 % of respondents to the Commission's B2B business panel survey considered the platforms they use to reach customers as 'important' or 'very important' to their business.[72]
7) A 2014 study showed a majority of EU software application developers complaining of their de facto total dependence on online platforms, with subsequent revenue impact.[73]
8) Several international organisations, such as the Council of Europe[74], United Nations[75] and the Organization for Security and Co-operation in Europe (OSCE)[76], call for greater transparency and due process around the removal of illegal or harmful content online.

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67 Bertin Martens (2016) *An Economic Policy Perspective on Online Platforms. Institute for Prospective Technological Studies Digital Economy Working Paper* 2016/05. JRC101501

68 Eurostat, Social media - statistics on the use by enterprises http://ec.europa.eu/eurostat/statistics-explained/index.php/Social_media_-_statistics_on_the_use_by_enterprises .

69 Special Eurobarometer 447, Online Platforms, June 2016.

70 Flash Eurobarometer 439 on the use of online marketplaces and search engines by SMEs, June 2016.

71 Ecorys/Kantar TNS 'European SMEs dealing with digital platforms', of January 2017.

72 Ecorys/Kantar TNS 'European SMEs dealing with digital platforms', of January 2017.

73 http://europa.eu/rapid/press-release_IP-14-145_en.htm .

74 The Council of Europe's Guide on Human Rights for Internet Users explains that the provider of online content and services has "corporate responsibilities to respect your human rights and provide mechanisms to respond to your claims. You should be aware, however, that online service providers, such as social networks, may restrict certain types of content and behaviour due to their content policies. You should be informed of possible restrictions so that you are able to take an informed decision as to whether to use the service or not. This includes specific information on what the online service provider considers as illegal or inappropriate content and behaviour when using the service and how it is dealt with by the provider". Currently, the Council of Europe is drafting Recommendations of the Committee of Ministers to Member States on internet intermediaries (foreseen to be adopted by end 2017).

75 According to the United Nations Guiding Principles on Business and Human Rights Business, enterprises have a responsibility to respect human rights, which requires them to avoid causing or contributing to adverse impacts on human rights and to provide for or cooperate in the remediation of such impacts. The duty to protect and to provide access to effective remedy is essentially incumbent on States. Furthermore, the study commissioned by UNESCO "Fostering freedom online – the role of internet intermediaries" promotes transparent practices and corporate responsibility to avoid interference to human rights: http://unesdoc.unesco.org/images/0023/002311/231162e.pdf.

76 The OSCE Representative on Freedom of the Media, Dunja Mijatović issued recommendations to Member States stating that "excessive and disproportionate provisions regarding content takedown and intermediaries' liability create a clear risk of transferring regulation and adjudication of internet freedom rights to private actors and should be avoided. States should also discourage intermediaries from automatizing decisions with clear human rights implications": Communiqué nº 1/2016 on Open Pluralism (https://www.osce.org/fom/219391?download=true). International documents on human rights responsibilitiesfor non-state actors, as well as multi-stakeholder debates and initiatives such as the Manila Principles2, should be given due consideration in this area.

9) Following a recent study covering the terms of service of 50 well-known online platforms, almost 50 % of the platforms analysed contain clauses stating that some kind of monitoring is conducted without specifying what type of content may be affected, or doing so ambiguously. In addition, while most platforms (70 %) provide clear and transparent information on how users report content they deem inappropriate (not illegal), the counter-notice mechanisms are seen as suffering from lack of due process. Finally, the majority of platforms (52 %) explicitly state that they may remove content based on third-party notification without offering any justification, notification or opportunity to be heard to the user who originally shared it.[77]

What has been delivered?

In its **Communication on Online Platforms and the Digital Single Market Opportunities and Challenges for Europe** of 25 May 2016[78] the Commission outlined the key issues identified in the assessment of online platforms and set out its position on the innovation opportunities and regulatory challenges presented by online platforms. It also announced a targeted fact-finding exercise on Business-to-Business (B2B) practices based on preliminary evidence available, inter alia through the public consultation that informed the 2016 Communication[79]. At the same time, the Commission also committed to explore the need for guidance on the liability of online platforms and review the need for formal notice-and-action procedures in light of the results of other relevant work streams, as explained below. In addition, the Commission committed to further promoting interoperability actions through issuing principles and guidance on electronic identification (eID) interoperability at the latest by 2017.

The **competition sector inquiry into e-commerce**[80] **(**described in section 2.2.11) and the updated **UCPD Guidance** (as explained in section 2.2.6.) are also relevant to online platforms, including their responsibilities stemming from the professional diligence duty and transparency obligations.

As regards the responsibility of platforms, several on-going work streams aim to address the issue of illegal or harmful online content and their transparency requirements. While these initiatives do not alter the liability exemptions applicable to online intermediaries in accordance with the E-commerce Directive[81], they impose certain obligations on them in specific problem areas. The legislative proposals on **copyright**[82] and the **revision of the Audio-visual Media Services Directive**[83], the proposed **Terrorism Directive**[84] and the ongoing **review of the Directive on the enforcement of intellectual property rights (IPRED)** are the most relevant examples in this respect.

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77 "Terms of Service and Human Rights – an Analysis of platforms contracts" (2016, Center for Technology and Society / Fundaçao Getullio Vargas).

78 COM(2016)288.

79 SWD(2016) 172 final.

80 COM(2017) 229.

81 Directive 200/31/EU of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market ('Directive on electronic commerce'), OJ L 178, 17.7.2000, p. 1–16

82 COM(2016) 593 final.

83 COM(2016) 287 final.

84 COM(2015) 0625 final.

In respect of non-legislative initiatives, the work of the **EU Internet Forum** as well as the **code of conduct on countering illegal hate speech online** should be mentioned. In line with the Communication, the implementation of these voluntary measures is currently being monitored to assess the effectiveness of self-regulation to tackle illegal content.

In 2015, the Commission awarded funding for actions to support transnational projects to combat sexual harassment and sexual violence against women, including in the online sphere.[85]

The Alliance to Better Protect Minors is a self-regulatory initiative bringing together leading ICT and media companies, civil society and UNICEF to provide fast and flexible solutions for protecting minors online in a highly dynamic technological landscape.[86]

The **Memorandum of Understanding on the sale of counterfeit goods via the internet** was reviewed in June 2016 to include Key Performance Indicators that will allow its impact to be objectively quantified. Therein, the need to position the EU competitively in the global platform economy was identified as a long-term strategic policy objective. This requires a continued analysis of policy options to improve the online platform e-commerce ecosystem on a global level.

New developments and challenges

Ensuring a fair and innovation-friendly platform economy

a) Fact-finding exercise

The on-going horizontal fact-finding exercise on potentially unfair B2B practices in the online platform environment notably includes: (i) a survey completed by 3 549 businesses users of online platforms[87], complemented by 50 in-depth interviews and several in-depth case studies; (ii) a number of workshops with business users of online platforms on the respective topics of data, legal terms and conditions and transparency, as well as the use of algorithms[88]; (iii) several external studies (including legal studies on online platforms' terms and conditions), as well as; (iv) internal research on the economic aspects of online platforms and their B2B practices. The Commission also organised a stakeholder workshop bringing together online platforms and business associations representing them, which addressed the practices reported during the B2B fact-finding exercise.

The survey of business users shows that many professional users (46 %) experience problems or disagreements with online platforms in the course of their business relationship. Among the business users with more than half of their turnover generated via online platforms (heavy users), the share of those that experienced problems is significantly higher (75 %). Out of all business users who have experienced problems, 21 % indicated that they occurred often over

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85 http://ec.europa.eu/justice/grants1/calls/2015_action_grants/just_2015_rdap_ag_sexv_en.htm .

86 https://ec.europa.eu/digital-single-market/en/alliance-better-protect-minors-online.

87 This stakeholder consultation consisted of five separate surveys: two invitation-only surveys for a large pre-selected sample of, respectively, online platforms and their business users, two open surveys made accessible through the European Commission's website for all platforms and their business users and a business panel comprising around 2 500 business users of online platforms.

88 High-level reports are available on the Commission's website: https://ec.europa.eu/digital-single-market/en/news/terms-and-conditions-and-algorithms-platform-business-trading-practices .

the course of the business relationship. As regards heavy users of online platforms, again a significantly higher share (32 %) experienced problems often.

A significant proportion of these problems remains unresolved, as follows. Whereas 11 % of respondents that experienced problems did not even undertake any action to resolve these, an additional 32 % of those respondents that did attempt to resolve them failed to do so. A total of 258 businesses (i.e. 7 % of all respondents and 16 % of those who experienced issues) indicated that they reduced or terminated their relationship with the platform as a result of the problems experienced. The effects of reductions and terminations vary, but an important percentage of firms that terminated their relationship with the platform generated more than 50 % of their turnover through that channel.

20 % of business user respondents in addition disagreed that online platform' contractual terms and conditions and related practices are fair. The reasons stated for this perceived unfairness overlap to a significant extent with the types of problems and disagreements encountered. They include a lack of transparency on platforms' practices concerning data and content; sudden changes in contractual terms or prices which business users are unable to negotiate and de-listing[89]; biased or non-transparent search practices; limitations on access, use and portability of data; limited access to dispute resolution and unfair pricing.

A series of interviews conducted with heavy users of platforms provided deeper insight into the possible effects of these practices for the businesses in question. Some were reported to have an immediate effect on operating conditions, including alleged unequal pricing, alleged unfair competition by platforms (vertical integration), suspension of accounts without giving enough information to react and overall insufficient redress mechanisms.

The discussions during the Commission workshops with business users of platforms also covered these issues. During the workshop dedicated to platforms' legal terms and conditions, the inability for business users to negotiate terms was agreed upon as the most common issue, together with online platforms' practice of unilaterally changing them, often without notice.[90] Account suspensions and delisting of products were singled out as well. Overall, the terms and conditions of online platforms were characterised as being generally complex and vague, therefore leaving significant scope for interpretation to the platforms' advantage when elaborating the practices that actually regulate businesses' experience with the platform. Another general conclusion highlighted the lack of an effective, accessible and quick independent redress mechanism.[91]

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[89] An important additional finding in this respect is that four out of five market places that participated in the Commission's e-commerce sector inquiry reported that they remove items or sellers from the market place on their own initiative, i.e. without receiving any notice from third-parties, cf. SWD(2016) 312 final, paragraph 462.

[90] This is consistent with the finding in the Commission's e-commerce sector inquiry that the majority of the contractual relationships that online e-commerce market places have in place with sellers are based on standard agreements, with only 13 % of the respondent platforms negotiating more than 10 % of their contracts individually, cf. SWD(2016) 312 final, paragraph 90.

[91] The latter finding is consistent with that in a recent Eurobarometer study on the use of online marketplaces and search engines by SMEs (see Flash Eurobarometer 439. Less than half (40 %) of businesses surveyed

On data, a number of workshop participants reported that online platforms in some cases restrict access to customer contact details, or impose limitations on the re-use of certain data. In advertising, businesses reported difficulties in accessing ad performance data and data on their sales statistics, which would lead to difficulties for them in assessing the effectiveness of their advertising campaigns, or adjusting their campaigns where and if necessary. These findings on the sharing of data in platform-to-business relations seem consistent with the results of a previous Eurobarometer study on the use of online marketplaces and search engines by SMEs.[92] Almost two thirds of the 4 900 surveyed companies replied that the information about customers received through online marketplaces (commercial data) is useful to develop or improve their products or services. However, 42 % said that they usually do not get the data they need about their customers from online marketplaces. 47 % stated that it is not easy to transfer key commercial data about their customers from one online marketplace to another.

Participants to the workshop on algorithms, search and ranking described a common set of issues as well as certain more sectorial problems depending on the type of platforms (e-commerce for goods, online travel agencies online advertising, app stores and social media). Among the common findings, an issue of general concern was the lack of transparency or verifiability around the way in which platforms actually use algorithms. Examples were mentioned of platforms possibly de-ranking or otherwise penalising businesses for matters unrelated to their performance in the criteria usually incorporated in the algorithms.

Online platforms that participated in the final Commission workshop agreed that some growing pains exist in some of the areas highlighted by their business users, but specified that the concerned practices would either be insignificant compared to the numbers of businesses active on platforms (regarding suspensions or delisting), or due to practical reasons (non-negotiability and unilateral changes of terms and conditions). Participating platforms rejected allegations of a lack of transparency in search and ranking, or discrimination issues between own and third party products/services. Regarding data, participants highlighted the constraints imposed on them by existing data protection regulations. Similarly, existing notice and takedown obligations were perceived as a significant challenge, leading platforms to act first and examine the claims later.

In conclusion, the fact-finding performed to date shows that businesses, in particular SMEs, encounter a variety of perceived unfair trading practices when dealing with online platforms. These notably include the delisting of products or suspension of accounts – often done in an arbitrary manner, without any prior information. Other issues revolve around terms and conditions (e.g. frequent unilateral and unannounced changes, or a lack of clarity), limited access to and use of data (including portability), and biased ranking and search results, all of

knew of existing complaint mechanisms of online platforms or third party dispute resolution schemes. Many respondents to the Commission public consultation on platforms also considered that internal complaint mechanisms set up by platforms were not effective and cost efficient to solve the problems that arise between online platforms and their suppliers, cf. Synopsis Report on the public consultation on the regulatory environment for platforms, online intermediaries and the collaborative, p. 10.

[92] See Flash Eurobarometer 439.on the use of online marketplaces and search engines by SMEs

which result from the significant imbalance in bargaining power existing between platforms and their business users. In addition, there is concern that some platforms may favour own products or services (including their exclusive use of superior data access to outperform third-party business users), or that they discriminate between different third-party suppliers and sellers, e.g. on their search facilities. Finally, a horizontal issue underlying all of the aforementioned perceived unfair trading practices is the reported general lack of accessible redress that would allow business users to tackle these issues effectively and quickly when they arise.

b) Other relevant Commission initiatives touching on Platforms' Business-to-Business (B2B) and Business-to-Consumer (B2C) relationships

The Directive on Misleading and Comparative Advertising (MCAD) is currently subject to the Fitness Check of consumer and marketing law and further action on fairness in online platforms' B2B relations will be informed, inter alia, by the findings of this exercise. Also, the need for pre-contractual transparency requirements for online platforms in their relations with consumers may be considered in the report on the Consumer Rights Directive and in the wider Fitness Check exercise in relation to the overall functioning of consumer and marketing law, as long as this is not already covered by the UCPD Guidance (as explained in point 2.2.6 above).

The ongoing REFIT Fitness Check of EU consumer and marketing law and the evaluation of the Consumer Rights Directive also assess whether rules need to be adjusted to inform consumers with whom they conclude a contract facilitated via online platforms and based on which criteria the online platforms present commercial offers.

Helping online platforms tackle illegal content

The vast majority of the information and content mediated by online platforms is legal, creates economic or social value by connecting users to the information they want or need, and forms the basis for innovation and creativity in the digital economy.

However, the role of online platforms in spreading illegal or potentially harmful content continues to be at the centre of many digital policy debates. Recent concerns expressed in the context of spreading of fake news or defamatory content, have further put into question the efficacy of content governance online. Notably, the efficacy and legitimacy of the rules that govern the removal of content have been criticised by some, with a perception that content removal is sometimes excessive. At the same time, in other areas, feedback is that removal is often slow or ineffective (e.g. in the context of illegal hate speech postings), with illegal content removed too slowly or not at all. Furthermore, after content is removed it can be uploaded again almost immediately.

Different rules and procedures depending on the Member State, content type or platform type can further reduce the effectiveness of removal procedures, while cross-border effects further complicate the issue. Some Member States have enacted notice-and-action procedures applicable to hosting activities in their national legislation. This is the case in particular in Finland[93], France[94], Hungary[95], Lithuania[96], the United Kingdom[97], Spain[98] and Sweden[99].

[93] Act No 2002/458 on the Provision of Information Society Services (transposing the E-Commerce Directive).
[94] Law No 2004-575 of the 21 June 2004 to support confidence in the digital economy

Furthermore, Germany has recently announced specific legislation concerning social networks[100]. Rules for content removal derive from national or EU legislation for the case of illegal content, in particular the E-commerce Directive, which established a harmonised framework for limitations of liability of intermediary service providers,[101] complemented by the terms and conditions of online platforms. Safeguards against excessive removal of content usually fall within the discretion of the platform operators.

Different, and sometimes contradictory, interpretations at national level of the regime on liability exemptions in the E-commerce Directive have led to a lack of legal clarity, which can prevent online platforms from taking more proactive voluntary measures. In particular, these liability exemptions are not available to service providers which play an active role in respect of the illegal third party content that they transmit or host. In the public consultation on online platforms, some platforms expressed the fear that taking proactive voluntary measures would prevent them from benefiting from the liability exemption, as they could no longer be seen as neutral, passive and technical, and thus expose them to legal risks. Although the Court of Justice has already provided clarification in respect of some of the key concepts of this regime, it appears that in practice several of those concepts are still seen as not sufficiently clear (e.g. what is actual knowledge, who can be considered a host), thus creating further legal uncertainty[102].

Finally, civil rights associations, consumers, fundamental rights experts and national authorities complain about the lack of public accountability for the mechanisms by which online platforms take decisions regarding removal of content. Many takedown decisions are taken by online platforms alone, and are perceived as lacking the necessary checks-and-balances, such as transparency or public oversight. These procedures not only impose burdens

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95 Act CVIII of 2001 on certain aspects of Electronic Commerce and on Information Society Services (transposing the E-Commerce Directive)

96 The decree of the Government of the Republic of Lithuania of 22 August 2007, No 881 on "*Approving the procedure on the removal of the possibility to access illegally acquired, created, modified, or used information*", which is based on the Law Nr. X-614 on information society services (transposing the E-Commerce Directive).

97 The Electronic Commerce (EC Directive) Regulations 2002 S.I. 2002/2013, which represents the national implementing measure in the United Kingdom.

98 Royal Decree 1889/2011 (http://www.boe.es/diario_boe/txt.php?id=BOE-A-2011-20652) and Law 21/2014.

99 The Swedish Act on Act on Responsibility for Electronic Bulletin Boards

100 http://ec.europa.eu/growth/tools-databases/tris/en/search/?trisaction=search.detail&year=2017&num=127

101 Directive 200/31/EU of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market ('Directive on electronic commerce'), OJ L 178, 17.7.2000, p. 1–16

102 In France, where user-generated-content platforms are concerned, after refusing to consider such operators as hosting service providers, courts decided to apply to them the safe harbour regime. As for search engines, the French courts have extended to them the safe harbour regime for hosts. In Spain, the courts also handed down decisions enabling YouTube to benefit from such regime, while in Italy the Court of cassation described Google Videos as a host. The court of Appeal of Milan reversed a previous decision in the case Yahoo v. RTI, denying the differentiation between active and passive service provider, and in a recent ruling it excluded the application of Recital 42 to hosting services providers; similarly Turin courts qualified YouTube and Dailymotion as host providers which could at most be subject to preventing re-upload of the removed illegal content. In Germany, local courts gave contradicting judgments as regards YouTube and appeal courts have found YouTube only liable as a host provider for taking down and filtering unlawful content where the unlawfulness (infringement) has been substantiated, but not for remuneration of right holders. In Poland, the Polish Chamber of Books sued the local UGC portal Chomikuj.pl to block certain content and to reimburse right holders, however courts rejected the case because of the safe harbour principle.

on platforms, but they also typically lack safeguards against unwarranted removal or effective redress mechanisms.

The public consultation conducted in 2016 showed that the majority of respondents demanded either clarification of existing or the introduction of new safe harbours, as the liability exemptions of the E-commerce Directive are known.[103] The most commented safe harbour was that for hosting service providers (Article 14), in particular in relation to the concept of "passive and neutral role".[104] When asked specifically about this concept, many respondents complained above all about the divergent interpretations at national level[105]. Several respondents supported providing clarification by means of soft-law measures such as recommendations issued by the Commission.

A great majority of respondents (70.6 %)[106] supported a differentiated approach as regards notice-and-action, without abandoning the notice-and-action system as such, but rather adjusting or improving the practice of action for a specific type of content; an overwhelming majority of respondents supported establishment of a counter-notice mechanism (82.5 %)[107]. Finally, a significant majority of respondents (76.7 %)[108] demanded more transparency on the intermediaries' content restriction policies (e.g. number of notices received)[109]. These percentages echo almost identical results in the preceding public consultation of 2012 on notice-and-action procedures[110].

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[103] 52 % across all stakeholder groups; in individual groups the percentages are the following: notice providers (56.2 %), researchers (61.5 %), individual citizens (75.2 %), right holders (64.7 %), their associations (52.9 %) and civil society associations (53.3 %).

[104] While majority of notice providers and right holder associations who provided explanations found the concept to be unclear, majority of intermediaries and their associations found it to be sufficiently clear. From the respondents who discussed applicability of Recital 42, the analysis shows that majority of intermediaries (61.9 %), individual users (90.6 %), individual citizens (98.2 %), associations of intermediaries (66.7 %) believe that Recital 42 should not apply to hosting, while all the notice providers (100 %) and right holder associations (100%) who provided explanations on this point were of the opinion that it should.

[105] See in particular the analysis of the replies to the public consultation, p. 19: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=15935

[106] This percentage represents the average across all stakeholder groups. Looking at individual stakeholder groups, there is a majority across almost all of them – intermediaries (72.4 %), content providers (59.3 %), individual users (62.4 %), notice providers (63 %), individual citizens (91.1 %), right holders (83.3 %), their associations (77.1 %), civil society associations (93.3 %) - with the exception of association of intermediaries (28.6 %) and researchers (41.7 %).

[107] This percentage represents the average across all stakeholder groups. Looking at individual stakeholder groups, there is a majority across almost all of them – intermediaries (64.4 %), content providers (87.7 %), individual users (87.9 %), notice providers (87.3 %), researchers (58.3 %), individual citizens (99 %), right holders (73.3 %), their associations (77.8 %) and civil society associations (91.7 %) – with the exception of associations of intermediaries (0 %)

[108] This view has obtained majority across almost all the stakeholder groups – intermediaries (72.4 %), content providers (59.3 %), individual users (62.4 %), notice providers (63 %), individual citizens (91.1 %), right holders (83.3 %), their associations (77.1 %), civil society associations (93.3 %) - with the exception of association of intermediaries (28.6 %) and researchers (41.7 %).

[109] Study on the role of intermediaries - Summary of the public consultation (https://ec.europa.eu/digital-single-market/en/news/study-role-intermediaries-summary-public-consultation).

[110] The public consultation revealed broad support for EU action on notice-and-action (among all categories of respondents). More specifically it revealed strong support for clarification on certain notions of the ECD, for rules to avoid unjustified actions against legal content (in particular consultation of the content-provider and counter-notification by the content provider), for requirements for notices and for feedback to notifiers: 48 % considered that if a hosting service provider takes proactive measures it should be protected against liability that could result ("Samaritan clause"); 53 % affirmed that action against illegal content is often ineffective and lacks transparency; 64 % considered that hosting service providers often take action against legal

In the context of the EU Internet Forum, the EU Internet Referral Unit set up at Europol in 2015 has played a key role in referring terrorist material online to the companies, successfully referring nearly 24,000 pieces of terrorist content to over 50 platforms[111]. The quality of the referrals has received praise from the internet industry and resulted in material being removed in approximately 83.3 % of cases (some companies up to 100 % success rate). This figure may fluctuate daily between 80-96 %.

In the case of illegal hate speech, a Code of Conduct on Countering Illegal Hate Speech was agreed with Facebook, Twitter, YouTube and Microsoft on 31 May 2016. The Code brought some important progress, as it ensures that the IT companies, upon receipt of a valid notification, review such requests in a majority of cases within 24 hours and not only against their rules and community guidelines but also where necessary against national laws transposing the Framework Decision 2008/913/JHA[112]. It also extended the trusted flaggers network across the EU. The first evaluation report of the Code of conduct on hate speech shows that on average only 28 % of all notifications of alleged illegal online hate speech as defined by national law implementing Framework Decision 2008/913/JHA led to the removal of the flagged content and 40 % of all notifications are currently reviewed under 24 hours[113]. Progress is expected by the second monitoring exercise, which will be carried out in 26 Member States, and whose results will be known by the end of May.

As regards notices based on copyright infringements, Google reports that, during the last year, it has removed 912 million urls, 88.3 % of all urls notified. However, it also reports that 99.95 % of all URLs processed from the Trusted Copyright Removal Program in January 2017 were not indexed in the first place, but generated automatically by the notice submitter[114]. A recent study[115] on the notice-and-action system in place in the USA for copyright infringements showed that nearly a third (28.4 %) of submitted notices raised questions about their validity; looking at Google Image takedown requests only, this percentage rose to 70 %.

The 2017 EU Justice Scoreboard will for the first time present data on the efficiency of interim measures on EU electronic telecommunications law and could facilitate a deeper assessment of the effectiveness of judicial interim measures in the field and assist Member States in improving their procedural rules.

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content; 71 % considered that hosting service providers have to consult the content providers first; for 72 % of the respondents, different categories of illegal content require different policy approaches; 80 % considered that there should be rules to avoid unjustified or abusive notices; 83 % considered that the notice should describe the alleged illegal nature of the content (http://ec.europa.eu/internal_market/consultations/2012/clean-and-open-internet/summary-of-responses_en.pdf).

111 http://europa.eu/rapid/press-release_IP-16-4328_en.htm.

112 Framework Decision 2008/913/JHA of 28 November 2008 on combating certain forms and expressions of racism and xenophobia by means of criminal law.

113 For further data on the outcome of the assessment http://www.google.be/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwj8vfqdxsbSAhVZGsAKHXfYAhcQFggcMAA&url=http%3A%2F%2Fec.europa.eu%2Fnewsroom%2Fdocument.cfm%3Fdoc_id%3D40573&usg=AFQjCNEL6trtMzPJWNOh316C243-bLooTg

114 https://www.google.com/transparencyreport/removals/copyright/?hl=en#glance and https://regmedia.co.uk/2017/02/23/google-section-512.pdf .

115 Urban, Jennifer M. and Karaganis, Joe and Schofield, Brianna L., *Notice and Takedown in Everyday Practice* (March 29, 2016). UC Berkeley Public Law Research Paper No. 2755628. Available at SSRN: https://ssrn.com/abstract=2755628 .

To fill remaining evidence gaps and to assess the need for intervention, an external study[116] has been commissioned by the Commission to obtain a comprehensive picture of the existing legislation and case law in the field of intermediary liability (including notice and action), existing voluntary practices by intermediaries and detailed information on the costs and effectiveness of notice and action and voluntary measures, as well as the cost of legal fragmentation. The first results will be reported in mid-2017. Several workshops on different topics, like the impact of voluntary measures on fundamental rights or the difficulties faced by national judges when applying the E-commerce Directive, will also be conducted.

3.2. Developing the European Data Economy

Policy Context

The value of the EU data economy was more than EUR 285 billion in 2015, representing over 1.94 % of the EU GDP.[117] Due to a year-on-year growth rate of 5.03 %, this value increased to EUR 300 billion representing 1.99 % of the GDP in 2016. The same estimate predicts that in the event of Europe's economy entering a higher growth path in the next years characterised by a stronger driving role of digital innovation and higher overall ICT investments as a share of GDP while the policy and legislative framework conditions around the data economy are put in place in time, the value of the data economy will increase to EUR 739 billion by 2020 representing 4 % of the overall EU GDP. The EU data economy employed around 6 million data professionals in 2015 and 6.16 million in 2016 which indicates a 2.6 % year-on-year growth rate. By 2020, it is estimated under the same growth scenario that the number of data professionals will increase to 10.43 million, with a compound average growth rate of 4.2 % if the policy and legislative framework conditions around the EU data economy are put right. Data companies are expected to grow at a compound annual growth rate (CAGR) of 4.5 % in the period 2015-2020 increasing to a total of 310,000 units in 2020. As far as data user companies are concerned, a moderate growth is expected in their number over the period 2015-2020 with a CAGR of 2.2 % increasing to a total of 724,900 units in 2020.[118]

However, regulation by local and national authorities can lead to market fragmentation and reduces possibilities for economies of scale and scope for cloud computing, data-driven services, science and the Internet of Things. Nevertheless, such measures are sometimes based on the protection of legitimate interests. However, recent technological developments are making some of these interventions disproportionate with respect to their public policy objectives, resulting in inefficient outcomes. To prevent this, a series of technical and legislative barriers may need to be addressed. In particular, some types of data localisation restrictions hampering a wider adoption of cloud and other data services should be scrutinised.

What has been delivered?

Building a European Data Economy Communication

[116] SMART 2016/0039.
[117] European Data Market study, SMART 2013/0063, IDC, 2016, http://www.datalandscape.eu/study-reports
[118] European Data Market study (SMART 2013/0063), Second Interim Report, June 2016 - http://www.datalandscape.eu/study-reports

The Communication on **Building a European data economy**[119] was adopted in January 2017, accompanied by available evidence.[120] It addressed a series of issues that were mentioned in the Digital Single Market Strategy as essential for innovation in a data economy based on big data, cloud services and the Internet of Things (industry 4.0). It also outlines a number of options for policy intervention, which are being assessed by the Commission based on the input of stakeholders through the online public consultation[121] conducted from 10 January till 26 April 2017 and through structured dialogues with Member States.

New developments and challenges

a) Free flow of data - by removing unjustified localisation restrictions

The evidence collected so far[122], points to a growing number of unjustified or disproportionate national measures that require businesses or public administrations to store and/or process data locally within a Member State. For example, measures requiring the localisation of tax, accounting and company data could both create unjustified burdens for entities generating or otherwise processing or providing services in respect of such data and inhibit the growth of innovative data services in this field. However, some restrictions could potentially also be justified.

The General Data Protection Regulation (GDPR) already ensures the free movement of personal data in the scope of its application. In relation to data which is outside the scope of the GDPR, the Communication urges Member States to be guided by a "principle of free movement of data within the EU" as a corollary of their obligations under the free movement of services and the free establishment provisions of the Treaty. It also announced the Commission's intention to take appropriate measures on the free flow of data, including, where necessary, the launch of infringement proceedings to address unjustified or disproportionate data localisation measures, in line with Better Regulation principles, and, if necessary, further measures on the free flow of data.

The December 2016 European Council Conclusions called for the removal of remaining obstacles within the Single Market, including those hampering the free flow of data. In a letter of 13 December 2016 to President Tusk from the Heads of State or Government of 16 Member States[123] an early legislative proposal providing for the free flow of data is considered crucial to avoid market fragmentation and further obstacles to the development of the data economy in the EU.

b) Emerging issues

The above-mentioned Communication presents possible ways forward with regard to issues that are currently typically governed by contracts rather than covered by existing regulation: a) access to and re-use of commercially-held non-personal or anonymised data, without stifling innovation; b) addressing the extra-contractual liability challenges, including in terms of safety, for damage caused by products and services that are connected through the Internet of Things or operate as autonomous systems. The latter issues are mainly linked to the

[119] COM(2017) 9
[120] SWD(2017) 2
[121] https://ec.europa.eu/digital-single-market/en/news/public-consultation-building-european-data-economy
[122] SWD (2017) 2
[123] Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovenia, Sweden and the United Kingdom.

difficulties of applying concepts as "defect" or "product" in a context of increasing interaction between autonomous devices and humans and of products being bundled with services that dramatically increase their utility and value; c) possible introduction of a portability right for non-personal data[124]. An experiment and test trial on cooperative, connected and automated mobility is proposed in order to test the suitability of possible solutions for data access and liability.

c) Complementarity with general personal data protection rules

The approach proposed by the Communication is complementary to the General Data Protection Regulation, which bans restrictions to the free movement of personal data within the EU where these are based on reasons connected with the protection of personal data. The Commission is working with Member States and national data protection authorities within the framework of the Article 29 Working Party to ensure effective and uniform application of the new legislation at national level.

The confidential transmission of both personal and non-personal data via public electronic communication networks is covered by the current ePrivacy Directive (to be replaced by the current proposal for ePrivacy Regulation).

Restrictions based on reasons other than the protection of personal data, e.g. under taxation or accounting laws, are not covered by the General Data Protection Regulation and could be covered by the free movement of data principle proposed in the Communication. Moreover, the GDPR regulates only the processing of personal data, which means any information relating to an identified or identifiable person. Therefore, under the "emerging issues", the scope of any further action is on non-personal or anonymised data, e.g. machine-generated or industrial data.

d) Cloud market and governance in the EU

The Cloud-Select Industry Group (C-SIG)[125] established in 2013 to allow stakeholders to collaborate on the implementation of the actions set out in the 2012 European Cloud Strategy, has prepared and presented a Data Protection Code of Conduct for cloud service providers relating to the processing of personal data, to a newly established stakeholder General Assembly. The Code is not yet fully compliant with the GDPR and it has not been approved by the Article 29 Working Party under the current Data Protection Directive 96/46/EC. The "C-SIG Code" has also been used as a model for a more specific code of conduct for cloud infrastructure providers (CISPE). This is at a similar stage of development and has not yet been approved under EU data protection legislation. The Commission will continue supporting the development of such initiatives and encourages the submission of the resulting codes for approval according to the procedures provided by the data protection legislation.

Building on the expert group on cloud computing contracts which looked into the issue of contract terms and conditions for B2C and B2B cloud computing services, in December 2015 the Commission tabled a proposal for a Directive on certain aspects concerning B2C contracts for the **supply of digital content**[126] which provides for harmonised consumer protection rules against defective cloud services and lock-in. Following up on the work of the expert group,

[124] The right to portability of personal data is regulated in Article 20 of the General Data Protection Regulation (GDPR).
[125] https://ec.europa.eu/digital-single-market/en/cloud-computing-strategy-working-groups
[126] COM(2015)634.

further evidence gathering is being launched to identify whether further action is warranted on B2B to protect (certain) business users of cloud computing services contracts.

These actions are expected to contribute to fostering a trustworthy single market for cloud services.

e) Improving re-use of data collected by public sector bodies

Public sector bodies collect valuable data as a result of the execution of their public tasks.

The Commission is striving to ensure the re-usability of such data through the provisions of Directive 2003/98/EC (as amended by Directive 2013/37/EU) on Public Sector Information. This Directive shall be reviewed before 18 July 2018. The upcoming evaluation of Directive 96/9/EC on the legal protection of databases will also look into the issue of re-use of such data from a database protection point of view. The Commission makes data it holds itself re-usable under the provisions of Regulation (EC) 1049/2001 and Decision 2011/833/EU. It funds web portals facilitating the findability of public sector information such as the European Open Data Portal.

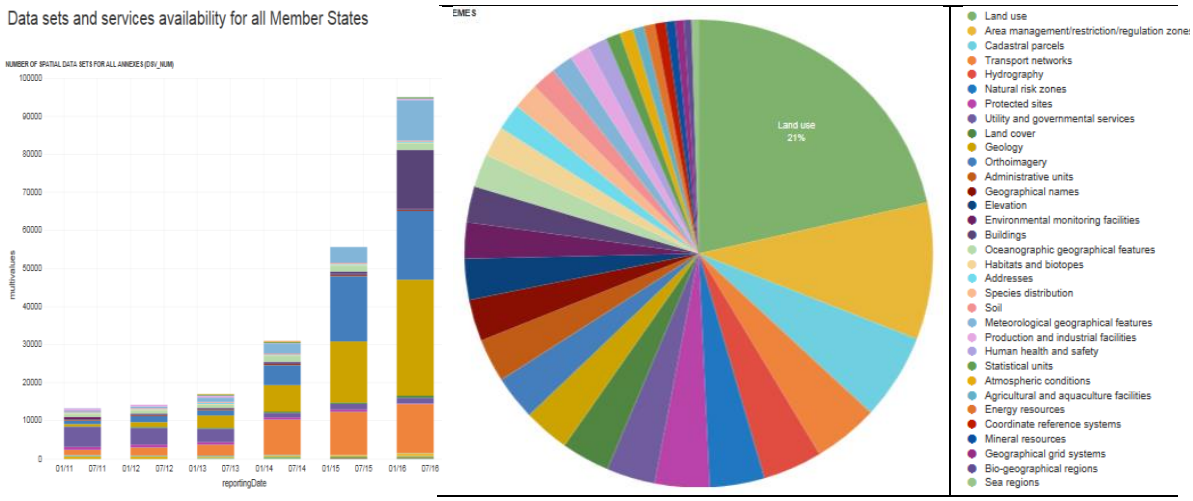
Researchers undertaking actions funded on the basis of public grants (either from the EU's framework programmes or from national R&D&I programmes) also produce valuable data as a result of their research actions. The Commission therefore mandates recipients of EU grants to apply an Open Access policy to such data unless legitimate grounds justify an 'opt out'. It recommends Member States to do the same. The implementation of this policy is subject of a review.

f) Sharing, access and use of spatial data in Government to Government and Government to Business context

Following the REFIT evaluation[127] of the INSPIRE 2007/2/EC Directive, the Commission and Member States agreed on a 2016-2020 work programme[128] aimed at closing implementation gaps and improving the fitness-for-purpose of the INSPIRE measures in view of greater synergies with the actions under the Digital Single Market.

This has led to the increased availability online[129] and use of spatial data in a wide range of applications and economic sectors. Through the work programme further legal and technical obstacles to the sharing and re-use will be addressed in full coherence with the principles of the European Interoperability Framework and the Directive 2003/98/EC.

[127] Report published as COM(2016)478 and SWD(2016)273
[128] INSPIRE Maintenance and Implementation Work Programme 2016-2020
[129] INSPIRE official monitoring dashboards



Source: INSPIRE official monitoring dashboards, May 2016.

g) Data for smart cities and communities

There are several initiatives at EU level for Smart Cities such as the European Innovation Partnership on Smart Cities and Communities, the European Energy Research Alliance (EERA)[130], the Joint Programme on Smart Cities[131], the ERA-NET on Smart Cities and the Joint Programming Initiative Urban Europe[132]. The Commission is gathering information from the monitoring of these projects and platforms in the EU Smart Cities Information System[133].

In particular, the European Innovation Partnership on Smart Cities and Communities aims to bring together 100 cities and 100 firms in areas like electro-mobility and mobility services, intelligent lighting or building blocks with positive energy balance. The partners work in a "Market Place", a platform to develop and replicate solutions.[134]

The Commission also contributes actively to the EU Urban Agenda improving legislation, funding instruments and knowledge on urban priorities. Three of these priorities are linked to smart cities and communities: digital transition, energy transition and urban mobility.

In Finland the project Open Data of the Six Cities (EUR 1.3 million) establishes cooperation models with companies and other developers as well as launches actions for developing and facilitating data-based business in the six biggest cities of the country. Other successfully implemented projects in this area include the JIC Innovation Park: A catalyst for innovation and growth in South Moravia in the Czech Republic and the project Apulian ICT Living Lab aimed at boosting digital innovation in southern Italy.

h) Agriculture and food data

130 EERA - European Energy Research Alliance is the public research pillar of the EU Strategic Energy Technology Plan (SET-Plan).

131 These two platforms are in the context of the Strategic Energy Technologies - SET Plan.

132 These two platforms are in the context of the European Research Area.

133 http://smartcities-infosystem.eu/concerto/concerto-tmd-database

134 https://eu-smartcities.eu/

While the implementation of precision farming and smart manufacturing technologies is already a reality, a comprehensive digital ecosystem[135] integrating existing technologies is still needed to gather all the relevant individual data which are needed for the monitoring, control and treatment on farms and along the food chain in a particular region. Such future data management and exchange scenario would allow monitoring and control of plant and animal products during the whole life cycle 'from farm to fork' including nutrition. It should also help farmers' and processors' decision making with regard to the use of inputs and management processes e.g. pesticide control, nutrient and water management, lowering ecological footprints and economic costs as well as increasing food security, as well as enable consumers to access trustworthy information about the traceability of products.

There is a broad range of existing and conceptual data sharing models in agriculture and food but here is no consensus or uniform approach yet on which type of data governance models are the most suitable to protect and satisfy the interests of the different parties involved in the agri-food chain. Especially relevant is the role of the farmers in this new data governance scenario. There is no consensus on which should be the most promising data governance model for the benefit of farmers (better position in the market, increase their production performance etc). Generally speaking there is demand for more openness. However, there is also a concern that the use of big data by market dominant players in the sector will exacerbate existing market power imbalances (concentrated upstream and downstream sector in relation to a fragmented mass of farmers and food SMEs). Clear models to share digitisation benefits are needed. Interoperability and proven business models combining different data sources are paving the road for data-based innovation in agriculture. Nevertheless, a part of the agricultural and food community is asking for more security and rights on data.

Crop monitoring with aerial robots can reduce the use of pesticides by about 75 %, by better targeting the areas to be treated[136].

3.3. Fostering a trustworthy cyber ecosystem: Tackling cybersecurity challenges together

Policy Context

Cyber threats are a borderless problem and have a negative impact on EU economy, on citizens' fundamental rights and on society. The growing number of offences (for instance data interception, online payment fraud, identity theft, trade secrets theft) is leading to significant economic losses. They often result in disruption of services, fundamental rights violations and undermine citizens' trust in online activities. For example, more than 4,000 ransomware attacks have occurred every day since the beginning of 2016 (a 300 % increase

[135] A digital ecosystem in smart farming needs to be developed in order to ensure that the sector can take fully advantage of the use of data gathered from different sources (sensors, tractors, satellites etc). The ecosystem needs to be developed at different levels: (1) ensuring connectivity infrastructure: fully broadband coverage is needed to fully deploy the most disruptive technologies (e.g. IoT); (2) innovation: supporting start-ups, SMEs and entrepreneurs and the involvement of farmers and cooperatives in the innovation process is required to ensure the adoption of technologies by the farming sector; (3) interoperability and data standards are required to ensure integration between different technologies allowing the development of data management systems.

[136] Finding of EU funded research project RHEA, http://cordis.europa.eu/result/rcn/89889_en.html

over 2015).[137] In the case of hybrid threats, cyber-attacks can be used in a coordinated manner with other activities to destabilise a country or challenge political institutions.

Member States and EU institutions have long acknowledged the need to protect our networks and critical infrastructure and to respond effectively to cyber-threats, leading to the adoption of the 2013 European Cybersecurity Strategy. In 2016 the **Directive on Security of Network and Information Systems (NIS Directive)** was adopted[138] and in the meantime many Member States started developing national cybersecurity strategies to address the growing challenge. An important body assisting Member States and the Commission is the European Union Network and Information Security Agency (ENISA), which is undergoing evaluation at the moment.
One of the key priorities of the European Cybersecurity Strategy was to develop industrial and technological resources for cybersecurity. For the period 2014-2016, the EU has so far invested EUR 160 million under H2020 in cybersecurity research and innovation projects.

EU investments in cybersecurity:

MUSES - EU-funded researchers have developed and tested a new corporate cyber security system – designed to fit with current trends of working on multiple devices – and identified a simple way of making corporate cyber space safer and more secure. The MUSES consortium ran a number of field trials and found that the introduction of MUSES' usable corporate security led to a decrease in incidents due to improved user behaviour.

EVIDENCE (European Informatics Data Exchange Framework for Courts and Evidence): The project proposes standardized solutions to maintain and prove the integrity of the digital evidence to enable policy makers to realize an efficient regulation, treatment and exchange of digital evidence; and law enforcement agencies as well as judges/magistrates, prosecutors and lawyers practising in the criminal field to share a Common European Framework to gather, use and exchange digital evidences according to common standards and rules.

However, at the time of announcing the Digital Single Market Strategy specific gaps were identified in the fast moving area of technologies and solutions for online network security. A more joined-up approach was needed to step up the supply of improved secure solutions by EU industry and to stimulate their take-up by enterprises, public authorities, and citizens. In addition, the lack of interoperable solutions (technical specifications), practices (process specifications) and EU-wide mechanisms of certification was identified as one of the gaps affecting the single market in cybersecurity.

In March 2017 the Scientific Advice Mechanism High Level Group published an Opinion[139] on Cybersecurity recommending to support the development of evidence collection methods, including sharing of evidence and best practices of cybersecurity-related information between EU Member States; to improve the mutual trust between national entities (e.g. CERTs) so that intelligence information can be more freely disseminated between stakeholders; to develop and monitor cybersecurity standards and practices, and to provide sufficient authority and resources to do so, including adequate technical expertise in European bodies.

[137] https://www.justice.gov/criminal-ccips/file/872771/download
[138] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union
[139] https://ec.europa.eu/research/sam/pdf/sam_cybersecurity_report.pdf#view=fit&pagemode=none

What has been delivered?

A Communication on Strengthening Europe's Cyber Resilience System and Fostering a Competitive and Innovative Cybersecurity Industry - In July 2016, the Commission, building on the Digital Single Market Strategy commitment and on one of the 22 actions under the Joint Framework on countering hybrid threats, adopted a Communication on Strengthening Europe's Cyber Resilience System and Fostering a Competitive and Innovative Cybersecurity Industry[140]. This Communication encourages Member States to make the most of the cooperation mechanisms under the NIS Directive and to improve the way in which they work together to prepare for a large-scale cyber-incident. It also outlines a number of measures to support the emerging single market for cybersecurity products and services in the EU. Some of the key initiatives under the Communication include:

A contractual public-private partnership (cPPP) with industry - The Commission and representatives of the stakeholder association, the European Cyber Security Organisation (ECSO), signed the contractual arrangement underpinning the cPPP on 5 July 2016. Between 2017 and 2020 the EU will invest up to EUR 450 million in this partnership, under its research and innovation programme.[141] Cybersecurity market players are expected to invest three times more, bringing the total investment value to EUR 1.8 billion. At the moment ECSO gathers more than 180 organisations including big and small companies, associations, public and regional authorities having a stake in cybersecurity.

Certification - The Commission, in cooperation with the Joint Research Center (JRC) and the European Union Agency for Network and Information Security (ENISA), organized two workshops with representatives of Member States to define the scope of a possible initiative in the field of certification of ICT products and solutions. In cooperation with the Alliance for Internet of Things Innovation (AIOTI), the Commission also organized three workshops with representatives of the industry on increasing trust in the Internet of Things and the minimum requirements for security and privacy in the Internet of Things. As a part of the evidence gathering exercise a study has been launched. In the course of 2017, several workshops will be organised with a specific aim to facilitate dialogue between experts from MSs and private sector, both from the ICT suppliers, integrators and users industry.

ENISA's review - In 2016, the Commission started the review of the ENISA Regulation[142] by presenting the initial roadmap for evaluation[143] and launching a public consultation between 18 January 2017 and 12 April 2017[144]. The evaluation is currently ongoing, supported by a study launched in November 2016, and it is expected to be completed in the second half of 2017.

Cybersecurity in key sectors - In December 2015 the Commission launched an Expert Group (Energy Expert Cyber Security Platform-EECSP) to analyse the energy sector specific needs in terms of cybersecurity and to reinforce the implementation of the Directive concerning measures for a high common level of security of network and information systems

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140 COM(2016) 410 final

141 https://ec.europa.eu/programmes/horizon2020/en/h2020-section/secure-societies-%E2%80%93-protecting-freedom-and-security-europe-and-its-citizens.

142 Regulation (EU) 526/2013, OJ L 165, 18.6.2013

143 http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_cnect_002_evaluation_enisa_en.pdf

144 https://ec.europa.eu/digital-single-market/en/news/commission-launches-public-consultation-review-european-union-agency-network-and-information

across the Union[145] at energy sector level. In addition the Commission will also establish stakeholder working groups under the Smart Grids Task Force to further elaborate a technical framework on energy-specific cybersecurity and common consumer's data format.[146] The structure, scope and planning of the groups will be ready by spring 2017 and final results by the end of 2018.

In aviation, the European Centre for Cyber Security in Aviation (ECCSA) was set up in 2016 to support the common effort of building increased resilience and responsiveness to cyber risks in the sector.

The EU funded the Smart Grid Protection against Cyber Attacks (SPARKS) project whose focus was to develop a range of solutions that can be used to mitigate threats to the electric smart grid. The project developed approaches to risk assessment, including processes and tools, which can be used to evaluate how severe the risk is from emerging threats that can cause operational consequences, such as blackouts. The project developed guidance for smart grid stakeholders regarding how to develop a secure architecture for the smart grid, leveraging standards from international bodies. The project also developed an intrusion detection system, which can detect malicious behaviour that is observable in the supervisory control and data acquisition communication protocols used in the smart grid, and a security analytics platform that makes use of operational data, collected from smart meters, to identify when a smart grid is behaving anomalously – such behaviour could indicate an attack.

New developments and challenges

As outlined in the previous section, in recent years, the EU has made significant progress in cybersecurity: in 2016 alone, the first EU-wide legislation on this matter, the Directive concerning measures for a high common level of security of network and information systems across the Union, was adopted. The European Commission is working closely with Member States to ensure a timely and effective transposition and implementation that should also lead to more cooperation between Member States.

A EUR 1.8 billion public private partnership on cybersecurity was launched. The seeds for stepping-up cooperation and nurture the cybersecurity market have been planted and measures to fight hybrid threats announced.

However, the threat landscape has evolved exponentially. 50 % of businesses in the EU have suffered a cyber-attack and the projected growth of cybercrime is now higher than the one of the internet. 85 % of internet users in the EU agree that the risk of becoming a victim of cybercrime is increasing.[147] If the EU fails to respond to cybersecurity challenges, it could sacrifice up to EUR 640 billion of potential EU economic value.[148] New threats include new actors and motives for cyber-attacks, including political motivation and cyber-terrorism. The misuse of the Internet of Things by the evolving cybercrime business models operating on a much larger scale are causing considerable financial damage and could lead to people's mistrust in using ICT. There is also a need for more targeted awareness-raising on cyber-

[145] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union, OJ L 194, 19.7.2016, p. 1–30
[146] COM (2016)860
[147] European Commission, Special Eurobarometer 423, 'Cybersecurity', 2015
[148] ENISA's role in the European Digital Single Market, December 2016

hygiene and strong work on cyber skills to make sure that the SMEs, who are important targets of cybercrime can better protect themselves.

The number of incidents is growing constantly and criminals increasingly see cyberspace as a new and profitable field of activity. In the last two months of 2016, a number of major attacks were widely reported (e.g. as the Dyn, ThyssenKrupp and Deutsche Telekom attack infecting nearly 1 million routers used to access DT internet service).

According to a study[149], at least 80 % of European companies have experienced at least one cybersecurity incident over the last year and the number of security incidents across all industries worldwide rose by 38 % in 2015. This damages European companies, whether they are big or small, and threatens to undermine trust in the digital economy.

The media also widely reports unlawful intervention in functioning of the democratic processes and institutions that are also proliferating (e.g. Italian case of cyber spying, recent cyber-attacks on European institutions).

Having digital solutions in every field of social and economic life due to the ever increasing uptake of connected smart objects presents opportunities but also makes modern society even more vulnerable to cybersecurity threats than ever before.

Cyber-security incidents can spread through connected devices from TV digital boxes, smart phones, apps to fridges or baby phones. In this context, ensuring an appropriate level of security, or 'security by design', in such devices is essential. The EU requires an integrated approach between industry, research and other actors, in order to develop the necessary technologies and good practices for minimising the cybersecurity threats. This creates the need for a more comprehensive approach.

According to a recent Eurobarometer survey[150], the majority of Europeans consider that security and privacy features of the product play a role in the purchase of an IT product such as a computer or a smart phone. In this context, certification and standardisation become a key issue. Currently various ICT security certification schemes for ICT products (e.g. software, operating systems) are either effective only in a few Member States or have limited membership. This could lead to a situation in which multiple national ICT security certification schemes – not mutually recognized – continue to surface and will become mandatory through future legislation.

4. MANAGING THE DIGITAL TRANSFORMATION OF OUR SOCIETY AND ECONOMY

Digitisation has been changing Europe's societies and economies for the last twenty years, and this evolution is gaining in speed. The pace, scale, scope, and impact of digital innovations have the potential to cause a further transformation of the current social and economic systems. Artificial intelligence, advanced robotics, cloud computing, innovative digital platforms, distributed technologies and new financial technologies are some of the key technologies underpinning major economic and social transformation. These developments are overwhelmingly positive, improving living standards, life expectancy and quality of life. Nevertheless, the changes, and the rapidity of those changes, in particular their impact on labour markets, can disrupt the lives of people.

[149] http://www.pwc.com/gx/en/issues/cyber-security/information-security-survey.html

[150] Special Eurobarometer 460 on "attitude towards the impact of digitisation and automation on daily life" (2017)

Digitisation impacts labour markets in many ways. The most obvious one is that it increases demand for certain jobs while reducing demand for others. Jobs are created in the new technologies themselves. For example, in 2015, the EU counted nearly 8 million Information and Communication Technology (ICT) specialists, representing 3.5 % of total employment.[151] 1.5 million of these jobs have been added since 2011, in such new markets as the app economy, which now employs hundreds of thousands of app developers. In addition, digital also sparks the creation of new jobs in sectors that are themselves not digital.

Digitisation can also have a profound effect on the organisation of work. It allows cooperation over longer distances, enabling globalisation and mobility of workers; by reducing transaction costs, it encourages work outside established structures, leading to the boom of platform-based work; by providing new technological solutions, it enables the emergence of innovative workplaces. Despite a pick-up in research in this area in the last few years, the complex interactions between digital transformation and labour markets are not yet fully understood.

As an indication of the efficacy of our joint efforts, the annual Digital Economy and Society Index (DESI)[152] allows the EU and Member States to monitor digital progress and identify areas for priority investment and action. The 2017 Europe's Digital Progress Report (EDPR)[153] includes country profiles combining the quantitative evidence from the DESI with country-specific policy insights. These reports show the progress made at both EU and Member State level. At the same time, there still is a significant gap between top digital players and lower-performing countries. Connectivity, human capital, use of digital technologies by businesses, and citizens' access to public services online have all improved, but progress is slow.

4.1. Digital skills and opportunities for all

Policy context

Already 90 % of all jobs require at least a minimum level of digital skills, and demand is growing for IT professionals, digitally highly skilled workers and business leaders.

The number of internet users has been steadily increasing in recent years (79 % in 2016). At the same time, on average across Europe, 44 % of citizens and 37 % of those in the labour force still do not have basic digital skills. While employment of ICT specialists in the EU has grown by over 2 million in the last decade, the supply of new graduates and career changers has not kept pace. In 2015, 4 in 10 companies in the EU trying to recruit ICT specialists reported difficulties in filling vacancies[154].

Education and training systems, while having made progress, in many countries are not fully adapted to meet the requirements and make best use of the digital evolution. According to forecasts, **those today in initial training are likely to change careers several times during their lifetime and thus need continuing training**. In an increasingly dynamic living and working environment the people with initiative and the right set of skills stand to gain the most. However, work-based access to training remains highly dependent on the type of

[151] Eurostat press release 25 October 2016
[152] https://ec.europa.eu/digital-single-market/desi
[153] European Digital Progress Report (EDPR) 2017, SWD (2017) 160.
[154] Eurostat, *ICT specialists - statistics on hard-to-fill vacancies in enterprises* http://ec.europa.eu/eurostat/statistics-explained/index.php/ICT_specialists_-_statistics_on_hard-to-fill_vacancies_in_enterprises

contract: almost one in two employees on permanent contracts receives training compared to 32 % of employees with fixed contracts and 19 % of self-employed[155]. The responsibility for curricula and the organisation of education and training lies with the Member States.

What has been delivered?

The New Skills Agenda for Europe

The New Skills Agenda for Europe[156], adopted on 10 June 2016, addresses digital skills at all levels of education and training. The following parts are relevant for digital skills:

1) The **Digital Skills and Jobs Coalition**, launched on 1 December 2016, is a multi-stakeholder collaboration, following on from the Grand Coalition for Digital Jobs (2013-2016). It aims to develop a large digital talent pool and ensure citizens are equipped with adequate digital skills. By 2020, the Coalition aims to have trained 1 million young unemployed people for vacant digital jobs via traineeships, apprenticeships and other training programmes.

   The Coalition calls on Member States to have comprehensive digital skills strategies in place by mid-2017 and to set up national digital skills coalitions among education, employment and industry stakeholders to help implement them.

   Around 60 organisations have already pledged to undertake new actions. The link between skills and digital innovation hubs will be addressed in the Horizon 2020 work programme 2018-2020.

   Organisations that are members of the Digital Skills and Jobs Coalition and active in Horizon 2020, the EU's research and innovation programme, or Erasmus+ will be well placed to make use of a new "Digital Opportunity" scheme, aiming at giving graduate students hands-on experience in the digital domain. This pilot project will be based on cross-border internships in the digital domain available to students of all disciplines.

2) The Council adopted a Recommendation on **Upskilling Pathways**.[157] It will help low-skilled adults to acquire a minimum level of basic skills such as reading, writing and maths and including digital skills, with the possibility of progressing their learning towards a qualification. The Recommendation calls on Member States to develop "a pathway that would improve support for adults with low skills and qualifications". The pathway consists of

   - a skills assessment, to identify existing skills and upskilling needs;
   - a learning offer based on that assessment; and
   - opportunities to ensure the new skills acquired are validated and recognised.

[155] EPSC Strategic Note #13 'The Future of Work - Skills and Resilience for a World of Change' http://ec.europa.eu/epsc/publications/strategic-notes/future-work_en

[156] COM(2016) 381 final

[157] Council Recommendation of 19 December 2016 (C 484/1, 24.12.2016), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOC_2016_484_R_0001

2) These three steps will be accompanied by outreach and support measures such as awareness raising of the benefits of upskilling and opportunities available, and incentives for those least motivated to take advantage of these. By mid-2018, Member States are requested to outline appropriate measures for the implementation of this recommendation at national level, including which groups of low-skilled adults should be given priority.

3) In 2014-2016 the Commission's Erasmus+ programme has supported more than 1 400 projects on the effective use or teaching of digital technologies, which reached more than 8 000 beneficiary organisations in the education and training field. In 2017, the Commission will continue these efforts and specifically support the use of European Social Funds (ESF) and Erasmus+ to fund projects that develop upskilling pathways, or improve current programmes, including Erasmus+ projects to design tailored learning provision but also support services such as outreach to learners furthers from learning, guidance services, skills assessment tools or procedures. The Commission will also launch calls for proposals under the Employment and Social Innovation (EaSI) programme to support awareness raising and under the Erasmus+ Key Activity 3 Call for forward-looking projects to develop pathways and learner support.

4) The Commission launched a **Blueprint for sectorial cooperation** on skills which supports employers, trade unions, education and training institutions and other relevant stakeholders to work together to identify and address skills mismatches in a number of sectors. Work at EU level will focus on developing a comprehensive skills strategy and, among others, on updating curricula and training modules. At national and regional level implementation will depend on national/regional specificities, and could be supported by European Structural and Investment Funds (ESIF). The Blueprint will be piloted in the automotive, defence, space data, maritime technologies, textile-clothing-leather-footwear and tourism sectors[158]. A call for proposals has been launched on 26 January 2017 under Erasmus+ to support EU partnerships (EUR 4 million for 4 years per sector).

5) In 2017, the Commission will propose a revision of the 2006 **Key Competences Framework**. The review will ensure the framework reflects political, social, economic, ecological and technological developments since 2006, such as migration, the challenges of radicalisation, digital communication, and the increased importance of science, technology, engineering arts, mathematics (STEM) and digital skills. The review will support education and training systems, institutions and educators to develop and implement competence based education, training and learning and, as a result, help to increase the number of people equipped with basic skills and key competences.

Competence frameworks

6) The **Digital Competence Framework** (DigComp), launched in 2015 provides the basis for a common understanding of what digital skills are and how to assess them[159]. Version 2.0 of the framework is used to develop education and training curricula and programmes on digital competences; create non-formal and work based programmes and training to support the development of digital competences; make policy and set targets for digital education and training to support digital skills and competences; design tools for

[158] Construction, steel, health, green technologies and renewable energies will be assessed in a second wave of implementation starting in 2017.

[159] The Digital Competence Framework is used in at least 19 Member States/regions for policy support, assessment for employability, education and training content and teacher's professional development

assessment and self-assessment of digital skills and competences including for employability.

A new version, with examples of use and eight proficiency levels is planned to be published in mid-2017. In addition, the Commission is developing a self-assessment instrument, planned for early 2018. The Commission continues to explore ways to widen the use of the Digital Competence Framework to all stakeholders in the European Union. A **Digital Competence Framework for Consumers**[160] (DigCompConsumers) was notably developed to offer a reference framework to support and improve consumers' digital competence. A framework for Educators' digital competence (DigCompEdu)[161] is under development.

7) In 2016, the **European e-Competence Framework** (e-CF) became a European standard and was published officially as the European Norm EN 16234-1. It provides a reference for the competences of IT professionals across Europe and it is designed to meet the requirements of businesses, education and other organisations in public and private sectors. Being a key component of the EU e-skills strategy, the e-CF is also supporting key policy objectives of the "Digital Skills and Jobs Coalition" and is promoted as a useful tool to foster ICT professionalism, boost digital skills and the recognition of the competences and qualifications across Europe. As the current version was technically finalised in 2013, the Commission launched the revision of the standard in 2017, in correspondence to new emerging digital business trends and market needs.

Peer support and research in education and training

Within the Education and Training 2020 Framework (ET2020), the Commission also supports Member States through exchanges of experience and best practice within a dedicated ET2020 Working Group on Digital Skills and Competences. This group discusses both the teaching of digital skills and competences across educational sectors, as well as the potential and effective integration of digital technologies in improving teaching and learning.

4.2. Startups and digitisation of industry and service sectors

Policy Context

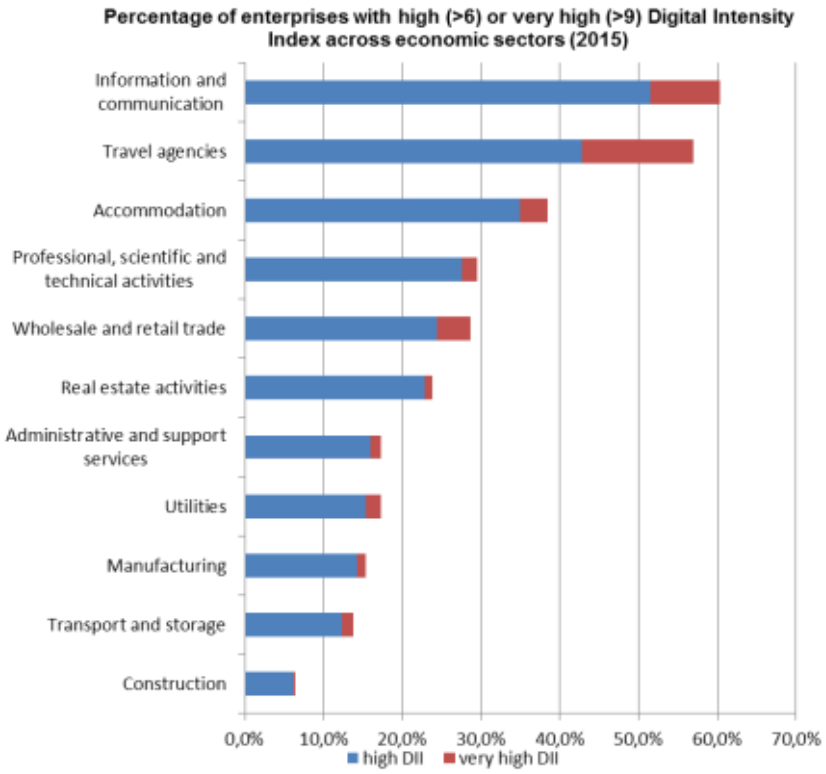
The DSM strategy aims to set framework conditions to help mobilise significant private investment to achieve the EU digital ambition, as articulated in the "Maximising the growth potential of the Digital Economy" chapter of the DSM strategy.

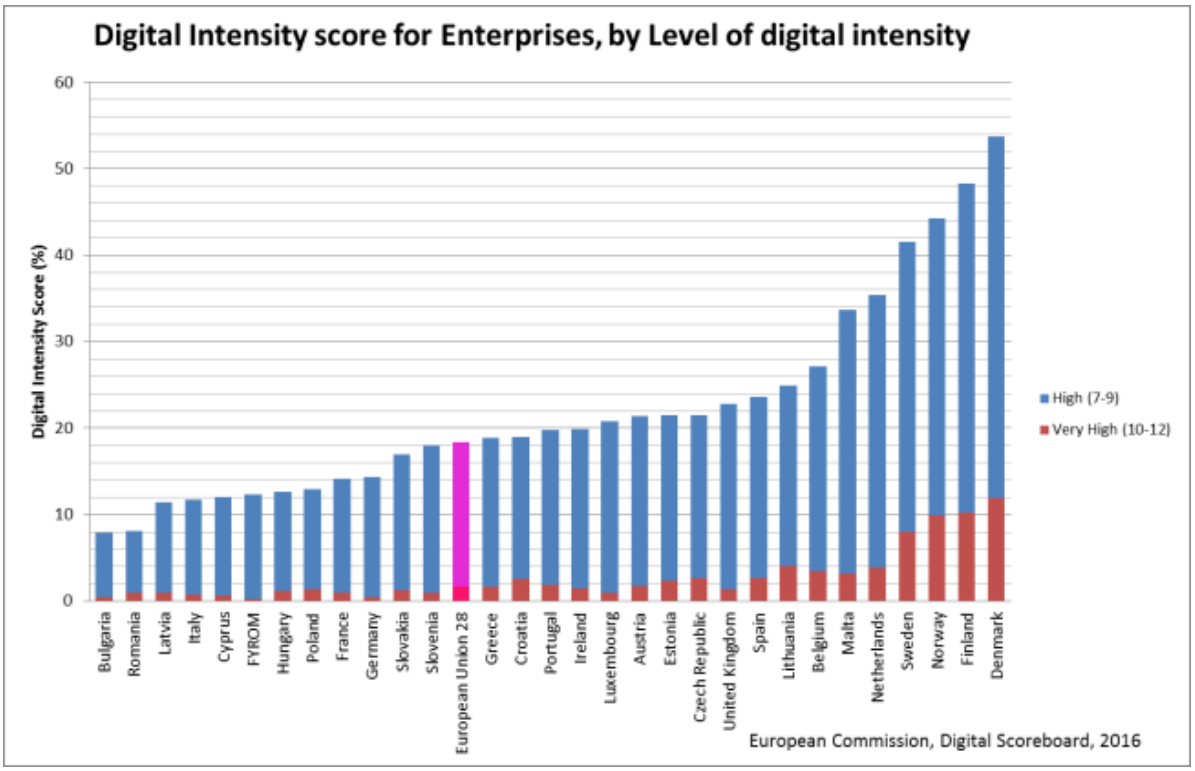
The wide integration of digital technologies and innovations in products, services and business models across all sectors of the economy is essential to pave the way for future sustainable growth and jobs.

During the past years, both the Commission and Member States have increased the digitisation awareness across the European industry, but European SMEs are still lagging behind in relation to awareness. Only about 1 out of 5 companies across the EU is highly

[160] https://ec.europa.eu/jrc/en/digcompconsumers
[161] https://ec.europa.eu/jrc/en/digcompedu

digitised, and rates vary significantly across different sectors of the economy and between Member States.[162]





[162] https://ec.europa.eu/digital-single-market/en/integration-digital-technology

Source: The Digital Intensity Index (DII) is a micro-based index that measures the availability to the firm of 12 different digital technologies[163]

What has been delivered?

The **Digitisation of Industry Communication**[164] includes a governance framework that links national initiatives on digitising industry, creating a 'European platform of national initiatives' to facilitate the coordination of EU and national digitisation initiatives and roll out the digital transformation of industry across Europe, notably to share experiences and collaboration and trigger joint investments. The Platform builds on and complements the 13 existing initiatives[165] and will welcome and support more upcoming national initiatives[166] as they are launched. The European Platform was launched on the occasion of the Digital Day in Rome in March 2017 and will contribute to the building of a critical mass of initiatives and investments. The strong ministerial presence at the launch event shows the desire of Member States to drive digitising initiatives at the highest level, in a common collaborative effort with the European Commission and with an ambitious level of investments at national level.

The Commission has developed a catalogue of national and regional initiatives and priorities[167], which it will update annually. In addition, the Commission will regularly report on the progress of all Digitisation of European Industry (DEI) actions.

Under Horizon 2020's transport challenge, about EUR 1 billion has already been provided to develop and test new approaches on connected and automated road transport as well as automation projects for rail (via the Shift2Rail Joint Undertaking), aviation (via Clean Sky Joint Undertaking and the Single European Sky Air Traffic Management Research – SESAR-Joint Undertaking) and for projects on connectivity and automation of logistics chains and waterborne transport.

The Commission has invested more than EUR 200 million on **Digital Innovation Hubs** (DIHs) to support experimentation with digital innovations, and for networking of competence centres to enable access to the latest technologies in 2016-17. It resulted in about 150 digital innovation hubs, about 50 % of them being new to the European network of DIHs. They support more than 1 500 Startups, SMEs and mid-caps to experiment highly innovative digital transformation. Moreover, initiatives of training and mentoring by existing DIHs were started to develop further DIHs in the next two years, notably in regions insufficiently covered in the network of DIHs and in Central & Eastern Europe. In the field of manufacturing, close to 400 SMEs have already benefited. They have tested out robotics, simulation and modelling, cyber-physical systems and internet of things, or laser based manufacturing. Most of these experiments have allowed them to radically improve their products or services. It has also allowed the developed products to reach the market faster, and increased business confidence that investments in these technologies will bring important benefits.

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[163] http://bit.ly/2mERBpd

[164] COM (2016) 180

[165] In Austria, Belgium, France, Spain, Portugal, Italy, Czech Republic, Hungary, Germany, Sweden, Denmark, Netherlands and Luxembourg.

[166] Such as Digital Impulse in Croatia and Manifesto for Digital Romania. Poland also announced the upcoming launch of their strategic initiative, and Latvia and Finland are making progress in the definition of their national initiatives. Additionally, an Industrial Strategy Green Paper has been published in the UK.

[167] https://ec.europa.eu/digital-single-market/en/cordination-european-national-regional-initiatives

An up-to-date overview will be provided by the European catalogue of DIHs and blueprint for operationalising, sustaining, and networking DIHs based on best practices, which will be delivered in autumn 2017. With EUR 100 million per year until 2020, the EU plans to invest in developing further digital innovation hubs and their networks.

Horizon 2020 addresses the technological foundations of industry in the Leadership on Enabling and Industrial Technologies (LEIT). Research and innovation priorities meet industry needs thanks to Public-Private Partnerships. These Partnerships are essential to develop the key technologies for digital innovations as well as for Advanced Manufacturing and Processing. The Contractual Public Private partnerships (cPPPs) "Factories of the Future" and "Sustainable Process Industry" include projects on the integration of Digital technologies and the "4th Industrial Revolution".

I4MS, ICT Innovation for Manufacturing SMEs, is an innovation programme under FP7 and H2020 endowed with EUR 110 million investment over 2013-2018. I4MS aims at supporting SMEs and mid-caps in the manufacturing sector with access to competences that can help in assessing, planning and mastering the digital transformation; access to innovation networks of a broad spectrum of competences and best practice examples and financial support to SMEs and mid-caps to master their digital transformation. Through close to 300 focused experiments of short duration, brokerage and transfer of know-how and technology are provided by the innovation hubs to the SMEs and mid-caps. It reaches out to 480 participants, 340 are from industry and 3 out of 4 industrial partners are SMEs and mid-caps, of which about two third had never participated in an EU research and innovation programmes before.

Manutelligence is a project of EUR 4.8 million that aims to improve product and service developments in multiple industries by digitally connecting all parts of their value chains right down to the customer. Funded under the Factory of the Future cPPP, the objective is to enable product designers to develop holistic views on the lifecycle of their creations by gaining access to relevant product and market data from multiple sources. By merging the design, manufacturing and product lifecycle management systems with those derived from the emerging Internet of Things, manufacturers have vastly more information at their disposal. This can help them to develop new innovative services based on their existing products and to create tailored services based on product usage information and customer’s wishes while eliminating resource waste in the process.

In June 2016, the Commission set up a thematic smart specialisation platform for industrial modernisation intended to support industrial projects across the value chain in several regions, and to combine regional funds with other available funds. This will support further investments into successful innovations developed through a European Network of Digital Innovation Hubs.

Over EUR 12 billion of regional funds were allocated to advanced support services for SMEs to support entrepreneurship and incubation:

- Around 12 % of the smart specialisation priorities that emerge from the over 120 national and regional smart specialisation strategies focus specifically on digital innovations; e.g. the Photonics Innovation Booster (Oberkochen, Germany) provides innovation management capacities, technology transfer and cluster development across sectors and technology fields.

- Many projects that support SMEs to be more innovative are under implementation such as

the project **Economy 4.0 in SMEs: The Digital Transformation (WiMiT)** (EUR 600,000) in Bayern Germany that supports medium-sized companies in the field of digitisation while the project **Innovaatioseteli (Innovation voucher)** (EUR 700,000) in Finland uses innovation vouchers to make it simpler for companies to choose service providers and to make production of services more dynamic and reactive to market changes.

- Many other completed projects in this area have helped the modernisation via ICT of SMEs in different sectors and in various Member States**. An innovative mobile application makes farming simpler and more efficient** in Slovenia (Ljubljana) (EUR 2 million). The new mobile application helps farmers in administrative tasks such as accounting, reporting and monitoring their daily activities. The project **"ICT Venture Capital Funds" – Supporting the Digital Economy** in Greece, which is making use of innovative financial engineering products to support investment in ICT startups. So far over 60 startups have been financed, leading to the creation of 700 jobs (EUR 42 million). In Poland the project **Boosting ICT startups in Poland** with the creation of The Torun Technology Park project helped IT entrepreneurs in northern Poland develop their startups (EUR 16 million).

- **Pipistel**, a highly sophisticated and cost efficient aircraft designer SME in Slovenia, was supported by the I4MS programme with digital skills and high-performance computing resources to develop an aircraft that uses less fuel with higher transportation capacities, showing the way how to dramatically reduce development time and costs, by a factor 15 and 10 respectively.

- Heildelberger Druckmaschinen – Printing RDI (Germany): the company received a EUR 100 million loan from the European Investment Bank (EIB), which it used to invest in research and development activities focused on digitisation, software integration and an expansion of its digital printing portfolio.

The development of digital industrial platforms is essential for facilitating the operations of the connected industry of the future. Platforms are bridging technology development and market deployment, and allow EU actors to join forces in driving future global standards in their interests. To ensure European leadership, collaboration is needed to develop the next-generation digital platforms, reference architectures, and integration and interoperability frameworks.

Promising initiatives such as RAMI (Reference Architecture Model Industry 4.0) and Industrial Data Space have been identified that could serve as a starting point to significantly ease integration efforts and facilitate the exchange and connection of data between different companies and organisations within a secure business ecosystem.

Horizon 2020 Public-Private Partnerships are essential for developing key digital technology building blocks. Large scale pilot projects prepare broad deployment through test beds, experimentation facilities and pilot lines, leading to standardisation. Examples include the ECSEL Lighthouse projects and a dedicated Focus Area in the R&I Work Programme 2018-2020 on “Digitising and transforming European industry and services”, which combines

budgets across PPPs. In total, EU spending for 2018-20 on platform building, large-scale piloting, pilot lines, etc. is targeted in the order of magnitude of EUR 1 billion. Based on preliminary inputs from Member States and industry, industrial platform initiatives have been identified for ‘connected smart factory’, ‘health and care’, ‘smart agriculture’, 'connected and automated mobility', "smart energy', as well as for cross-cutting industrial data and Internet of Things platforms.

Building further on the successful EU wide partnerships, which have enabled the latest technologies to be brought to market and strengthened collaboration of academia and industry with important spill-over effects on the whole economy, it is essential to further continue the development of digital innovations, and their integration into digital industrial platforms, critical to the EU industry.

It is being considered to implement the above initiatives with support from Horizon 2020 and the Connecting Europe Facility in the Work Programmes 2018-20, from regional and national programmes, and from industry and the private sector. In 2018-2020, projects will be launched to support the development of next-generation digital platforms and their validation via large-scale piloting in the areas of Connected Smart Factories, Smart Agriculture, Digital Transformation of Health and Care, Industrial Data Platforms, and the Internet of Things.

In this new environment, devices, services and applications need common ICT technical specifications to communicate seamlessly with each other, regardless of manufacturer, operating system and other technical components. For instance, ongoing work on ICT technical specifications inter alia aim at ensuring that connected vehicles will be able to exchange data with other brands, and circulate across borders communicating with different road operators and traffic management centres.

The **ICT Standardisation Priorities for the DSM Communication**[168] identifies Cloud, Internet of Things, Cybersecurity, 5G and Data as the five priority areas for standardisation.

The priority areas are being followed through collaboration with the relevant stakeholders, in particular with the European Multi-stakeholder Platform on European Standardisation.

5G - The 5G Public-Private Partnership (PPP) ensures integration of requirements from all sectors. The Global Partnership Project responsible for 5G standards (3G PP) is working towards 5G standards.

Internet of Things (IoT) - Stakeholders have set up the Alliance of Internet of Things Innovation, to build consensus on reference architectures and support standardisation to fill any identified gaps. The global partnership project to develop IoT technical specifications has adopted a common service platform.

Data - The Commission established the Big Data Value PPP and funds research projects to develop a roadmap towards a big data reference architecture and the production of ICT standards for better interoperability of data to support cross-sectorial integration.

Cloud - EU funded projects are contributing to development of standards allowing service level agreements and interoperability/portability across the cloud. Alignment of open source and common technical specifications can speed-up development processes and up-take of ICT technical specifications, and reduce public procurement costs.

[168] COM(2016) 176 final

Cybersecurity - The Commission is working closely with Member States and the European Union Agency for Network and Information Security (ENISA) in the Network and Information Security (NIS) Directive Cooperation Group to identify best practice and sector-specific guidance for cybersecurity risk management based on European and international standards. Furthermore, work is on-going on ICT security certification with the support of ENISA and the Commission, while a dedicated Working Group on Standards and Certification has been set up in the Cybersecurity contractual Public-Private Partnership.

The Communication also proposes a high-level political process to validate, monitor, and adapt the list of priorities. New standardisation domains are being assessed, e.g. financial (FinTech) and blockchain/distributed ledger technologies. The potential of these developments has caught the attention of the European Parliament.[169]

Startup Europe[170]

To boost digital entrepreneurship across Europe, the Startup Europe[171] initiative actively works to create links between ecosystems of entrepreneurs, connect highly skilled people, local ecosystems and international partners, and provide startups with information through the One Stop Shop. In 2017, the Commission will reinforce Startup Europe to help startups benefit from the Digital Single Market. Startup Europe will coordinate EU work to connect digital ecosystems across Europe and bring greater coherence between EU initiatives in the area of digital entrepreneurship, particularly by linking up national and regional Ministries, innovation agencies and other stakeholders and ecosystems.

Promoting Innovation Examples

SME guarantees

In the field of equity financing, in addition to the InnovFin Venture Capital product launched in June 2015, designed to back the Venture Capital Funds supporting innovative small and medium-sized enterprises and innovative intermediate-sized enterprises in their growth, the Commission has (mid-October 2016) extended the range of products in support of investments with InnovFin Business Angel and InnovFin Technology Transfer. Innovative SMEs and small mid-caps are among the targets of these three products which aim, in partnership with the European Investment Fund (EIF) and the European Fund for Strategic Investments (EFSI), to invest in such companies no less than EUR 4 billion.

Mid-caps and large companies

Three instruments (two for innovative intermediate-sized enterprises and one for innovative larger companies) are available for loans of between EUR 7.500 and EUR 300 million. The digital economy is one of the investment targets.

Equity for SMEs and small mid cap:

Via **InnovFin Equity**, the European Investment Fund (EIF) provides equity investments and co-investments to or alongside funds focusing on companies in their pre-seed, seed, and startup phases operating in innovative sectors covered by Horizon 2020, including life sciences, clean energy and high-tech. Under InnovFin Equity, EIF targets investments in around 45 funds, mobilising a total amount of EUR 4-5 billion to be invested in enterprises

[169] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P8-TA-2016-0228, http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=&reference=2016/2243(INI)

[170] http://www.startupeuropeclub.eu

[171] COM (2016) 733

located or active in the EU and Horizon 2020 Associated Countries (Participating Countries).

Startup Europe
Over 700 startups have benefitted from Startup Europe programmes and over 3400 jobs have been created as a result. Over 200 million euro has been raised by startups that passed through Startup Europe projects.

Peter Boye is the founder of Learning to Sleep, a startup in the Healthcare and Mobile sectors in Sweden. "Startup Europe has connected us with startup communities around Europe which have been of great help in internationalisation activities. A concrete example is our future expansion into the German market, where the contacts provided by Startup Europe gave us access to the startup community in Berlin and presence at the CEBIT 2017 conference. We are really satisfied and our experience has made the difference for us when now expand to other markets".

Blockchain and Fintech

Blockchain refers to a public register containing all transactions that have taken place across a peer-to-peer network. It is a decentralised technology that enables participants to make transactions, such as online payments, without having to go via a trusted central authority (a "middleman")[172]. The well-known cryptocurrency Bitcoin relies on blockchain technology, but blockchain can potentially be used for all sorts of digital transactions, redefining how we operate, record, authenticate and share data. Blockchain technologies can transform digital services, moving away from centralised platform models and can be applied to different domains: eHealth services, eGovernment and social goods delivery, energy, supply-chains, Internet of Things, the financial sector and others. By offering transparency and auditability Blockchain have the potential to empower citizens' control and help reduce fraud and compliance costs for public authorities and supervisors.

Fintech (technology-enabled financial innovation) innovators and entrepreneurs are redefining the way we save, borrow, invest, spend and protect our money. They transform financial services and pioneer an innovative culture. Traditional financial institutions invest significant effort and money to adapt to this new environment, to respond to new consumer needs and behaviours. Across Europe, there has been considerable uptake of new digital channels: over 58 % of Western Europeans (85 % for Northern Europeans) prefer to use digital over physical branches. Investments in this area have increased fivefold between 2013 and 2015.

The financial industry has been a first mover in testing blockchain-based solutions[173]. In order for blockchain to be widely rolled-out, the issues of scalability, governance, interoperability, legal and regulatory aspects need to be addressed. This would require creating an environment that is safe, future-proof, favours experimentation and enables innovation.

Some regulatory adjustments have already been adopted such as amendments to the Anti-Money Laundering directive and the use of electronic identification. Since July 2016, the Electronic Identification and Trust Services Regulation can give e-transactions and other e-signed documents the same legal status as those that are paper-based. The new Capital

[172] https://www.enisa.europa.eu/topics/national-csirt-network/glossary/blockchain
[173] 90% of major North American and European banks are exploring Blockchain. They have built proof-of-concepts for different applications such as trade finance, international payments, securities markets, new customer on boarding, with huge efficiency gains and cost-cutting potential.

Requirement Regulation CRR2 package adopted in 2016 takes technological innovations into consideration, and so is the 2017 Action Plan for Retail Financial Services.

Following several public consultations regarding financial services, the EU Parliament report on Blockchain and Virtual Currencies[174] and a Roundtable "*Banking in the Digital Age*", the Commission has set-up an internal horizontal Financial Technology Task Force to explore the impact of new financial technologies on consumers and businesses and the possible risks for financial stability. In particular, it covers regulation and supervision, data protection, cloud services, cybersecurity, electronic identification and blockchain. A specific public consultation has been launched in order to formulate recommendations for further actions at EU level.

The Union has much to gain from a true Digital Single Market in financial services. Enabling innovative services and fully digital processes and interactions can reinforce the European financial sector's competitiveness, and stimulate the growth of startups.

Geo-spatial and metrological data

The Commission will encourage greater use, take-up and exploitation of **Copernicus**[175] data by launching the Data and Information Access Services (DIAS). In this, massive amount of Copernicus and other data is made available together with processing capacities and tools allowing businesses and public authorities to offer added-value services based on Copernicus data and information. This will be operational in early 2018. The DIAS will be a cloud-based infrastructure set up by industry that, in the future, will link to the European Open Science Cloud and to other e-infrastructures such as the EU Infrastructure for Spatial Information (INSPIRE Directive) to allow the integration of Big Data coming from different sources.

Transport and mobility

Mobility faces great challenges and given its important role in the economy it is imperative to address them efficiently. Among the main challenges are

1) road safety, as 26 000 people died on European roads in 2015[176];
2) the environmental impact, as transport is responsible for a quarter of all greenhouse gas emissions in the EU;
3) the successful introduction of new transport modes such as drones;
4) economic concerns, as roads congestion causes a huge cost to the EU economy; and
5) the global competitive position of EU industry, especially the automotive sector, where Europe is still in the lead, but is challenged by big US entrants from the IT sector.

Connected, cooperative and automated vehicle and system technologies are advancing rapidly for road, but also in other modes, and creating high expectations: offering new mobility services for passengers and freight, improving traffic management, saving fuel and emissions, reducing road fatalities by mitigating human error, helping integrate all transport modes, and creating new jobs and business opportunities, to mention just a few of the potential benefits.

The Commission is supporting not only technology research and development but also large scale cross-border trials of automated vehicles with dedicated calls on automated road

[174] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P8-TA-2016-0228

[175] Through the Copernicus programme, the EU collects earth observation data and makes it available to public bodies, researchers, business and citizens through an open data policy.

[176] http://ec.europa.eu/transport/road_safety/specialist/statistics_en

transport and Internet of Things in Horizon 2020. On vehicle legislation and traffic rules for automated vehicles, the Commission together with Member States and international partners (e.g. Japan) have developed in the framework of United Nations Economic Commission for Europe a first set of international rules for vehicles and traffic law for upcoming partially automated systems.

Regarding the deployment of interoperable infrastructure and services for Cooperative Intelligent Transport Systems (C-ITS), the Commission launched the C-ITS platform in November 2014, to allow road users and traffic managers to share information and use it to coordinate their actions. This resulted in an expert report endorsed and published in January 2016 which laid the groundwork for the EU Strategy on C-ITS[177]. This, in turn, enables pan-European deployment of C-ITS services from 2019 onwards.

The Commission also adopted a number of horizontal EU policies which are relevant for connected, cooperative and automated mobility: the Action Plan for the deployment of 5G for Europe[178] calling for the availability of 5G along main European transport paths, the Space Strategy for Europe[179] encouraging the use of GALILEO and EGNOS positioning systems and the Communication on the future framework for a European data economy. Finally, a comprehensive reform of legislation on the protection of personal data (GDPR) in the EU entered into force on24 May 2016 and it shall apply from 25 May 2018.

In line with the Declaration of Amsterdam, endorsed by Transport Ministers in April 2016, the Commission announced in the 2017 work programme its intention to work in an integrated way on mobility, connectivity and the future of the automotive industry.

To further advance the deployment of interoperable infrastructure and mobility services, the C-ITS platform started its second phase in July 2016, seeking recommendations on how to exploit synergies with automated vehicles. The platform expects to endorse and publish a second expert report, concluding this phase, by September 2017. This is complemented by the C-ROADS platform which launched at the end of 2016 and links all C-ITS deployment activities (amongst others making use of co-funding from the Connecting Europe Facility) to jointly develop technical specifications and to verify cross-border interoperability.

In order to ensure a coherent EU policy on vehicles, the Commission launched in January 2016 the GEAR 2030 High Level Group gathering the relevant Commissioners, Member States and stakeholders representing various industries: automotive, telecoms, IT, insurance. The High Level Group will assist the Commission in developing a long-term EU strategy for highly automated and connected vehicles by the end of 2017. The Group will build on complementary EU initiatives and will make recommendations to ensure that the relevant policy, legal framework and public support are in place for the roll-out of highly automated and connected vehicles by 2030. The Group delivered its first recommendations for automated and connected vehicles up to 2020 and is currently working on developing recommendations for automated and connected vehicles up to 2030.

A High Level Roundtable involving telecom and automotive industry was launched in September 2015 to develop joint roadmaps and establish cross-border deployment actions.

[177] https://ec.europa.eu/transport/themes/its/c-its_en
[178] https://ec.europa.eu/digital-single-market/en/5g-europe-action-plan
[179] http://ec.europa.eu/growth/sectors/space_en

The Roundtable has already achieved a commitment from both industries to form new alliances and to start real life experimentation with 5G technologies for connected, cooperative and automated mobility[180].

For longer term issues regarding connected, cooperative and automated mobility, in the context of the Strategic Transport Research and Innovation Agenda, the Commission is developing a roadmap on connected and automated transport to steer and coordinate R&I activities and policies in Europe[181].

As announced in the Commission Communication on "Building a European data economy", *the Commission intends to work with a group of interested Member States to create a legal testing framework for conducting experiments on the basis of harmonised rules on data access and liability. To allow for access to a sufficiently high volume of data, the trials should be based on 5G, operating in seamless co-existence with technologies already being deployed and under a complementarity principle.*

A Letter of Intent[182] has been signed on 23 March 2017 by all Member States except the UK, and by Norway and Switzerland as well. These countries are ready to:

1) Support the implementation and cooperation on cross-border initiatives (on sections, itineraries or corridors) and extend existing ones on which to conduct and facilitate research, tests and large scale demonstrations notably on road safety, data access, data quality and liability, connectivity and on digital technologies for Connected and Automated Driving (CAD);
2) Support the development of shared practices and voluntary common building blocks to conduct such experiments;
3) Support the availability of spectrum for cross-border experimentation and deployment of CAD based on advanced communication technologies;
4) Work together with the Commission to identify by September 2017 the actions to be undertaken on the testing and large scale demonstrations.

Such cross-border test beds will build on the pilot projects foreseen under Horizon 2020 and the Connecting Europe Facility (CEF) in the area of connected, cooperative and automated mobility.

Furthermore, the European Aviation Safety Agency's (EASA) Data4Safety (or D4S) programme[183] initiated in March by a broad alliance of industry players and governmental bodies sets an example for organising the free flow of data within a sector, leading to tangible benefits for both aviation safety and the leadership of European industry. It will take advantage of Big Data technologies to organise the collection of data from different actors in the aviation sector and support their analysis for the benefit of the European aviation safety system.

Energy

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180 https://ec.europa.eu/digital-single-market/en/cooperative-connected-and-automated-mobility-europe
181 http://ec.europa.eu/programmes/horizon2020/en/news/towards-strategic-transport-research-innovation-agenda-stria
182 http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=43821
183 https://www.easa.europa.eu/newsroom-and-events/news/easa-and-aviation-partners-launch-data4safety

In November 2016 the Commission adopted the "Clean Energy for all Europeans" package. Digital technologies can help in making the energy system more renewable-based, energy-efficient and bring better service to consumers, with the package putting strong emphasis on digitalisation.

a) Energy markets and smart grids

The energy sector involves a number of different actors in different roles: energy producers, transmission system operators and distribution system operators. For the functioning of the single market at wholesale and retail level, cross-border access to relevant data is of key importance. In addition, real-time information from the smart grids can support the efficient operation of the grid and facilitate energy services. This is in particular the case for example when renewable energies are integrated in the energy system. Access to such data would enable innovative solutions which can lower energy costs and enhance security of supply.

A more efficient use of European electricity resources and balancing the grid needs to have a European scale, thus requiring a European data access governance framework. This framework is to take into account data management models currently in use while guarantee security and minimise cybersecurity risks.

b) Energy markets and smart meters

With the massive roll-out of smart meters measuring electricity consumption, there are many possible uses for the enormous amount of data produced by energy market players. Improving access to smart metering information, produced in a more detailed level and close to real-time, is one of the objectives of the proposal for a recast Electricity Directive. The proposal requires from Member States to ensure consumers' free access to their consumption data and to ensure the interoperability of smart metering systems, including through open standards.

The Commission also proposed a new design of the EU energy market under the 2016 "Clean Energy for all Europeans" package. The objective is to ensure transparent and non-discriminatory data access by any third parties with whom the consumers may choose to share their metering data, under a common format and procedures set up at European level.

The project Intelligent Network Building in Poland (EUR 2.5 million) aims to ensure an economically and technically effective and sustainable energy system of low loss, high quality, reliability and security of electricity supply level for the electric grid in the municipalities of Dąbrowa Chełmińska i Sicienko.

iSARE, MICROGRID GIPUZKOA in Spain (EUR 3 million) designs and builds an efficient, sustainable and safe smart grid, to develop and experience the state of the different energy generation and storage technologies.

The EU-funded initiative EcoGrid EU equipped almost 2 000 homes and businesses in Bornholm in Denmark, with demand-response devices using smart controllers to automatically adjust electricity consumption depending on fluctuations in supply. During peak generation periods when the wind is blowing strongly, the system automatically lowers prices, encouraging consumption and ensuring renewable energy usage is maximised. If the wind dies down, prices rise and the smart controllers automatically reduce consumption in homes, such as by turning down heating within predefined parameters. Danish electricity suppliers and grid operator Energinet.dk have estimated that the widespread deployment of smart grid solutions in Denmark would generate savings of at least DKK 1.6 billion. Last year

Denmark's wind farms supplied 42 % of demand, and by 2020 it is expected that wind power will exceed total demand for electricity by more than 1 000 hours per year. The EU grant amounted to EUR 12.6 million, while the total budget of the project is EUR 20.6 million.

With the Smart Meters UK–Spark project (United Kingdom) suppliers can avoid deploying their staff to read meters which will save on operational costs. Customers will not need to stay at home for the reading, improving efficiency.

c) Digitisation in buildings

The use of sensors, controls, real time data and cloud based solutions greatly facilitates the energy efficient management of buildings. The proposed revision of the Energy Performance of Buildings Directive aims to provide incentives for smart buildings deployment, such as the introduction of recharging points actively reacting to price signals, and promotes the use of European standards including the Smart Appliances Reference ontology (SAREF). Furthermore, the proposal establishes the possibility to access aggregate anonymised buildings data from national databases for statistical and research purposes.

d) Energy poverty

At present there is limited sharing of data between key stakeholders in some Member States (e.g. energy suppliers, municipalities, healthcare services) that would facilitate the identification of vulnerable and energy-poor households and enable the provision of targeted policy measures to support such households.

Under the Governance Regulation, Member States will be required to collect data related to energy poverty. Linking this data with data on health, housing and environmental spatial data would enable authorities to address issues such as poor housing stock that may result in respiratory diseases and excess winter deaths.

e) Accelerating clean energy innovation through digitisation

Innovation in the energy sector will arise from the combination of digital technologies and new energy technologies (such as photo voltaic panels, local storage, electric transport and heating). Besides energy companies, data and communication companies are increasingly active in this sector and opportunities open up for new players. The EU needs to turn its political leadership into business opportunities for companies that develop and offer innovative solutions and services to the consumers.

Therefore, the Commission intends to increase its support for both sectors across Horizon2020, with the aim to promote rapid and wide dissemination of innovative technologies and services, helping the Energy Union objectives[184].

Modelling and optimisation software solutions will support the secure real-time operations of a pan-European power system with very high shares of decentralised renewables and the planning of its long-term development. They will also enable the integration of an energy system efficiently combining electricity, gas, heating, cooling and transport.

[184] COM(2016) 763

Modelling of the energy system and of its impacts will also support the assessment of policies for the decarbonisation of the European energy sector, their follow-up and the reconciliation among policies at member state and European level.

4.3. Digital innovation for modernising the public services

Modernising public administrations

Policy Context

For Europe to become a better place to invest and live in, public administrations must take a leading role by widely embracing the opportunities offered by digital technologies. In order to ensure that businesses can achieve returns on investments in digital technologies and that companies can conduct their business without unnecessary administrative burden, there is a need for effective and efficient public administration. At the same time, governments need to live up to citizens' rising expectations by designing policies and providing services addressing their needs, while improving sustainability, social inclusion and government accountability. The challenge is not to introduce digital technologies into public administrations, but rather the integration of digital technologies into public sector modernisation efforts.[185] It is its transformative nature, impacting all levels of government and various public policy domains, that has a great potential to realise significant benefits. Every year, over 250,000 public authorities all across the EU spend around 14 % of GDP on goods, services and works. If their processes and demand increasingly turn digital, they can spur investment and innovation in the wider economy. Apart from being digital, public administrations also need to be interoperable, in other words be interconnected with each other to implement digital services that seamlessly traverse their departments end-to-end. This can in turn allow citizens to easily identify and use these services while tracking the progress of their requests, and businesses to report and interact with the public authorities in a costless and simple way. For those reasons, the Digital Single Market Strategy provided for the development and adoption of a new eGovernment Action Plan and of a new European Interoperability Framework.

What has been delivered?

The **Communication EU eGovernment Action Plan 2016-2020 – Accelerating the digital transformation of government**[186] was adopted in April 2016. It contains a vision for the future, a set of principles and specific actions aimed to address the problems faced by citizens, businesses and public administrations. Some of these actions included the following:

1) Modernising public administration with ICT through the roll-out of **eProcurement** ensures the transition to end-to-end eProcurement (by using contract registers which digitally record public contracts, a single European Single Procurement Document (ESPD) and an online database of certificates delivered by public bodies (e-Certis) and **eInvoicing** (which traces precisely how public money is spent), promoting the uptake of **secure electronic identification and trust services** and testing a common reference **catalogue of ICT standards for public procurers.** A prototype of this catalogue, covering four domains (eGovernment, Electronic Tolling Systems, Cloud Computing and Energy Efficiency), has been developed and recently published[187].

[185] Digital Government Strategies for Transforming Public Services in the Welfare Areas, OECD, 2016
[186] COM(2016) 179 final
[187] https://joinup.ec.europa.eu/community/european_catalogue/home

2) **Enabling cross-border mobility** through the interconnection **of national systems** (business and insolvency registers, value added tax registers, social security and health systems) and the establishment of a single digital gateway[188] offering a better package of services to people and businesses interested in going cross-border. The single digital gateway is designed with the user at its core. It will operate across administrative and sectorial silos and radically improve the findability, quality and availability of the services offered. It will not be a new website, but will build on existing ones both at national and EU level and make them searchable through an easy-to-use interface. Common minimum quality criteria will apply to all integrated services. Selected procedures will be digitised in all EU countries and exchanging supporting documents among competent authorities will be made much easier so that citizens and businesses do not have to submit the same paperwork several times. The initiative will also eliminate discrimination against any EU citizen in accessing existing online procedures in another Member State. The single digital gateway will be continuously updated and improved based on users' feedback.

3) **Facilitating digital interaction between and with administrations** by opening up public sector data and services to third parties and removing practical obstacles to the sharing of data between public administrations (for instance of geographical and spatial information).

The Commission is also taking the necessary steps to apply the principles of the eGovernment Action Plan and facilitate access to information as well as interaction with stakeholders. For example, we will apply the 'digital by default' principle both internally and when interacting with external stakeholders through grants or tenders using eIDAS services, eInvoicing and eProcurement.[189]

The eGovernment Action Plan 2016-2020 is making an important contribution to the success of the digital transformation of society by accelerating the digital transformation of government. As it also provides for a dynamic and flexible approach, further actions can be added throughout its lifetime[190] to pursue the realisation of a connected Digital Single Market and to work towards modern, open, inclusive, multilingual, efficient and borderless public administrations.

In the area of interoperability, the Commission adopted on 23 March 2017 the Communication **European Interoperability Framework - Implementing Strategy**[191]. It sets the foundation for interoperability to apply nationally and consequently globally in the Union, within and across policy sectors.

The new framework includes 12 principles and 47 recommendations to guide public administrations in their modernisation efforts by practising ‘interoperability by design’ for the implementation of end-to-end public services. Member States should align their national digital and interoperability actions with the framework and use it as the ultimate guide for their eGovernment projects. The framework should also be used as the reference point for achieving interoperability when preparing EU legislation in concerned policy sector thus, increasing the interoperability effect following national transposition.

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188 COM(2017) 256.

189 The full list of actions can be accessed here https://ec.europa.eu/futurium/en/egovernment4eu/actions

190 Either by the Commission or by stakeholders, including Member States and public administrations at all levels (local, regional, national), see: https://ec.europa.eu/futurium/en/egovernment4eu

191 COM(2017)134

Except from developing a strategic approach to interoperability through a framework, the Commission with instruments dedicated to interoperability such as the ISA^2 programme[192] has already delivered a series of interoperability solutions linked to core DSM priorities, in areas such as e-procurement (e-Prior, e-Certis, European Single Procurement Document), secure network infrastructure (sTesta) and data management (semantic specifications like ADMS, DCAT-AP, core vocabularies for person, location, business and public service).

New eGovernment Actions in 2017

In view of the above the following new actions were added to the eGovernment Action Plan:

IT platform for exchange of electronic evidence between judicial authorities: In line with the EU security agenda and in order to effectively combat cybercrime, there is a need to improve the possibilities for judicial authorities in different Member States to exchange electronic evidence between them. In the context of its work on e-Justice[193] the Commission will develop a secure online platform for requests and responses between judicial authorities of the EU Member States concerning e-evidence[194]. Member States that presently lack such capacity will be able to install the portal nationally. Target date: 2019.

Electronic Official Control for food and plant products: This initiative will pursue the digitisation of animal and plant health certificates, in the context of the revision of the Official Control Regulation, where an Integrated Management System for Official Control (IMSOC) is foreseen. This will lower the administrative cost and burden when importing and exporting food and plant products, by integrating better the national and EU food safety services, using the possibilities of eSignatures. Target date: 2020.

Enforcement of EU agri-food legislation in online sales: This action will improve the enforcement of EU rules that apply to the sale of food products, when such sale takes place over the internet. The action aims to explore potential improvements of the current control regime through coordinated control actions by national authorities, the identification of officially controlled online food businesses through seals or logos, or other innovative technologies, and a reference database for all mandatory indications from EU and national legislation for the labelling of certain categories of foods. This will boost consumers' confidence in e-commerce and foster consumer and food chain actors' information. Target date: 2020.

'Digital Government for Citizens' Charter: The aim of the guide is to outline how the principles of the eGovernment Action Plan 2016-2020 will help citizens in the European Digital Single Market save time, money and effort when dealing with administrative matters in the future and improve the quality of interactions with public administrations. The initiative aims to put citizens at the heart of the digital transformation to ensure that they have easy, trusted, and seamless access to public services, whenever they need them and independently of their geographic location. Target date: Q4 2017.

'Urban Digital Transition' actions: As local administrations are at the forefront of delivering many of the public services, the Digital Transition partnership of the Urban Agenda for the EU aims to provide better public services to citizens and create business

[192] https://ec.europa.eu/isa2
[193] June 2016 Council Conclusions
[194] This action is part of an initiative on e-evidence included in the Commission Work Programme 2017 and linked to the implementation of Directive 2014/41/EU on the European Investigation Order.

opportunities at local level, with a focus on open data and digital services. The 'Urban Digital Transition' actions will identify areas where cities face issues in their digital transition as regards legislation, access and use of available funds and knowledge base. The initiative is part of the Urban Agenda for the EU and the related Pact of Amsterdam, which aim to better exploit the potential of cities. Target date: 2018.

Overall, the new actions aim to address specific citizens' needs and to facilitate their mobility within the Digital Single Market, help the integration and use of electronic means for various operations of public administrations, streamlining the processes in line with the Action Plan principles. They will also help stimulate the functioning of the Single Market by better enforcement of EU legislation.

EU-funded projects have contributed to

Citizens' security by helping to increase the level of security in the national public administration (project in the Czech Republic EUR 2.5 million); offering a digital safety observatory to society (project in Poland Śląskie Voivodeship Silesian Police, EUR 4.2 million); issuing biometric travel documents (project in Hungary, EUR 2.7 million).

Reduction of red-tape through more efficient tax services (project in Latvia, EUR 3.5 million).

Well-being and tourism by enabling elderly people with memory disorders to continue living at home (project in Finland, EUR 350,000); using a mix of online communications and social media to attract tourists (project in Lapland - North of Finland, EUR 2.9 million); providing e-services in the field of culture, protection and promotion of cultural heritage (Internet portal of the Border Land of the Old Republic Heritage Museum in Poland, EUR 1.3 million); modernising tourism information services through digital kiosks (Spain, Madrid EUR 1.7 million).

Creation of jobs through a **New generation data centre** that has trickledown effect on an entire region (Portugal, Covilha, EUR 15.7 million).

In the area of interoperability, the ISA^2 programme will continue delivering concrete solutions contributing to the completion of the Digital Single Market. Planned actions include support to the implementation of the INSPIRE Directive when it comes to interoperable exchange of location data, production of a framework and roadmap for financial data reporting and standardisation, and development of services related to case management for competition policy.

Digital transformation of health and care

Policy Context

Europe faces a major challenge with ensuring the sustainability and quality of health care provision, as a consequence of demographic change, increased longevity and rising prevalence of chronic conditions and the re-emergence of infectious diseases. Public expenditure on health and long-term care has been increasing over the last decades in all EU

Member States, and is expected to rise even further[195]. To a considerable degree this is a consequence of an ageing population. In 2015 healthcare spending accounted for 8.7 % of GDP in the EU and could reach up to 12.6 % of GDP in 2060[196]. The extra years of life gained through increased longevity are not necessarily spent in good health. Healthy life years (HLY) have not been increasing. Between 2010 and 2014 there has been a decline in average HLYs in the EU28.

The Commission Communication[197] on effective, accessible and resilient health systems concluded that Member States' future ability to provide high quality care to all will depend on making health systems more resilient, more capable of coping with the challenges that lie ahead. And they must achieve this while remaining cost-effective and fiscally sustainable. Digital technologies, such as 4G/5G mobile communication, artificial intelligence and supercomputing offer new opportunities to transform healthcare systems[198]. They enable new approaches to personalised medicine, independent living or integrated health and social care, accelerate scientific progress for early diagnosis and prevention of diseases and more effective treatments. Technology can help improve citizen's health and address the systemic challenges faced by health and long-term care systems.

What was delivered?

The 2015 DSM Strategy highlighted the need to make progress on standardisation and interoperability of eHealth solutions in support to health system reforms. In response to the Strategy, work focused on the major identified areas, including those in the digitising industry and public services package of April 2016 (specifically in the ICT priority standardisation plan[199] and the eGovernment action plan[200]. Other relevant actions[201] include: (i) the adoption of new guidance on interoperability and standards for digital health and care, (ii) strengthening of the digital infrastructure for cross border exchange of health data through the Connecting Europe Facility (CEF), and (iii) new investment commitments in large scale implementation of in digital health and social care programmes from national and regional

[195] With an average age of 44 years, Europe will be the 'oldest' region by 2030 — more than double the average age of 21 in Sub-Saharan Africa. People over 65 will account for close to 23 % of the European Union's population, compared with 16 % today (Rand Europe report to ESPAS 2013).

[196] According to the European Commission's Joint Report on Health Care and Long-term Care Systems and Fiscal Sustainability (7 October 2016).

[197] COM(2014) 215 final.

[198] Health and care has been identified by most of the digital PPPs in Horizon 2020 as a core business area where digital technologies can play a major role. The Digitising European Industry (DEI) high level group recently established a working group on health. The profound transformation of the job market sees an increasing number of routine tasks being replaced by automated processes, but at same time it leads to opportunities multiplying in the digital health care sector (Deloitte 2016 Transformers: How machines are changing every sector of the economy).

[199] COM(2016) 176 final.

[200] COM(2016) 179 final.

[201] The eHealth Network, under Article 14 of Directive 2011/24/EU, has adopted guidelines on the minimum patient summary datasets for electronic exchange and on ePrescriptions. On 28 July 2015 the Commission has adopted the Decision on the identification of 'Integrating the Healthcare Enterprise' profiles for referencing in public procurement. In 2016 a total of 74 European regions from 18 Member States were awarded the title of 'Reference Sites of the European Innovation Partnership on Active and Healthy Ageing' (EIP on AHA). The network of 74 reference sites have committed to invest EUR 4 billion in digital innovation for health and care services over the next three years, benefiting over 4 million people.

authorities[202]grouped under the European Innovation Partnership on Active and Healthy Ageing. Furthermore, the EU provides approximately EUR 1 billion research and innovation funding opportunities under Horizon 2020 that support the development and implementation of digital health and active and healthy ageing innovations.

The **PASSPORT project** developed a "virtual liver" that helps surgeons take critical decisions on whether to operate a patient or not. In 2013, the project coordinator IRCAD launched Visible Patient, a startup that developed further the two main results of the project: the patient-specific preoperative planning software and the 3D modelling service that can create 3D models of any part of the human body. This service, operating since April 2015 is used in more than 10 different countries with more than 200 clinical cases modelled during the last months.

New developments and challenges

a) Limited access to personal health data across borders

Notwithstanding the considerable potential of digital technology to contribute to better health and care outcomes[203] existing barriers limit access to personal health data when citizens travel to another Member State. Citizens' access to digital health and care solutions vary greatly across Member States and regions.

According to Eurobarometer, approximately 52 % of European citizens (respondents) wish to have online access to their health records (including health data, prescriptions and medical records)[204]. However, only 9 % of hospitals in Europe allow citizens to access online their own medical records (and most of those only give partial access).[205] In 2008, Estonia became the first country in the world to implement a nationwide “birth-to-death” electronic health record system for nearly every citizen. But since then only an additional 13 Member States have granted citizen access to electronic health records (EHRs).[206] The use of electronic prescriptions (ePrescriptions) across Europe is equally diverse, with only a minority of Member States having it widely available to their citizens[207].

The eHealth Action Plan, supported by the Directive 2011/24/EU (Articles 11, 14) identifies electronic health records (EHRs), electronic prescriptions (e-prescriptions) and telemedicine as crucial components to enable the emergence of innovative digital health and care solutions

[202] In December 2016 the European Commission recognised with Reference Site status 74 EU regions for their commitment to invest over EUR 4 billion in innovative digital services for health and social care https://ec.europa.eu/digital-single-market/en/news/74-european-regions-awarded-investing-digital-health-and-care-elderly .

[203] The Impact of eHealth on the Quality & Safety of Healthcare (Imperial College London) http://www.ehealthnews.eu/images/stories/Impact_of_eHealth.pdf and WHO Monitoring and Evaluating Digital Health Interventions: A practical guide to conducting research and assessment.

[204] Special Eurobarometer 460 on "attitude towards the impact of digitisation and automation on daily life" (2017).

[205] European Hospital Survey – Benchmarking Deployment of eHealth Services 2012-2013 (PwC) https://ec.europa.eu/digital-single-market/en/news/european-hospital-survey-benchmarking-deployment-ehealth-services-2012-2013 .

[206] Overview of National Laws on Electronic Health Records in the EU Member States and their interaction with the provision of cross-border eHealth services, July 2014 (Milieu Ltd).

[207] Euro Health Consumer Index 2016 Report - Professor Arne Björnberg, Ph.D (http://www.healthpowerhouse.com/files/EHCI_2016/EHCI_2016_report.pdf).

benefiting citizens across the Digital Single Market[208]. The adoption of EHR and ePrescriptions[209] across the EU would improve health and care services to citizens and generate efficiencies[210]. However, the reality across Member States remains very diverse. The level of detail of the legislation on EHR contents varies greatly, ranging from a simple reference to health data to exhaustive and detailed list of categories or data items to be included as part of the EHR.[211]

Under the Framework setup by the eHealth Network[212], Member States have worked together with the Commission to build the eHealth Digital Service Infrastructure (DSI) for cross-border exchange of Patient Summaries and ePrescription. Co-funded by the Connecting Europe Facility (CEF), the first Member States should go live in 2018, and then the number of participants to the exchange will grow. The 2015 CEF Work Programme supports the first 16 Member States in building the eHealth DSI; the second CEF eHealth call will open in May 2017 and further Member States are expected to join.

Europeans requiring medical care when traveling or moving residence to another EU Member State are often confronted with the lack of access to their own medical records or medication. Access is particularly important when citizens seek emergency treatment while traveling outside their country of origin or residence. The percentage of hospitals exchanging clinical care information about patients electronically remains low. Exchange of care information within the same country ranges from 33 % to 39 %, whereas exchange with health and care providers in another EU country is only 4 %.[213] The percentage of general practitioners (GPs) using electronic networks to exchange medical patient data with other healthcare providers and professionals varies greatly between Member States (from 91.8 % of GPs in Denmark to only 5.4 % GPs in Slovenia). Even in countries with high levels of domestic exchange of patient data, the exchange with healthcare providers in other EU Member States remains

[208] Directive 2011/24/EU on the application of patients' rights clarified the legal framework for patients to be reimbursed for cross-border healthcare. Firstly, it established the principle that a telemedicine service is considered to be provided in the Member State where the service provider is established. Secondly, the e-Health Network established cooperation between Member State health systems. The Network has adopted guidelines on patient summaries and e-prescriptions, and is working on the use of health data for public health and research. The IT system supporting the exchange of patient summaries and e-prescriptions is being built with funding from the Connecting Europe Facility.

[209] Tora Hammar, Sofie Nyström, Göran Petersson, Tony Rydberg, and Bengt Åstrand, "Swedish Pharmacists Value E-Prescribing: a Survey of a Nationwide Implementation," Journal of Pharmaceutical Health Services Research, Vol. 1, No. 1 (March 2010).

[210] Health Information and Quality Authority (HIQA), "E-Prescribing and Electronic Transfer of Prescriptions: An International Review," Report, December 2012.

[211] Overview of the national laws on electronic health records in the EU Member States and their interaction with the provision of cross-border eHealth services, July 2014.

[212] http://ec.europa.eu/health/ehealth/policy/network_en .

[213] European Commission Digital Scoreboard 2013 https://ec.europa.eu/digital-single-market/en/create-graphs .

low.[214] This is particularly relevant as the number of patients receiving treatment in another EU Member State continues to increase.[215]

b) Fragmented infrastructures limit the advancement of health research, prevention and care

According to Eurobarometer approximately 70 per cent of Europeans (respondents) would be ready to share their personal health and wellbeing data (medical and care data, lifestyle, physical activity, nutrition, etc.) and a significant number of them would be willing to support scientific research to enhance treatment and early diagnosis of disease[216]. Patient and user-generated health and care data are expected to further proliferate in the coming decade, creating an opportunity for continuously evolving and learning health systems[217]. Despite a growing capacity and performance improvements in high performance computing and other digital technologies, progress in translating these innovations into better health outcomes remains slow and limited, varying greatly across regions and Member States.[218]

Advanced expertise on rare diseases is not only scarce, but also scattered in different laboratories and knowledge centres throughout the EU. This scarcity of expertise and data availability translates into delayed diagnosis, fewer products and difficult access to care for those suffering from rare diseases.[219] Faster diagnosis and more personalised treatment of rare genetic diseases (it is estimated[220] that 5 000-8 000 different rare diseases exist, affecting 27 to 36 million EU citizens) can be achieved if scientific expertise, data and advanced computing capacity are pooled across borders, significantly reducing the 5.6 years on average that it takes today to diagnose a rare disease in Europe. Rare diseases are ideally suited for rolling out personalised medicine given high patient buy-in for data sharing and an established scientific and health community[221] supporting an integration of research and innovation pipelines with a secure digital infrastructure to enable the transfer of knowledge from lab to clinic and feedback from healthcare so that research findings quickly get translated into clinical care improvements.

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[214] Cross-border health care in Europe by Katharine Footman, Cécile Knai, Rita Baeten, Ketevan Glonti, Martin McKee (World Health Organization 2014). For example, Techniker Krankenkasse surveying 45,000 German insurants who had received services abroad in 2010. The company found that 37 % of insurants required follow-up treatment after receiving care abroad, which was mostly provided by a German physician at home (92 %). But communication between the physician abroad and the patient's physician at home was rare (15 %).

[215] European Commission - European Core Health Indicators (ECHI) based on the Percentage of non-resident people among all people being discharged from hospital.

[216] Special Eurobarometer 460 on "attitude towards the impact of digitisation and automation on daily life" (2017).

[217] In terms of data production, the landscape is changing dramatically – from the amount of data produced, who produces it to the way it is stored and used. According to CSC, "experts point to a 4 300 % increase in annual data generation between 2012 and 2020" http://www.csc.com/insights/flxwd/78931-big_data_just_beginning_to_explode.

[218] Blueprint on Digital Transformation of Health and Care in the Ageing Society (Dec. 2016).

[219] The Council Recommendation of 8 June 2009 on an action in the field of rare diseases (2009/C 151/02), suggested that the coordination of Community, national and regional programmes for rare disease research should be improved.

[220] Source European Commission https://ec.europa.eu/health/rare_diseases/policy_en .

[221] Notably the European Reference Networks , E-RARE, IRDiRC , RD-Connect , Orphanet , the European Platform for Rare Diseases Registration.

In 2017, the Commission launched 24 European Reference Networks[222], which will provide an unprecedented capacity for cross-border collaboration to diagnose and treat rare diseases, using online consultation tool built with Connecting Europe Facility co-funding. They will pool knowledge and expertise, and offer an opportunity for clinical and scientific innovation. Further on rare diseases, the Commission has since 2003 supported the Orphanet database, the world reference now describing ca. 6 000 rare diseases. It is the major inventory of information for health professionals and patients. Orphanet plays a central role in interoperability for rare diseases systems and developing rare diseases codification.

With cross-border movements[223] comes the spread of communicable diseases such as tuberculosis, influenza, SARS and Ebola. Freedom of movement means EU-wide coordination is necessary for early identification and effective and sustainable response to epidemics and infectious diseases across the EU territory. The EU is ideally placed as a regional organization to protect EU citizens and Member States from major public health threats not only by acting to prevent health threats spreading and providing rapid responses when a threat emerges - but also by ensuring that there is a robust data and computing capacity to anticipate and rapidly identify infectious threats and thus limit the spread of epidemics.

Horizon 2020 funds **COMPARE**[224], a project with a budget of almost EUR 21 million that brings together key national reference laboratories from 10 EU countries. COMPARE has developed a globally linked data and information sharing platform that uses advanced IT technologies to generate genomic data of infectious pathogens and integrate these data with other relevant (clinical, epidemiological, demographic, environmental etc.) data. It aims to facilitate rapid identification of emerging infectious threats in the human health, animal health and food safety domains.

Personalised medicine[225,226,227,] informed by health data analytics can lead to drug and therapy development that are more effective, with less adverse effects and that can ensure improved quality of life[228]. Physicians are increasingly welcoming therapies supported by data analytics[229] which have the potential to minimize trial-and-error diagnosis and treatment, benefiting both the provider and the recipient of health and care services.

Horizon 2020 funds **ELIXIR-EXCELERATE**: an INFRADEV project with a budget of EUR 19 million and duration from September 2015 to August 2019 to accelerate the implementation and early operation of ELIXIR, the European life science Infrastructure for

[222] http://ec.europa.eu/health/ern/networks_en .
[223] The WHO estimates more than two million people cross international borders each day.
[224] http://www.compare-europe.eu/.
[225] Nimmesgern E, Benediktsson I, Norstedt I,. 2017. Personalised medicine in Europe. Clinical and Translational Science (http://onlinelibrary.wiley.com/doi/10.1111/cts.12446/epdf).
[226] Council conclusions on personalised medicine for patients (2015/C 421/03) (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2015.421.01.0002.01.ENG&toc=OJ:C:2015:421:FULL).
[227] Personalised Medicine Conference 2016 (https://ec.europa.eu/research/conferences/2016/permed2016/index.cfm?pg=about).
[228] During 2016 the International Consortium for Personalised Medicine (IC PerMed) was established as a Member States led initiative, focusing inter alia on digitalisation of health data to support personalised medicine.
[229] The Big Data Revolution in Healthcare (McKinsey and Company), Peter Groves, Basel Kayyali, David Knott and Steve van Kuiken (January 2013),

Biological Information. With 41 partners in 17 countries this grant enhances existing resources into a world-leading data service for academia and industry, increases bioinformatics capacity and competence across Europe.

c) Lack of wide-spread adoption of patient-centred digital innovation in response to chronic diseases

Globally, Europe has the highest burden of chronic diseases which are responsible for 86 % of all deaths. The World Health Organisation considers the rise in chronic diseases an epidemic and estimates that this epidemic will claim the lives of 52 million people in the European Region by 2030. Chronic diseases affect more than 80 % of people over 65 in Europe. Amongst the different chronic diseases, mental health is a real public health challenge; an estimated 18.7 million EU citizens are expected to suffer from dementia by 2050.

Health systems' reforms aim at a shift from a hospital-centred system to more home and community-based, person-centred and integrated care structures[230]. This will allow systems to address more effectively the needs of an ageing population and the rising prevalence of chronic diseases. Digital solutions are central to support this shift in health and care provision allowing the citizen to be actively engaged in prevention of chronic diseases (active and healthy ageing), adherence to treatments and providing feedback on the quality of health and care.

Digital technologies (e.g., smartphones, tablets, wireless sensors, etc.) that can be employed in mobile health (mHealth) surveillance, prevention, and intervention efforts have become affordable, easy to use, and widely adopted by users across socioeconomic statuses and age groups. When integrated within health and care systems, these solutions can help addressing preventable risk factors associated with chronic diseases (e.g. unhealthy diet and physical inactivity) supporting active and healthy ageing, early detection of symptoms and timely treatment, thus reducing the need for more burdensome treatments later on (annual savings in Europe estimated at EUR 69 billion[231]). Telemedicine and telecare, for example, can improve the quality of life of patients suffering from chronic conditions such as dementia or diabetes and provide them with the support they need to live safely and independently for a longer period of time while reducing the need for institutionalised care.

While there are numerous examples of proven digital health programmes across Europe that contributed to reduce the prevalence and burden of chronic diseases[232] most of them remain on a small scale and fail to scale up across Europe, despite the clear benefits they could bring to citizens and society. The differences between the European health and care systems, the lack of interoperable solutions and low awareness by health and care authorities of co-investment opportunities have been identified as the main obstacles to large scale uptake and implementation of digital health programmes to address the chronic disease epidemic.[233]

[230] WHO Global Observatory for eHealth Series http://www.who.int/ehealth/en/ .
[231] Socio-economic impact of eHealth An assessment report for the European Union (PwC 2013).
[232] The Innovative Practices Repository of the EIP on AHA (2016) https://ec.europa.eu/eip/ageing/home_en .
[233] Synthesis report on the public consultation on the European Innovation Partnership on Active and Healthy Ageing (http://ec.europa.eu/health//sites/health/files/ageing/docs/consult_report_en.pdf).

EU funding of more than EUR 4.6 million towards joint procurements in 7 countries for innovative health and care solutions is benefitting more than 5 000 users in the STOP&GO project, done in consultation with industrial suppliers and allowing for opening up major lead cross-border markets in Europe.

4.4. Stepping up investments in digital technologies and infrastructures

Policy Context

As with past technological revolutions, making the most of the new opportunities whilst mitigating negative impacts will require massive investments. At EU level there is a clear case for investment into major and systemic projects that will support the rise of digital ecosystems in cities, regions and Member States. Building a world-class data economy infrastructure will require Europe to invest EUR 500 billion over the next decade. One third of this amount is above current investment trends. More generally, the EU needs to catch up in a global race and as EU's key trading partners (China, Korea, Japan and US) are investing heavily in digital. This is all the more important that while all Member States are progressing, significant differences still remain between Member States, as shown by the Digital Economy and Society Index (DESI).

Under the current EU Multiannual Financial Framework (MFF), 2014-2020, several EU Programmes contribute to investments into digital infrastructures and services, throughout the different stages of technological development: research and innovation, testing, deployment and market up-take. The digital component in the current MFF amounts to EUR 37.4 billion, of the total commitment of EUR 1 082 billion between 2014-2020 (this is only 3.9 % of the total).

Over the last programming period, the Research & Innovation (R&I) investment for digital increased by 26 %, which corresponds to the overall increase of the R&I programme from the Framework Programme 7 to Horizon 2020. This means that the investment share for digital in R&I remained stable while the digital economy is becoming bigger.

In order to maximise the impact of those investments the EU leverages additional public and private funding through public-private partnerships, thematic and/or regional platforms and hubs as well as through different intermediaries such as banks.

Under the European Structural and Investment Funds (ESIF) roughly EUR 21.4 billion have been allocated to finance the digital sector for the period 2014-2020, of which more than EUR 6 billion only for high speed broadband roll-out both in urban and rural areas (see section 2.2.8). As of April 2017, the European Fund for Strategic Investments (EFSI) related investments in the digital sector account for around EUR 17.8 billion (10 % of the overall amount of investment mobilised at that date).[234]

[234] As of April 2017 EFSI financing of EUR 3.2 billion has triggered around EUR 17.8 billion of total EFSI related investments into the digital sector. The EFSI investments are intended to trigger EUR 315 billion of investment in three years. The list of projects is available on http://www.eib.org/efsi/efsi-projects/index.htm?c=&se=4 .

The 2016 EU Semester exercise identified more limited bottlenecks in investment in the digital economy with respect to other network sectors like energy and transport. Nevertheless, further efforts are needed to reduce investment barriers, at both national and EU level.

Investments in ICT account for 50 % of all European productivity growth.[235] The ICT sector represents 4.8 % of the European economy. It generates 25 % of total business expenditure in Research and Development (R&D). This EU investment in ICT will support the whole chain from basic research to innovation that can deliver new business breakthroughs, often on the basis of emerging technologies. The Digital Agenda target of doubling publicly funded R&D in ICT between 2007 and 2020 requires an annual growth rate of 5.5 % (assuming constant annual growth rate). Estimated public ICT R&D expenditure was below the necessary trend line in 2015, with a gap of more than 20 %.[236]

The policy framework for the Digital Single Market is of course crucial to incentivise private investment. The Scientific Advice Mechanism High Level Group's Opinion, for instance, points out to the importance of investment in Cybersecurity to reduce uncertainties in investment and conversely the importance of a specific effort to reinforce the cybersecurity industry in Europe.

An indicative table of EU funding and financing to digital infrastructure and services as well as digital skills for the period of 2014-2020 can be found in the annex.

4.4.1. Towards a Gigabit society

Policy Context

The Digital Single Market Communication highlighted the need to encourage the deployment of very high capacity networks as the backbone of the DSM while maintaining effective competition and adequate returns relative to risks.

What has been delivered?

Following an extensive public consultation on the need for internet speed and quality beyond 2020, in September 2016 the Commission adopted a **Communication on Connectivity for a Competitive Digital Single Market – Towards a European Gigabit Society.**[237] Building on work to deliver the connectivity objectives of the Digital Agenda for Europe (30Mbps connectivity available to all and subscription to 100Mbps connectivity by half the EU households by 2020), the new Strategy sets out a vision for a European Gigabit society around three new strategic and complementary connectivity objectives for 2025:

1) All main socio-economic drivers such as schools, universities, research centres, transport hubs, providers of public services such as hospitals and administrations, and enterprises relying on digital technologies, should be able to *download/upload 1 gigabit of data per second*. This objective aims to optimise investment in new very high-capacity networks, ensuring that such connectivity is installed in priority where it is most needed, i.e. locations or hubs where people gather to learn, work or access public services and where a single connection provides internet to multiple users. In addition, the roll out of networks which offer Gigabit connectivity at those points will contribute to developing demand for such connectivity more widely and deepening the reach of the networks supporting it.

[235] https://ec.europa.eu/programmes/horizon2020/en/area/ict-research-innovation
[236] Joint Research Centre's calculations and estimates, based on EUROSTAT data and PREDICT project.
[237] COM(2016) 587 final

2) All European households, rural or urban, should have access to connectivity offering a download speed of at least 100 Mbps - upgradeable to gigabit speed. In most rural and remote areas, internet connectivity can play an essential role in preventing a digital divide, isolation and depopulation by reducing the costs of delivery of both goods and services and offsetting remoteness. Reaching this objective can also help rural businesses to reduce their costs and modern agriculture to benefit from online applications and sensor monitoring. In 2016, 76 % of European homes could already access high-speed broadband (at least 30 Mbps) and in some Member States a significant proportion of these households could already access networks capable of providing 100Mbps or more, but rural areas still lag behind[238].

3) All urban areas, major roads and railways should have uninterrupted 5G wireless coverage. This will allow users and objects 'on the move' to remain fully connected at all times. As an interim target, 5G should be commercially available in at least one major city in each Member State by 2020.

The European Regional Development Fund will make it possible to provide more than 14,5 million households across the EU with a high speed broadband access of at least 30 Mbps by 2020. In addition the European Agriculture Fund for Rural Development (EAFRD) supports investments in ICT infrastructure and accompanying measures (such as training, advisory services and cooperation) with the aim of rolling out broadband to 18 million rural citizens by 2020.

European Strategic Investment funds provide a substantial contribution to the achievement of EU broadband targets. Projects under development in the area of Broadband Networks contribute significantly in increasing the broadband coverage in many Member States. As an example, the **Broadband Network Development in White Rural Areas in Greece** (EUR 97 million) helps close the “broadband gap” between remote and disadvantaged areas of Greece and the rest of the country where such services are already available.

Other broadband projects funded by the European Regional Development Fund (ERDF) include the **Construction of the Wielkopolska Broadband Network** in Poland, where a fibre-optic network open for all the operators was designed, built and operates. This project won the European Broadband Award 2016[239] in the category of Innovative models of financing, business and investment and is an example of public private partnership and a successful mix of managing different financial sources. The **Catalunya Connecta** (EUR 30 million) is an example of a project driven by the regional government in cooperation with the local actors, with a high impact on bridging the digital divide as well as enhancing the competitiveness of the regional economy. The **Net4all project in the Emilia Romagna region in Italy** is the winner of the 2016 EU Broadband award for “Cost reduction and co-investment”: a public and private partnership (with co-investing enterprises) which brought very high speed connectivity to industrial areas, based on reuse of existing passive public infrastructure and resulting in an open network.

In **France, the project "Nord-Pas-de-Calais THD"** aims to provide Fibre to the home (FTTH) to over 500,000 households as well as to public and business sites, all located in areas

[238] European Commission, The Digital Economy and Society Index (DESI), 2017 https://ec.europa.eu/digital-single-market/desi

[239] See: https://ec.europa.eu/digital-single-market/en/news/winners-european-broadband-awards-2016

not covered by the commercial operators. The European Investment Bank (EIB) financing amounts EUR 147 million out of a total cost of EUR 606 million.

In addition to the contribution expected from the review of the Electronic Communications Code described in section 2.2.8, the Communication outlined a number of areas for follow-up action to achieve these objectives.

4.4.2. Developing a European Open Science Cloud, High Performance Computing and European Data Infrastructure

Policy context

The latest technological trends in Big Data, High Performance Computing (HPC) and Cloud offer a wealth of opportunities for scientists to revolutionise the way they share and re-use knowledge and data in all disciplines. To support the digitisation of industry, HPC is a critical technology. It enables traditional computational-intensive sectors to move up into higher value products and services. Currently Europe is not fully embracing the potential of data: it is not always open, or interoperable, and data structures are fragmented. Yet the demand for a world-class HPC infrastructure to process data is surging.

Expenditure in Europe on cloud services is expected to reach between EUR 24.4 billion and EUR 59.6 billion in 2020, as part of EUR 439 billion of total IT spending. However, only 1 out of the top 10 cloud service providers is based in Europe.[240]

The Commission has already made available around EUR 1 billion of funding from H2020, including from the High-Performance Computing and Big Data Public-Private Partnerships, and from the Connecting Europe Facility instrument. This should leverage a similar amount from the private and the public sectors covering the needs of this Financial Framework. This does not include investments necessary for demonstrating and testing the performance of the HPC and big data service infrastructure facility to a number of compute-intensive industrial applications.[241]

Europe is leader in the use of HPC-powered applications: the users of HPC systems and applications in Europe include the most profitable and vibrant industrial sectors such as manufacturing, oil & gas, or pharmaceutical. A huge demand for HPC is also present in emerging domains such as health and wellbeing; secure, clean and efficient energy; smart, green and integrated transport; climate study, monitoring and action; food security, sustainable agriculture, marine research and the bio-economy. While Europe consumes ~30% of the HPC resources worldwide, EU industry supplies only around 5%.

Europe does not have a HPC capability according to its economic power. None of the ten leading HPC infrastructures in the world is in the EU. In the world ranking the EU dropped from a peak of four machines in 2012. The U.S.A., China, and Japan, are racing ahead and have declared HPC an area of strategic priority, with large investments to develop HPC technology and deploying state-of-the-art exascale supercomputers. Today, the USA has five, China two (China has fielded the fastest world supercomputer since 2013).

[240] Enter the Data Economy EU Policies for a Thriving Data Ecosystem, EPSC, January 2017.
[241] COM(2016) 178, p. 12

What has been delivered?

The Communication on the European Cloud Initiative[242] proposes actions around 3 axes:

1) A **European Open Science Cloud (EOSC**), a federated virtual environment with free at the point of use, open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines.
2) A **European Data Infrastructure (EDI),** building a world-class European infrastructure of HPC and data capability, and their high-speed interconnectivity, and exploiting the potential of quantum technologies.
3) Gradually **widening the user base** of the Science Cloud and Data Infrastructures to the industry and the public sector, and building trust.

The planning and implementation of the **European Open Science Cloud** takes into consideration the recommendations of the High Level Expert Group on the EOSC set up by the Commission that delivered its first report in October 2016.[243]

The Commission already started developing the services of the European Open Science Cloud with the integration and consolidation of existing eInfrastructures that will form the basis of the European Open Science Cloud services. The initial phase of the European Open Science Cloud addresses issues such as its governance, its catalogue of services and their uptake by scientific communities, its interoperability and connection to disciplinary research infrastructures[244]. This initial phase of European Open Science Cloud began with the launch of calls in the Horizon 2020 Work Programme 2016-2017 and it is considered to continue support in the next programme. The Commission is preparing a Roadmap for the European Open Science Cloud, which could be annexed to the Commission Decision on the Horizon 2020 Work Programme 2018-2020. It would address the issues of governance, funding and rules of participation. It is intended to become a platform for engagement with the Member States on the European Open Science Cloud vision.

From January 2017 open access and reuse of research data became mandatory for all projects funded by Horizon 2020[245], while part of the Horizon 2020 budget is directed towards supporting FAIR[246] data by rendering related costs eligible. The proposed Copyright Directive (see section 2.2.4) introduces a new mandatory exception for text and data mining carried out for the purposes of scientific research, offering research organisations legal certainty.

The preparation of the **European Data Infrastructure** (EDI) is facilitated through Horizon 2020 and the Connecting Europe Facility (CEF). The Commission launched several initiatives, such as a Public-Private Partnership (PPP)[247] for the research and development of supercomputers (EUR 700 million committed), and is providing users with access to

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[242] COM (2016) 178 final

[243] http://ec.europa.eu/research/openscience/pdf/realising_the_european_open_science_cloud_2016.pdf#view=fit&pagemode=none

[244] ESFRI – European Strategy Forum on Research Infrastructures has a key role in policy-making on research infrastructures in Europe. In particular the ESFRI contributes to the development of a strategic roadmap that identifies vital new European Research Infrastructures for the next 10-20 years.

[245] With a possibility to opt-out in justified cases.

[246] FAIR stands for: Findable, Accessible, Interoperable and Re-usable. These are data management principles.

[247] High Performance Computing Contractual Public-Private Partnership (HPC cPPP), https://ec.europa.eu/digital-single-market/en/high-performance-computing-contractual-public-private-partnership-hpc-cppp

supercomputers through PRACE[248] and GEANT.[249] The Commission is also working in close cooperation with the Member States for the coordinated acquisition of exascale supercomputers (by around 2022-2023) which will rank in the top three in the world. At least one of the supercomputers will be based on European technology.

Work is in progress towards setting up an Important Project of Common European Interest (IPCEI) on "High Performance Computing and Big Data enabled Applications". The Important Project of Common European Interest is under preparation by Luxembourg, France, Italy and Spain, open to other Member States to join, and will include the development of industrial applications that need exascale supercomputing and data infrastructures. A study on access-to-finance conditions was also launched by the European Investment Bank for European Cloud and High Performance Computing infrastructures and services to inform future decisions.

The Commission is preparing for new breakthroughs in computing and networking technologies based on quantum physics. The aim is to accelerate the development and commercialisation of products and services exploiting the fundamental principles of quantum physics through the launch of a new Flagship initiative on Quantum Technologies. This would be done in close cooperation with Member States and would require a total investment of around EUR 1 billion. First steps for setting-up this initiative started in 2016, the ramp-up phase is considered for funding under the Horizon 2020 Work Programme 2018-2020.

In respect of **widening access** to the European Open Science Cloud and the European Data Infrastructure, several actions are considered in the context of the Horizon 2020 Work Programme 2018-2020: incorporation of commercial services into the European Open Science Cloud to better serve thematic communities, offering big data and computing capabilities to sectors in-demand, developing High Performance Computing-enabled application test beds with industry or the public sector. The Cloud Select Industry Group (C-SIG) is also being re-tasked to provide industry input.

4.4.3. Building artificial intelligence capacities

Policy context

Artificial intelligence (AI) is fast becoming one of the most promising technologies for innovation, e.g. autonomous robots are increasingly used in factories, homes, cities and hospitals. Commercial AI platforms such as IBM's Watson have now moved to real applications in health and environment; the automotive industry is developing autonomous vehicles.

AI-based systems can bring unique solutions to some of the world's biggest societal challenges ranging from treating diseases and finding the best cures to decreasing fatality rates in road transport and minimising the environmental damage of farming. They have also a critical role in preserving security and safety and can accomplish tasks like rescue missions that save lives and protect environments and that are impossible to achieve without. Moreover, they are one of the key drivers of future productivity growth.

A recent report estimated that the market for robots and AI solutions will grow to USD 153 billion by 2020, comprising USD 83 billion for robotics and USD 70 billion for AI-based

[248] PRACE: Partnership for Advanced Computing in Europe, http://www.prace-ri.eu/.

[249] GEANT: the Pan-European network that interconnects research, education and innovation communities worldwide, with secure, high-capacity networks. For more, see https://www.geant.org/Networks

analytics. The Boston Consulting Group estimated that the annual global market for fully autonomous cars could grow from EUR 5 billion in 2025 to EUR 35 billion in 2035. The combined economic impact of the automation of knowledge work, robots and autonomous vehicles is estimated to reach between EUR 6.5 trillion and EUR 12 trillion annually by 2025 including gains in productivity and benefits in areas such as healthcare or security.

Despite these huge opportunities, AI is often perceived by citizens as a threat, ranging from existentialist ("AI could end mankind") to the more concrete ("AI costs jobs"). A recent Eurobarometer survey[250] found that 72% of EU citizens think that robots steal peoples' jobs. At the same time, almost two thirds of respondents of the same survey have a positive view on robots and AI-based systems, with people having knowledge of robots/AI exhibiting an even more positive view.

Advanced robots, autonomous and AI-based systems are capable to understand and interpret their environments and act appropriately. The current regulatory framework related to the liability for defective products, which applies in the business-to-consumer context, is under evaluation with a view of clarifying whether Directive 85/374/EEC[251] is fit-for purpose for covering damages caused to consumers by advanced robots which can display varying degrees of autonomous behaviour. In particular, the evaluation should investigate and provide an evidence-based assessment related to possible problems or gaps that could arise in the context of product liability rules as, for instance, the attribution of a strict liability to the producer, the definition of defectiveness based on the lack of safety or the fact that it applies only to products. As regards the product safety regulatory framework for these systems, the EU legislation on radio equipment (Radio Equipment Directive 2014/53/EU) regulating among other things aspects on safety and electromagnetic compatibility, allows the possibility to address in the future any potential challenges related to the interconnectivity of robots, while the EU legislation on machinery (Machinery Directive 2006/42/EC) which covers robots, is in process of being evaluated with a view to adapting it to such new emerging autonomous systems.[252]

Europe needs to maintain its strong position in basic and robotics-related AI technology. More than 40 % of service robot manufacturers are based in Europe[253]. Half of the top 10 nations with the most industrial robots per 10 000 employees belong to the European Union[254]. European startups play an important role in AI, robotics and virtual reality. Since 2011, the number of deep tech startups founded in Europe has grown by 3.5[255].

Europe is particularly strong in a number of AI technologies such as cooperating robots; speech and haptics-based human-machine interface; knowledge extraction and semantics; learning; safety; actuation (other than gears); grippers and dextrous hands; locomotion (except bipedal locomotion); navigation and collision avoidance; motion and task planning; modelling for control (kinematics and dynamics), bio-inspired systems, bionics, and cybernetics.

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[250] Special Eurobarometer 460 on "attitude towards the impact of digitisation and automation on daily life" (2017).

[251] Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products

[252] The EU relevant the product safety regulatory framework is complemented by the General Product Safety Directive 2001/95/EC which regulates safety aspects not already covered by more specific EU legislation.

[253] https://ifr.org/downloads/press/02_2016/Presentation_12_Oct_2016__WR_Service_Robots.pdf

[254] https://ifr.org/ifr-press-releases/news/world-robotics-report-2016

[255] http://www.atomico.com/news/the-state-of-european-tech-2016

However, one of Europe's key weaknesses in the area of AI is the dominance of non-European players in the burgeoning field of AI platforms. IBM, for example, has successfully launched Watson, Microsoft has announced an open-source AI platform called Malmo, and Google is making its library for machine intelligence, Tensor Flow, also freely available. Their competitive advantage derives in no small part from the simultaneous access to large quantities of data that can be used to refine the quality of the results.

In conclusion, AI is a key technology for Europe's future competitiveness. Many, if not all, sectors will be affected. A concerted effort must be made to develop the next generation AI platforms and underpinning technologies, and to accelerate their take-up by businesses, industries and public authorities across all sectors to ensure Europe does not become dependent on non-European suppliers. At the same time, societal concerns and legal issues linked to the development of AI, in particular the need to have adequate safety and liability rules have to be addressed.

What has been delivered?

Since 2004, AI has featured in robotics Research & Innovation projects in the Framework Programme, and basically every funded project in robotics has some AI component. Overall, the investment in robotics in the 7th Framework Programme (FP7) reached EUR 550 million over the period 2007-2013, increasing to up to EUR 700 million in Horizon 2020.

AI is a strong focus in Future and Emerging Technologies (FET) with investments of around EUR 120 million resulting in around 50 projects. Activities include support for projects in the area of situational awareness, machine learning and data mining, for bio-inspired approaches (swarm intelligence), intelligent sensors and robots, and to investigate artificial emotions, creativity and consciousness.

The Big Data Public Private Partnership also has considerable activities in AI, mainly for deep learning analytics, semantic technologies, natural language understanding and interaction, decision-making tools and data-driven learning. Most of these activities are industry-driven and innovation-oriented.

Under the Internet of Things area in 2016, a large-scale pilot on autonomous driving with a funding of EUR 20 million is being launched with major car Original Equipment Manufacturers and navigation system providers involved. Other Internet of Things large-scale pilots such as in agriculture and healthy ageing will also feature AI.

The European Commission has launched a series of calls for research proposals in Horizon 2020 centred on developing Europe's production base in the context of the digitising revolution. They include in particular areas such as: AI and flexible robots; optimisation of production flows using sensors and data analytics; flexible, customised and distributed production using 3D printing; acceptance and training of manpower. The aim is notably to combine high-performance and quality with customer orientation, productivity, while realising reconfigurable, adaptive and evolving factories capable of small scale production in an economically viable way. It is also to ensure social sustainability of manufacturing by integrating human skills with technology and to ensure environmental sustainability of manufacturing by reducing resource consumption and waste generation. The digitising revolution is therefore at the heart of this vision, with funding of around EUR 160 million in 2016 and a sustained effort foreseen until 2020. The numerous projects which have already been selected in the domain under FP7 and Horizon2020, including under the Factories of the Future contractual Public-Private Partnership, cover the whole range of the challenge.

A good example of this diversity is given by the **Lean Intelligent Assembly Automation (LIAA)** project, which mobilises EUR 10.6 million. Humans and robots working collaboratively on assembly lines can improve worker safety and boost productivity. With this in mind, the EU-funded under FP7 around EUR 8 million for this project to develop a software framework for assembly systems that merges the capacities of humans and robots. The framework enables the use of robot assistants on assembly floors through existing lightweight robots sold commercially, inexpensive sensors and open source robot control software. The workstation assigns jobs accordingly and sends specialised commands and instructions.

Through SPARC, the Public-Private Partnership in Robotics, work has been done as well already on the ethical, legal and socio-economic aspects of robotics and artificial intelligence. Several reports were published, which summarise the current thinking, e.g. on the impact of automation on employment.

4.4.4. 5G

Policy Context

The DSM Communication and the subsequent Communication on Connectivity[256] underline the importance of very high capacity networks like 5G as a key asset for European global competitiveness.

Moreover, the digitisation of industry (DEI) package presented by the Commission in April 2016 reconfirmed 5G as a key technology to serve the innovative digital business models of key vertical industries like automotive, healthcare, media, smart factories and energy.

Project mmMAGIC[257] (EUR 8 165 million EC support) has paved the way towards economic exploitation of new spectrum above 24 GHz, a spectrum region currently not used for mobile terrestrial services. Compared to today's mobile systems, the use of such high frequency bands will allow data rates above 20 Gb/s to be supported, whilst the most sophisticated version of 4G would not exceed 3.2 Gb/s. This in turn supports the availability of gigabits/s access rates for single users on wireless networks, in line with the policy objectives of the Communication on Connectivity. Results of this project are currently being exploited in the context of a pre commercial trial launched in the UK.

Project FANTASTIC-5G[258] (EUR 7 986 million EC support) developed new radio technology that overcomes the disadvantages of 4G radio access, in terms of poor spectral containment, lack of robustness in highly asynchronous and high mobility scenarios, as well as inflexibility for the support of diverse services. The radio technology developed allows a more efficient use of spectrum, with more than 20 % spectrum use improvement compared to existing technologies. This works also forms the basis of the submissions of European industry tow standardisation bodies which have planned to finalise 5G standards by the end of 2019.

[256] COM(2016) 587.
[257] https://5g-mmmagic.eu/
[258] http://fantastic5g.eu/

All projects implemented under the 5G Public Private Partnership (PPP) work together towards exploitation of research results, notably with a view to contributing to the overall 5G standardisation roadmap and to the identification of 5G spectrum and of its technical operations and licensing.

What has been delivered?

In September 2016 the Commission's Communication '5G for Europe: An Action Plan'[259] proposed a set of strategic non-legislative actions to accelerate preparations for the coordinated deployment of 5G network infrastructure across Europe.

Actions related to radio spectrum

The **Radio Spectrum Policy Group** (**RSPG**), which considers input from the **5G-PPP spectrum working group**, provides advice on spectrum planning for 5G.

1) A short RSPG Opinion on the overall strategy and the identification of pioneer bands for the initial deployment of 5G services was adopted in November 2016;
2) A fully-fledged RSPG Opinion on the EU 5G spectrum roadmap, including assignment methodology, is planned for adoption by February 2018.

In January 2017 the Commission issued a **Mandate to the European Conference of Postal and Telecommunications Administrations (CEPT)** to develop the technical conditions of use of 5G spectrum bands:

1) Early CEPT deliverables on pioneer bands are expected in March 2018;
2) Final CEPT deliverables on all 5G spectrum bands are expected in March 2019.

Actions related to the preparation of advanced pre-commercial trials

The Commission has selected the EU projects that will conduct the key technological experiments and initial 5G demonstrators in the context of Phase II of the 5G Public Private Partnership (Horizon 2020) and is preparing a call for specifications for Phase III on end-to-end demonstrators.

In addition, a number of companies have responded to the call to organise pre-commercial 5G trials involving key vertical industries (e.g. healthcare, media, smart factories), as set out in the 5G Action Plan. As a result, a draft version of the strategic EU roadmap for pre-commercial 5G trials was agreed between the main promoters and will be delivered to the Commission by the end of May 2017.

Actions related to standardisation

The Commission has promoted the EU vision for 5G actively through the adoption of public positions in relevant events and participation in key meetings of 3G PP. The Commission has also conveyed its views on standards through cooperation with international partner administrations, notably of South Korea, Japan, Brazil and China, to support the emergence of global 5G standards and globally harmonised frequency bands.

[259] COM(2016)588 and SWD(2016)306

Finally, the Commission manages the monitoring and support activity in the context of its general ICT standardisation policy, where 5G is one of the five priorities.

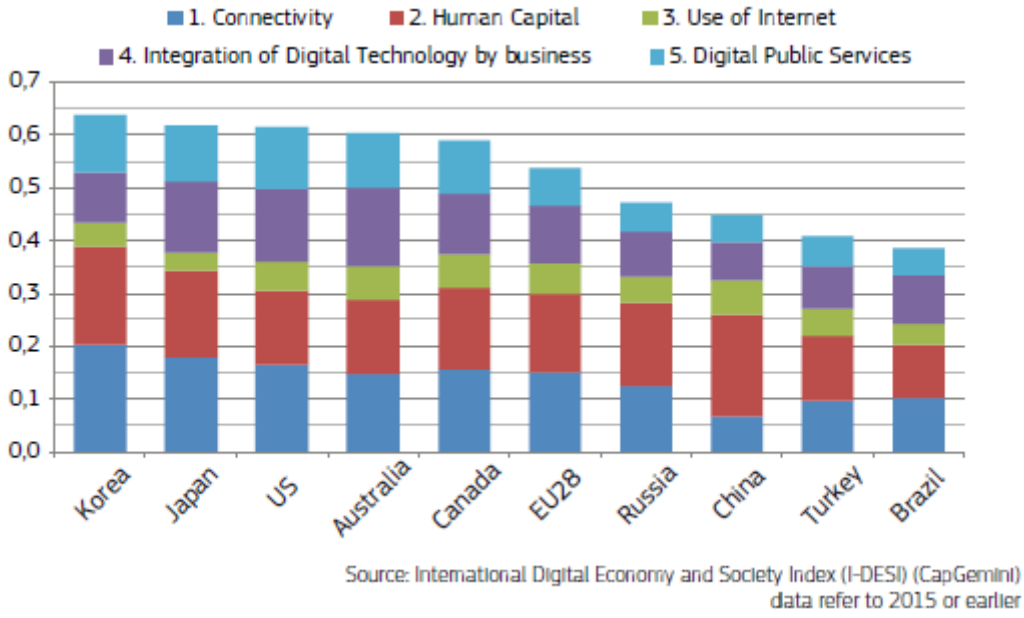
Actions related to the planned venture financing facility to stimulate 5G innovation and take-up

The facility should combine public resources, such as the European Investment Fund (EIF), and private resources, such as corporate venture capital, to stimulate the new 5G-enabled innovation ecosystems on the edge of the network. The feasibility study is expected to be completed in the third quarter of 2017. Depending on the outcome, the Commission may propose any appropriate allocation, or re-direction of EU funding to support the action.

5. THE DIGITAL SINGLE MARKET: EUROPE'S MAIN ASSET IN THE GLOBAL DIGITAL ECONOMY AND SOCIETY

Policy Context

Overall, the EU has a strong position on the global digital stage. It is the biggest exporter of digital services, has enshrined its values, such as privacy, the protection of personal data or net neutrality in European regulations and can count on a dynamic community of digital startups that are part of broader hubs across the world. Thanks in part to the EU's research and innovation programme, Horizon 2020[260], Europe is at the cutting edge of innovation and is a leader in digital sectors such as smart cities and networking technologies. However, the EU can improve in other areas, such as providing faster connectivity to more of its citizens, and fostering the creation of large internet platforms.[261]



While the Digital Single Market offers many opportunities for the EU to promote its values and interests globally, it also faces a number of challenges on the global stage notably linked to the rise of protectionism and diverging values.

[260] The world's biggest multinational research program

[261] The EU the EU currently represents only 4 % of the total market capitalisation of the largest online platforms: the vast majority of platforms originate in the US and Asia.

What has been delivered?

Protection of personal data

The General Data Protection Regulation offers a set of flexible tools for the transfer of personal data from the EU to third countries so that when the personal data of Europeans is transferred abroad the protection travels with the data.

Building upon the new personal data protection framework, the Commission's Communication, 'Exchanging and Protecting Personal Data in a Globalised World'[262] of January 2017, aims to facilitate cross-border data flows while ensuring a high level of protection of personal data, both in the commercial sector and in the area of law enforcement cooperation. It recognises that an adequacy finding for a specific third country "reduces the risk of invocation by that country of personal data protection grounds to impose unjustified data localisation or storage requirements." Exploring the possibility for an adequacy finding with respect to third countries that fulfil the legal requirement of an essentially equivalent level of data protection is thus a strategic priority for the Commission and the Communication stipulates a set of criteria to guide the Commission's efforts in this regard. At the same time, the Communication points to the need to monitor existing adequacy decisions such as the recently adopted EU-US Privacy Shield. Moreover, the Communication explains the possible use of the other tools for cross-border data transfers in the General Data Protection Regulation, which can be adapted to specific types of business or processing operations, thereby providing a high degree of flexibility.

Trade policy

In its Communication on "Trade for all"[263] the Commission committed to seek to use Free Trade Agreements (FTAs) and the Trade in Services Agreement (TiSA) to set rules for e-commerce and, if appropriate, cross-border data flows, and tackle new forms of digital protectionism, in compliance with the EU's privacy and personal data protection rules.

Developing alliances and fostering EU's soft power

Cooperation to develop the global digital economy is one of the main deliverables at EU summits with its key partners. These are prepared and further implemented through a large ecosystem of **ICT dialogues** and workshops on the digital economy with *inter alia* Brazil, China, India, Japan, Mexico, South Korea and the USA.

The EU also promotes the Digital Single Market internationally through the **G20 & G7**. The international dimension of **Horizon 2020** aims to support EU research and innovation excellence and our economic and industrial competitiveness. By cooperating with our strategic partners internationally, the Commission promotes the global adoption of European technological developments and market innovations. International research cooperation and science diplomacy remain the key instruments for asserting the relevance of the EU in research and innovation, and enhancing the role of the EU as a global actor.

[262] COM(2017) 7 final.
[263] COM (2015) 497.

Standards, spectrum and 5G

In its Communication on ICT Standardisation Priorities for the Digital Single Market adopted in April 2016[264] the Commission set out a number of measures to strengthen its presence in the international dialogue and cooperation on ICT standards. To meet objectives on global interoperability on 5G (spectrum, standards and research) the Commission signed a joint declaration with its counterparts in Brazil, China, Japan and South Korea and cooperates closely with the USA and India.

International spectrum convergence and harmonisation is particularly important for the development of 5G. The EU is working, through the European Conference of Postal and Telecommunication Administrations (CEPT), to agree on a strong EU position on spectrum in the International Telecommunication Union. The EU also reaches out to its neighbourhood and supports Africa on spectrum harmonisation.

Startup Europe

Creating connections between EU startup ecosystems and other leading technology hubs across the world benefits both the wider uptake of the Digital Single Market policy framework and opportunities for European digital businesses. In 2016, Startup Europe started its international outreach with partnership activities with Silicon Valley, India and Africa.

Internet Governance

The EU has played a major role in ensuring that the UN negotiations preceding the renewal of the World Summit Information Society (WSIS) led to an outcome that reinforced the role of the multi-stakeholder model in a free and open internet.[265]

In September 2016 the contract between the Internet Corporation for Assigned Names and Numbers (ICANN) and the US Government, on the supervision of the Internet Assigned Numbers Authority[266] was allowed to lapse. Up to that point, the US provided oversight of ICANN's management. From October 2016, that supervisory role became the responsibility of the multi-stakeholder community, in which the European Commission participates, together with the EU Member States. This was a major success for the long standing position of the EU in the area of internet governance, and paved the way to develop a sustainable approach to internet governance with the aim of keeping the internet open. The Commission Work Programme for 2017 also includes an evaluation and revision of the Regulations establishing and implementing the EU trusted domain names.

New Developments and challenges

The rise of the digital economy and global trade flows

Between 2000 and 2015, internet penetration increased from 6.5 % to 43 % of the global population. In 2015, e-commerce was worth around USD 22 trillion.[267] Mobile technology is

[264] COM (2016) 176

[265] Outcome document of the high-level meeting of the General Assembly on the overall review of the implementation of the outcomes of the World Summit on the Information Society

[266] IANA – the global worldwide "allocation" contract/process for IP addresses and protocol assignments that keeps the internet together

[267] UNCTAD, press release July 2016, http://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=1281

used by around 4.5 billion people around the world, and digital solutions are powerful enablers of growth in developing countries. The development of e-commerce provides a global platform for European business to access the global marketplace, expand their consumer base and globally extend their value chain.

The importance of data flows in global exchanges is also rising rapidly[268]. Data flows are emerging as a potential substitute for trade in physical goods, namely thanks to technologies such as three-dimensional (3D) printing. Between 2008 and 2012, world-wide cross-border trade in data increased by 49% while trade in goods or service rose by just 2.4%.[269]

Promoting EU values

The adoption and further development of a comprehensive and up-to-date European framework for personal **data protection** and privacy, guaranteeing free flow of data between Member States under the General Data Protection Regulation and the recent Commission proposal for a Regulation on Privacy and Electronic Communications[270], creates a baseline for Europe to develop its external policy on the global data economy. Promoting upward convergence of data protection principles, through adequacy decisions, cooperation between data protection authorities, bilateral agreements and multilaterally within the Council of Europe, the Organisation for Economic Co-operation and Development (OECD), the Asia-Pacific Economic Cooperation (APEC) or the G7/20 will be key to ensuring the trust of citizens globally. Strong cybersecurity measures play an essential role in protecting data, including personal data and privacy, and the EU promotes such measures in various forums, including the Internet Corporation for Assigned Names and Numbers (ICANN).

Through supporting and promoting cooperation between regulatory authorities, the Commission contributes to the creation of stable, predictable and non-discriminatory regulatory environments which in turn improves business conditions and market access for European industry in our partner countries. Initiatives like EMERG in Southern Mediterranean and EU4Digital: Telecom (EaPReg) with the Eastern Partnership may serve as examples for future support actions in Latin America and Africa. The EU is also a member of the International Competition Network.

Another area where gaps could emerge in the future is related to the approach towards net neutrality and the open internet. The EU has been at the forefront of defending net neutrality and an **open internet**. The transition of the Internet Assigned Numbers Authority (IANA) function from the US government to the multi-stakeholder community and improvements to ICANN's accountability procedures should be followed up by continuous development of the multi-stakeholder approach both in the EU and internationally.

Defending EU interest on the global stage

There is a rising number of takeovers of European companies by foreign investors, resulting in a potential loss of control and ownership of strategic technologies. For example, between

[268] McKinsey estimates that cross border flows of capital goods, services and data added an extra EUR 7.4Tn to the global economy in 2014, with data flows representing EUR 2.6Tn, slightly more than the value of the global trade in goods.
[269] Enter the Data Economy, EU Policies for a Thriving Data Ecosystem, EPSC, January 2017.
[270] COM(2017) 10 final 2017/0003 (COD)

2010 and 2015, the number of European companies bought by Chinese companies grew from 91 to 183[271]. In turn, European companies only bought 20 Chinese companies, and the majority of European foreign direct investment (FDI) in China consists of new production facilities that are built from scratch ("greenfield investments"). The scope of these acquisitions seems to be focusing on AI, robotics and micro / nano-electronics, with the acquiring companies mainly coming from the USA and China.

EU enlargement and neighbourhood policies

Alignment between EU digital policy and the Digital Single Market is also achieved through an active policy towards the EU's neighbours. For example, through the accession negotiations with the **candidate countries**, through ICT projects and cooperation with the **Southern Neighbourhood**, or through the more selective approximation with the 6 **Eastern neighbours**[272] under the existing Association Agreements.

Using digital technologies to improve our Development assistance

Following the UN General Assembly's approval of the 2030 Agenda for Sustainable Development[273], the Commission proposed in the Communication on a "Proposal for a New European Consensus on Development"[274] that the EU would focus on mainstreaming digital solutions in development as they are powerful enablers of growth. The EU Council on Foreign Affairs/Development adopted conclusions[275] on mainstreaming digital solutions in EU development policy and invited the Commission to prepare a Staff Working Document on that issue[276].

A strong digital pillar in our development policy can be helpful in accelerating the economies of least developed and developing countries, particularly in the EU neighbourhood. The African continent, since 2006, has leaped from twelve mobile subscriptions per 100 inhabitants to 80. There are now more households in developing countries that own a mobile phone compared to having access to electricity or clean water, which have spurred productivity growth and created jobs. In Africa, it is estimated that in 2010 the mobile phone ecosystem employed, directly or indirectly, nearly 5.8 million people. This corresponds to 1.4% of the total African workforce.[277]

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[271] Ernst & Young Report, "Chinesische Unternehmenskäufe in Europa, Eine Analyse von M&A-Deals 2005–2016", July 2016: http://www.ey.com/Publication/vwLUAssets/ey-chinesische-unternehmenskaeufe-in-europa/$FILE/ey-chinesische-unternehmenskaeufe-in-europa.pdf (slide 3)

[272] Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.

[273] Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly on 25 September 2015, UN, A/RES/70/1, available on http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

[274] COM(2016) 740 final

[275] Council of the European Union, Council conclusions on mainstreaming digital solutions and technologies in EU development policy adopted on 28 November 2016, 14682/16

[276] SWD (2017) 157 final.

[277] GSM Association (commonly referred to as 'the GSMA') is a trade body representing the interests of mobile operators worldwide.

ANNEX: INDICATIVE TABLE OF EU FUNDING AND FINANCING TO DIGITAL INFRASTRUCTURE AND SERVICES, AS WELL AS SKILLS, 2014-2020

i. Funding through grants

EU Programme	Short description of digital topics funded	EU contribution	Percentage of programme going to digital	Additional Member States and private investments mobilised (leverage effect)
European Structural and Investment Funds - regional - rural development	Digitizing economy, public administration, e-skills, infrastructures, e-inclusion and ICT use, health. ESIF technical assistance budget (within ERDF and EAFRD programmes) can finance the Broadband Competence Offices (BCOs) at national and/or regional level. The EC complements this action by financing a support facility for managing and	EUR 21,4 billion - of which more than EUR 6 billion to broadband	4,8 % of overall EU ESIF (456,5 billion)[278]	There are in total 211 ERDF (including 36 Interreg.) programmes and 48 EAFRD programmes with DSM related allocations. Member States contribute between 15 % and 50 %, depending on type of Region and type of Country Project selection on-going.

[278] https://cohesiondata.ec.europa.eu/overview

	assisting the network of BCOs.			
HORIZON 2020 grants[279] - FET and e-infrastructures - LEIT - Societal Challenges (including externalisation/external agencies) *Health, demographic*	Digital transformation of the economy and society to address societal challenges and enhance EU competitiveness	~EUR 12 billion for ICT for 2014-2020, including notably: - more than EUR 5 billion on Public-Private Partnerships, including Electronics Components and Systems (EUR 1.2 billion), High Performance Computing (EUR 700 million), 5G (EUR 700 million), Big Data (EUR 480 million), Robotics (EUR 630 million), Photonics (EUR 630 million), Cybersecurity (EUR 450 million), Factories of the Future (EUR 450 million); - more than EUR 500 million on Digital Innovation Hubs, out of which EUR 200 million have been invested till 2016; an additional EUR 300 million is planned. - EUR 1 billion for Societal	16 %	- EUR 20 billion of additional co-investment from industry and EUR 15 billion from Member States and regions over 2016-2020 to PPPs. For instance, the industry committed to invest three times more than the money put by the European Commission to cPPP on cyber security, envisaging in total the investment of EUR 1.35 billion between 2017-2020. Societal Challenge Health,

[279] According to the Digitising European Industry Communication, COM(2016) 180 final, the planned activities in Horizon 2020, CEF and COSME and related national public and private efforts will mobilise close to EUR 50 billion of public and private investments.

change and wellbeing		Challenge Health, Demographic Change and Wellbeing. - more than EUR 890 million on eInfrastructures to provide ITC services to our scientists in Europe (e.g. about 50 Million users in the GEANT network, managing a traffic per researcher 10 000 higher the traffic per EU citizen) - more than EUR 620 million on the digitization and clustering of research infrastructures and the management of open research data of H2020 projects. -Total EC contribution budget for H2020 projects in Transport with digital component (Joint Undertakings not comprised): EUR 650 million (Work Programme 2014-15 and 2016-17) - EC contribution to transport		Demographic Change and Wellbeing funding leverages an estimated EUR 252.9 million of additional co-investment from regional authorities (PPI/PCP), Member States (AAL) and industry (Innovation Actions and SME instrument). -eInfrastructures in Europe are co-funded by Member States, in the case of the example GEANT, co-financing by National Research and Education Networks equals approx. 55 %. - research infrastructures in Europe are mostly funded by Member States.

		Joint Undertakings for their digital components (2014-1027): EUR 70 million (Shift2rail) plus EUR 300million (SESAR)		
Smart, green and integrated transport	- Automated road transport, Logistics, Road, ITS, Urban Mobility, Safety, Waterborne, Aviation		34 % of the total EC contribution budget	
Secure, clean and efficient energy	Societal Challenge Energy	- Projects supported under the Societal Challenge Energy also address the use of ICT in the energy sector. Between 2014-2016, more than EUR 130 million has been dedicated to energy projects contributing to the DSM strategy. The Energy work programme 2018-2020 foresees 4 substantial joint topics with the ICT programme part (jointly financed) targeting ICT-related issues for the energy sector. Combined budget of EUR 30 M for 2016-2017 for these activities.		
Smart, green and integrated transport	- connected and Automated road transport, Logistics, Infrastructure, Urban Mobility, Safety,		34 % of the total EC contribution budget	EUR 23 million of direct cofinancing of H2020 funded projects, notwithstanding the leverage effect for which no

	Waterborne, Aviation, Rail			complete data is available
Food security, sustainable agriculture and forestry, marine maritime and inland water research and the Bioeconomy (SC2)	Horizon 2020, through the synergies between SC2 and Climate Challenge and ICT parts of the programme provides funding for several digital related activities, e.g. Robotics Advances for Precision Farming, observation systems or sea and soil integrated observation systems IoT Large Scale Pilot in funding on Smart Farming and Food Security	EUR 30 million		
Inclusive, innovative and reflective societies (SC6)	ICT enabled open government (eGovernment)	EUR 240 M including the Large Scale Pilot with the Member States' authorities in view of implementing the 'Once Only Principle' at European level		
Connecting Europe Facility	Digital Service Infrastructures, through building blocks, that can be used for services in eGovernment, eProcurement, eIdentity, eHealth	EUR 1 Billion in total, out of which	3.3 %	

- Telecoms		-EUR 770 million for cross-border digital services infrastructure. For instance EUR 33 million related to cybersecurity (2014-2017); EUR 30.1 million related to Digital Service Infrastructure for eHealth (ePrescriptions, ePatient summary and European Reference Networks (ERN) (2015 -2017) -€120 million for WiFi4EU initiative (pending approval from EP and the Council).		Member States contribution for cross-border digital services infrastructure amount to at least 25 %.
Creative Europe MEDIA subprogramme	MEDIA support the competitiveness and adaptation of the AV. industry to the DSM..	Creative Europe has a budget of EUR 1.56 billion in 2014-2020. The MEDIA sub programme accounts for at least 56% of the budget.	Approx. 8% of MEDIA is devoted to digital promotion of EU works.	MEDIA complements Member States significant investment on AV policies, estimated at over 2 billion per annum.
European Social Fund	Enhancing the accessibility, use and quality of information and communication technologies for the disabled	2.3 billion € overall (digital part not specified)		

ii. Financing through financial instruments

EU Programme	Short description of digital topics funded	EU contribution	Percentage of programme going to digital	Additional Member States and private investments mobilised (leverage effect)
European Fund for Strategic Investments	Next Generation Access networks, high speed broadband, 4G mobile network, digitalisation of the bank sector, on-line sales, health and life sciences sectors	EUR 3,2 billion (amount of EFSI financing approved under the Infrastructure and Investment Window (IIW) and the SME Window of EFSI contributing to the digital objectives) EUR 1 billion has been approved for broadband related projects	10 % (so far)	EUR 17,8 billion (estimated total related investments triggered by the 3,2 billion of EFSI financing) EUR 3.2 billion (estimated total related investments triggered by the 1 billion of EFSI financing).
Horizon 2020 financial instruments (through banks and other intermediaries)	- InnovFin financial instruments, a coherent set of financial products co-developed with the EIB Group (EIB and EIF) and implementation for the latter, complementing grants, over the entire value chain of research and innovation in order to support investments from the smallest to the largest	EUR 2,61 billion: overall budget foreseen (as at 31/12/2016) for the total programming period (digital part not specified)		EUR 25,75 billion of loans, guarantees and/or equity financial products overall: target for the entire period of the programme, covering InnovFin Equity (H2020), Innovfin guarantee (H2020) and R&I H2020 (digital part not specified)

	enterprise - InnovFin SME Guarantee - Innovfin for Equity (SME and small mid cap) - Innovfin for large project and midcap		- ICT is 40 to 50 % - ICT is 15 to 20 %	- EUR 15 billion of loans and/or guarantees for innovative small and medium-sized enterprises and small mid-caps, including innovative ones (digital part not specified)
COSME Financial Instruments, Equity Facility for Growth (EFG)	Investments into venture capital and private equity funds which have a focus on ICT (not further specified)	EUR 78 155 470 (accumulated budget committed since the beginning of the programme to ICT funds)	Per latest reporting date 77 % of all EFG commitments went to ICT oriented funds	Expected leverage of operations financed to date is about 8 (i.e. for every 1 Euro invested under the EFG it is expected that EUR 8 will be invested in SMEs in the ICT sector)
CEF Broadband	Broadband deployment in less dense areas between 2017 and 2021	EUR 130 million for broadband infrastructure, out of which EUR 100 million for the Connecting Europe Broadband Fund (equity and quasi equity) and approx. EUR 30 million for CEF debt instrument (a cross sectoral instrument with transport and	100 %	Connecting Europe Broadband fund: EUR 500 million from public and private sources. It is expected to trigger additional investments amounting to EUR 1 billion to EUR 1.7 billion.

		energy)		
Creative Europe Culture and Creative Sectors Guarantee Facility	To enhance the access to finance of SMEs in the cultural and creative sector, operational as of 2016.	EUR 121 million in total for 2016-2020 (with no current split of funds between media/digital/cultural available)		Leverage effect is expected to be 5.7 with the investment objective of EUR 600 million by 2020