ENABLING FUTURE SOCIAL MEDIA

June 2018

Introduction

This publication is a follow-up from the activities of the Vital Media project and the NEM Initiative laid down in the White Paper "Towards Future of Social Media", published in December 2017. The White Paper identified several aspects of Social Media, where specific actions are needed to be performed by overall European media community, in order to move towards the future social media. In this publication, the main identified aspects are further elaborated, providing concrete ideas on the needed approach in the future.

Beside education, the White Paper considered the following key areas, important for the future social media landscape and its further evolution:

- Data protection
- Trust
- New areas in social media
- Business and cooperation models

Regarding the data protection, the emphasis is in protection of individual user rights, data portability, and handling competition and monopoly related issues, including overall user information management and management of data portability.

Trust, as an important paradigm in social networks, can be established by appropriate regulation methods combined with ensuring broad diversity in the social media platforms and information flow through the social networks. Various social media tools, such as the fact-checking tools, can further increase the trust in the social media.

Nowadays, people, the social media users / consumers, understand the social media as a mix of various platforms allowing publication, sharing, and consumption of various types of information. However, in the future the machine based communication will increase in all sectors of life and will influence the future social media by introducing new ways of social media communication, e.g. by introduction of so-called Social IoT.

The business and cooperation models in the social media also cannot be seen as static and will need to evolve in the future to meet the new requirements of users but also other actors in the social media, such as the platforms, publishers, etc. Application of new business models in the social media are also seen as one of the means to efficiently reduce spreading and impact of disinformation in the social media, so-called fake news.

The Vital Media project and the NEM Initiative consider all the four aspects presented above as crucial for future development in the social media in particular in the European social media landscape where there is obviously a need to increase level of activities, needed to get into a position to become a significant player in the world-wide social media eco-system at the same level as the today's main global players are already acting.

In this publication, the data protection issues are handled in the second section by considering processes for management of user data and options for ensuring data portability in social media. Ensuring trust in the social media is considered through elaboration on possible solutions to implement efficient fact-checking tools in the third section and impose appropriate regulation means for the social media in the fourth section. Social IoT is considered, in the fifth section, as specific and possible trend in the social media interactions, whereas the business models and collaborative workflows for the future social media are elaborated in the sixth and seventh sections of this document.

Conclusions on the social media aspects elaborated in the document are provided within the corresponding sections.

Note, that education and media literacy, in relation to the social media, are also identified in the above mentioned White Paper as important aspects to be considered, but the related actions are not seen as focus of the activities to be performed by the Vital Media project and the NEM Initiative at this stage of discussions. A corresponding Media Literacy Expert Group has already been established by the European Commission to discuss the related matters in details.

Acknowledgements

Authors of this publication are the following members of the Vital Media project consortium:

- Jovanka Adzic, Telecom Italia
- Silvio Boi, Engineering
- Pierre-Yves Danet, Orange
- Halid Hrasnica, Eurescom
- David Jiménez Bermejo, UPM

We would also like to thank to authors of the White Paper “Towards Future Social Media” (December 2017), for their valuable initial inputs, allowing detailed elaboration of these in this document. Furthermore, an acknowledgement goes to members of the NEM Initiative, in particular members of the NEM Steering Board, for their inputs, suggestions, and useful discussions significantly contributing to this publication.

Table of Contents

1) Handling user data

1.1) Management of user data

One of the defining phenomena of the present times reshaping the world as we know it, is the rise of Social media, which comes in many forms, including blogs, forums, business networks, photo-sharing platforms, social gaming, microblogs, chat apps, and last but not least social networks. Social media phenomena have influenced human behavior much deeper than any other media revolution before. The development of social media communities is only partly moderated but boosted through highly personalized advertising and influencer marketing that expands into every part of human life.

The power of social networking is such that the number of worldwide users is expected to reach some 3.02 Billion monthly active Social media users by 2021, around a third of Earth's entire population.

The leading Social media platforms are usually available in multiple languages and enable users to connect with friends or people across geographical, political or economic borders and usually boast a high number of user accounts or strong user engagement metrics. Approximately 2 Billion Internet users are using social networks and these figures are still expected to grow as mobile device usage and mobile Social networks increasingly gain traction.

Market leader Facebook was the first Social network to surpass 1 billion monthly active users, whereas recent newcomer Pinterest was the fastest independently launched site to reach 10 million unique monthly visitors. The majority of social networks with more than 100 million users originated in the United States, but European services like VK or Chinese social networks Qzone and Renren have also garnered mainstream appeal in their areas due to local context and content.

Social media usage is diverse: platforms such as Facebook or Google+ are highly focused on exchanges between friends and family and are constantly pushing interaction through features like photo, or status sharing, and social games (Figure 1). Other Social media like Tumblr or Twitter are all about rapid communication and are aptly termed microblogs. Some Social networks focus on community, others highlight and display user-generated content.

However, regardless of the kind of interaction that is enabled in the community and the business model that is used to generate economic value, every Social media platform shares a common characteristic with each other: the size of their business is strictly related to the number of users actively taking part to the social network, with particular emphasis on the "Monthly Active Users" (MAU) metric, which defines the users that perform at least one access in a month. This number is so relevant to the economics of the Social media platforms that it is typically used as the reference metric to be exposed to investors and financial community. For these reason only players with either a huge number of MAUs or with a bullish growth trend can act profitably in this market, avoiding to be cannibalized by much bigger fishes that can count on big network externalities.

Figure 1: The heterogeneous world of Social Media

The Figure 2 shows an updated statistic on the most popular networks worldwide as of April 2018, ranked by number of active accounts. Market leader Facebook currently sits at 2.2 billion monthly active users. Sixth-ranked photo-sharing app Instagram had over 800 million monthly active accounts. Meanwhile, blogging service Tumblr had an estimated 794 million monthly active blog users on their site.

At a first look the landscape happens to be heterogeneous and distributed, with a first group of huge social media with 800 million users or more on one side, and a second group of small-middle sized players with less than 300 million accounts. However, taking a careful look at the first group and bearing in mind that WhatsApp, Messenger and Instagram are all Facebook properties, **it suddenly comes clear that this market is highly concentrated among just 2 players, Facebook and Google/YouTube**, with a share of about 44% and 11% each over the first 20 Social Media.

Concern about digital competition in social media platforms is acute in Europe because few, big and foreign companies, accumulate large volumes of exclusive operating data on their platforms and their dominant position could lead to situation where competition and innovation are undermined. The concentration around few platforms that have strengthened their position, becoming powerful integrated ecosystems, lead potentially to situations of consumers lock-in. Users gain good services, often free of charge, from such platforms but there are also some potential drawbacks; e.g. using a

dominant position to collect data, and keeping that data exclusive in order to maintain monopoly position could be used to prevent customer to change the platform providers.

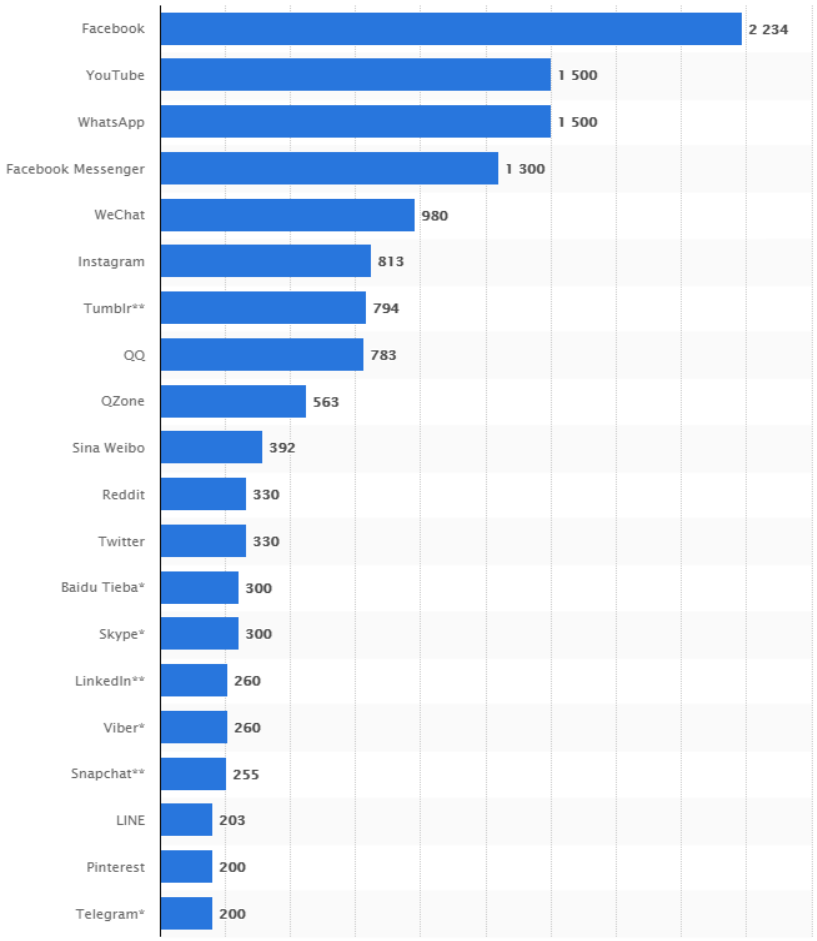

Figure 2: Most popular social networks worldwide as of April 2018, ranked by number of active users (in millions)

Using that huge amount of user data as the raw material for analytics, artificial intelligence and machine learning could have an insuperable competitive advantage over new entrants in existing services and businesses and even more for the future and potential new services and businesses based on data exploitation and monetization.

For the reasons explained above, it appears extremely unlikely for small players currently struggling in this market or newcomers to get the traction required to foster their business, creating an enormous barrier to new players and a relevant lock-in effect on active users of well-grown big Social media platforms. Capital expenditure for research & development in this sector, that is crucial for long-term growth and sustainable presence in the market, is strongly correlated with the volume of business or the potential revenue growth, which is in turn related to the community size; this brings to a situation where small players could not bear fair competition with bigger and well established Social media platforms,

because of much bigger costs per user to deal with and limited potential to innovate in order to reduce costs and increase revenue reach through innovative services.

Today's Social Media platforms have the dominant position to further exploit user data economy in the data-driven society, creating new services and business opportunities based on Big Social Data collection and processing, Artificial Intelligence (AI) and Machine Learning (ML) techniques in combination with Internet of Things (IoT).

Considering the huge amount and relevance of user data that Social media platforms are supposed to handle in the coming years (see Social IoT), it becomes extremely important to impose to Social media platforms a correct management of user information and guarantee a set of rights and tools to the final users that range from data security and protection, porting of user data to another platforms, to complete user control on personal information.

Regulation should address this potential issue of concentration and potential user lock-in, fostering the possibility of social network users to move freely between many platforms, reducing the side effects of relocation on different social media platforms and aiming at the creation of a common reference model for user information in order to facilitate the retrieval and injection of users data from the old platform to the new one chosen by the user.

1.2) Data portability

General Data Protection Regulation (GDPR),applied in Europe from 25th May 2018, addresses data protection and privacy issues for individuals in European Union with a set of prescriptions, including a mandate for data portability in order to enable people to transfer personal data from one electronic processing system to and into another.

GDPR presents a set of recommendations and rules that could provide, particularly on data portability, a promising route to combat customer lock-in, fostering switching between social media providers, including potential new (hopefully European) entrants in this space.

It could be of great interest for the development of the market, for competition and for end user value creation to have ICT tools, protocols, APIs and systems that can help to declare, enforce, control and report on data management and also on GDPR implementation as well as to ensure the needed user data portability.

The concept of portability (retaining the customer's identifier when changing service provider) and support for switching are well established in the context of broadband and voice services and is tightly regulated at EU and/or national level and should be strictly applied in social media services.

Data Portability is quite a big issue if applied to Social media platforms for several reasons:

- Different user profiles in every Social media platform (e.g. the set of all information that describe user inside community);
- Different data formats for Social media platform (e.g. kind of data shared by the user inside community);
- Many Social media platforms have terms and conditions (accepted by users at the time of registration) that set a sharing property of user data uploaded on the platform (e.g. pictures, videos…), preventing users to erase all their data while relocating on another platform.

Regarding the set of data that is included in GDPR, it is considered both data being 'provided' by the user (data subject) and data being 'observed', such as data about behavior, interaction,…; both kid of data, according to the regulation, “have to be provided by the controller in a structured and commonly used standard electronic format”, but there is no standard defined yet for user data structure that can play the common framework part across all platforms.

Furthermore, after signing a contract during registration phase where the user accepts terms and conditions that gives the Social media platforms some rights on the data published on the platform, it may be difficult to completely retrieve user data at the time of relocation to another player; this would put a limit on end user freedom to use any platform, reducing the possibility to cut any relationship with former Service Provider if he wants to.

For all these reasons there is still some uncertainty on how this issues will be addressed, bearing in mind the imminent deadline required by GDPR. While it is predictable that in the short time all big platforms will be working separately and in a heterogeneous way in order to solve this issues, some worries arise looking at the long-term scenario, where a common solution is expected to streamline the data portability process, just like it currently occurs in the Mobile Telecommunications with the Mobile Number Portability procedure that is a standardized and well-established process.

The way Social media platforms currently work, implies a central logical repository role for the platform where, after initial registration, users upload their profile information and personal data in order to allow other members of the community to access their content stored in central repository, as described in the Figure 3. This approach require users to accept upload, in order to share, personal files and documents, that will be stored in the Social media data centers; this could also implies that users cannot get any visibility of which (and when) members of the community are either accessing or even downloading their contents, lacking any kind of user’s control on his personal data stored on the platform.

Figure 3: Current approach of Social media to User Profile and Personal Data sharing

While on one hand, it would be crucial to pave the way to a structured and common activity framework for the specification of the data portability procedures, on the other some members of the media industry are looking for alternative approaches to comply to GDPR prescriptions, such as Data Decentralization and Trusted Third Parties Data Portability.

1.2.1) Data decentralization

A first alternative to actual implementation of data management within Social media platforms could be data decentralization. In order to maximize users' control over their personal data and to simplify data portability process across Social media platforms, a decentralized approach to data storage and access could be beneficial. Decentralized approach would overturn the classic paradigm of interaction within the Social platforms, followed by any player in the Social media landscape, in line with the client-server communication typical of the OTT operational model.

In a centralized approach, the platform that retrieves and stores all users' content plays the role of the server that processes the requests coming from all the clients, represented in this case by the users. This paradigm fits with the call of Social media platforms for data ownership and control, since it boosts their profiling-based advertisement business model, and it is fostered by the continuous capacity growth of telecommunication networks, both on Fixed and Mobile, sustained by Telcos all over the world; thus it is possible to quickly, almost instantaneously, upload text, pictures, videos and other kinds of personal user data on the platform, via reliable broadband and ultra-broadband connections. Social media platforms are used to take advantage of Telcos huge investments in network evolution and capitalize in the best way their own ability to quickly launch new services (e.g. 360° video, AR/VR) to increase user engagement, boosting the advertisement revenues, simply relying on the Telcos need to provide quality of experience to their customers.

A decentralized approach is more similar to a peer-to-peer type of communication, and requests in addition a fast and efficient control engine to manage routing and forwarding of requests and data. According to this view users do not need to upload their information and contents on a centralized platform, where they are cached locally in order to be delivered when accessed or downloaded by other users; in a decentralized system, personal data and information are always inside the user storage devices/cloud and the only way to get access to these contents is through a request authorized by the user. The role Social media platforms could play in this approach would be, as depicted in the Figure 4, the control platform that handles all the requests coming from the users and routes correctly the signaling to the proper recipient in order to get access, if granted by the end user.

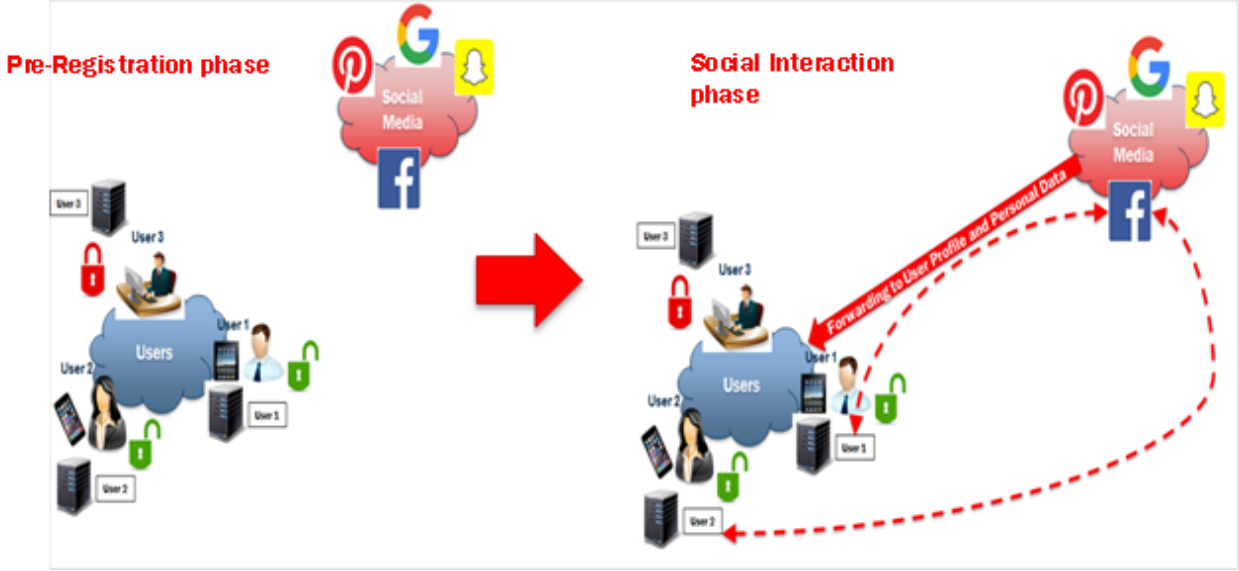

Figure 4: Alternative hypothetical approach of Social media to User Profile and Personal Data sharing

Therefore user profile and personal data would not be bound anymore to the particular Social media platform used by the users, leading to a simplified data portability process; indeed, by changing Social media platform, the user would just select another point of access to his data and contents, without need to re-shape and move his own data set.

In order to modify so heavily the Social media environment, some activities are required:

- Regulatory recommendation to shape the current approach to user data management in Social media platforms, including for example:
  - new requirements for user data storage and management inside the Social media platforms;
  - enabling users to opt-in for a decentralized approach;
- Definition of a brand new set of standards and rules for the management of user data by Social media platforms, ranging from:

- possibility to retrieve and access User Profile and Personal Data according to user grants;
- possibility to retrieve and aggregate user information in anonymous way in order to be monetized;
- request for total transparency - the Social media platforms does not see any user data/content;
- implying new business models for Social media platforms particularly those based on subscription, in-App selling, fee for premium contents,….;

- Innovation activities to support this brand new approach, taking care of all aspects that would be affected by the paradigm shift:

Platform processing capacity, network capacity, routing/forwarding efficiency, security and privacy issues…All these activities require deep investigation and studies to be carried out at European level, involving all interested players. This process could help to investigate all aspects that would be overturned by decentralization and would help to fine tune all the actions to be taken and the tasks required to streamline the process, which will take years to complete.

1.2.2) Trusted Third Parties Data Portability

Another innovative approach to help Social media platforms to comply to GDPR regulation in terms of data portability is to rely on trusted third parties that would be responsible for data retrieval, collection, parsing in a common standardized format and delivery to the new Social media platform selected by the end user. It is well known that every Platform has its own format and is oriented to a particular kind of communication: Twitter for many years has been entirely based on short text sharing, while Youtube relied heavily on video contents; other Social media selected a mixed content approach and are investing to enrich the set of contents the user can share, in order to increase users engagement and enhance customer profiling. For instance, if video contents have historically been almost entirely low quality 2D on-demand videos, in recent years big social platforms like Twitter, Facebook and Youtube have been increasingly betting on Live videos, that are supposed to be about 3 times more engaging than classic VoD (source Facebook).

Parsing user data would be a fine and complex process to take as an input all the data shared through a Social media platform and user profile and having in output a set of data sorted in a common standardized format. Therefore, every new Social media platform could collect information from the trusted 3rd party and populate its platform accordingly, as described in the steps highlighted in the Figure 5 – Trusted 3rd Party Data Portability process:

1) User 1 during the interaction with the former Social media platform uploads his contents and user information, which are stored in the platform data center;
2) Following user's decision to relocate to a new Social media platform, the former one uploads all his data to a trusted 3rd party (the selection criteria of the 3rd party that should be in charge of the data portability process is out of scope);

3) Selected 3rd party receives user data in the format used by the old platform and performs data parsing to achieve a standard format;

4) 3rd party delivers all user data to the new Social media platforms in order to populate all the fields in the user profile and contents, to let the user immediately interact within the platform with other users.

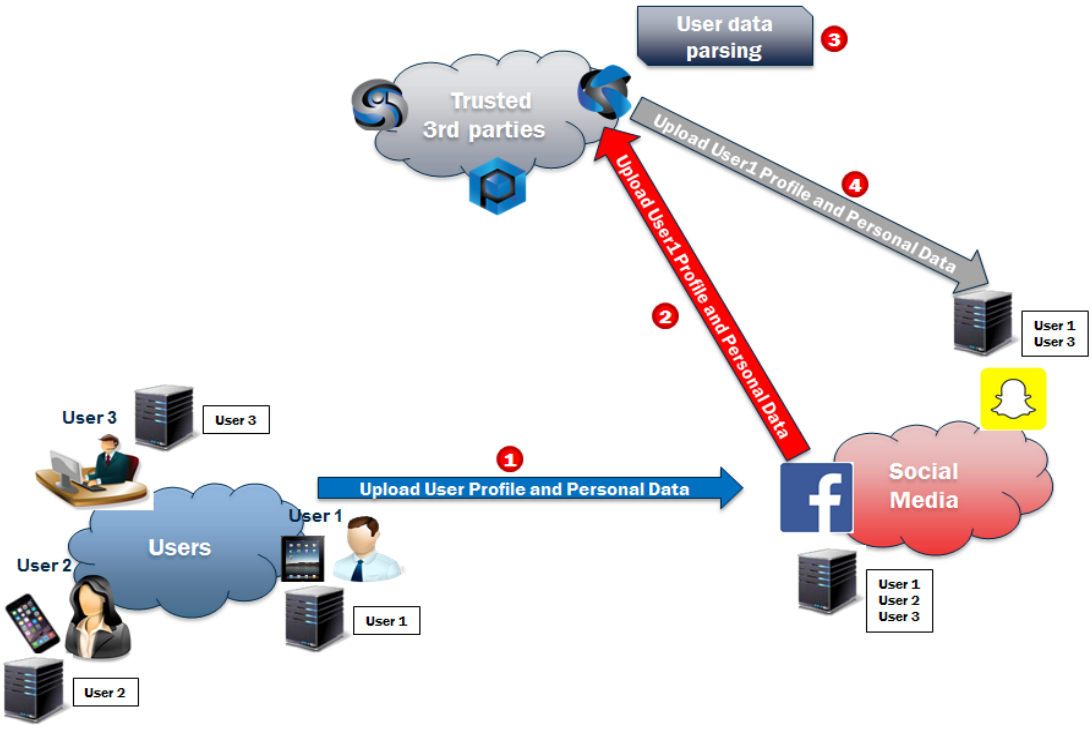

Figure 5: Trusted 3rd Party Data Portability process

Even in this case, some activities are required to make this scenario feasible:

- Regulatory recommendation to shape the current approach;
- Specification of the data portability process;
- Definition of the trusted 3rd party entity, role, function, responsibilities;
- Innovation activities to support this brand new approach, taking care of all aspects that would be affected by the paradigm shift.

1.3) Summary on user data

Today's Social Media platforms have the dominant position to further exploit user data economy in the data-driven society, creating new services and business opportunities based on Big Social Data collection and processing, Artificial Intelligence (AI) and Machine Learning (ML) techniques in combination with Internet of Things (Social IoT). Some fundamental and critical aspects are already identified

- Transparency, Privacy and User Data management;
- Users lock-in situations due to market dominated by a few big platforms providers; Huge volumes of exclusive Big Social Data accumulated and used as the raw material for Artificial Intelligence and Machine Learning as an hardly superable competitive advantage over new entrants.

For some visionaries Social Media are already old and will disappear in the future. The future of Social Media is not about posts, mobile apps, Social Media platform pages, but it is about Cyber-Physical-Social Hyperspace where meeting someone and being able to see and know all the events that concern her/him, thanks also to new wearable devices. Users will continue to provide photos, videos, opinions, routes in cars, all various information about their life's in a searchable database: they will be completely transparent, and with a Digital Identity. This could be seen as a sort of the Digital Historical Identity: digital trace of our existence as a consultable unicum. Obviously, a system of superior privacy and user data management will have to be established. Europe is becoming a sort of leader in this field with General Data Protection Regulation (GDPR), a robust set of requirements aimed at guarding personal information and reshaping how organizations approach user data protection and management.

It is quite clear that a sort of crossroad for Social Media platforms are coming: they are going to become an even bigger and more powerful Cyber-Physical-Social Hyperspace, a place for further socio-technological disruption, or they are going to have their position limited by new requirements and regulations coming from governments.

Personal data management is one of the key issues in order to give back the power to the end users. Several solution are possible, they need to be investigated further in order to build a powerful sustainable manner to manage personal data. For that purpose, one of the first needs is the personal data set standardization that should be used to ensure access and portability of personal data.

2) Ensuring trust in social media / tools for fact-checking

2.1) Machine Learning and collaborative algorithms to detect fake news

State-of the-art: Massive amounts of misinformation have been observed to spread in uncontrolled fashion across social media. Examples include rumors, hoaxes, fake news, and conspiracy theories. The resulting information cascades contain instances of both accurate and inaccurate information, unfold over multiple time scales, and often reach audiences of considerable size. According to [Shao16], the sharing of fact-checking content typically lags that of misinformation by 10-20 hours. Moreover, fake news are dominated by very active users, while fact checking is a more grassroots activity. In platforms such as [Shao16] the system collects data from two main sources: news websites and social media. From the first group, we can obtain data about the origin and evolution of both fake news stories and their fact checking. From the second group authors collect instances of these news stories (i.e., URLs) that are being shared online. However, automatic tracking of online misinformation is not present in such platform. Other authors base the research in the identification of sources promoting the fake news

[Saez14] by collaborative analysis to identify users that are consistently uploading and/or promoting fake information on social networks, using credibility classification for the tweet and the user.

Ambition: The future ambition is to improve the efficiency of the mentioned techniques. This will be reached by the concentration of diverse data sources in a common system that allows to fuse the information of the diverse data-sources as well as the results provided by these techniques to overcome individual disadvantages of every technique,

Innovation potential: Provide a deep understanding of how to translate gathered data into new knowledge involving diverse data sources and complex techniques.

2.2) Content-based analysis to detect fake news

State-of the art: There exists a wide range of assessment methods for content-based analysis relying on two major categories: Linguistic and Networking approaches. In the former category, several types of analysis such as syntax, semantic and discourse are identified. An analysis of "liars" yields to infer that there exist some hard-to-detect language "lackages": negative emotion word usage, patterns of pronoun, conjunctions, among others. The main goal of linguistic approaches is to identify such "predictive detection cues". In [Rubi15b], the syntax analysis is performed by the creation of advanced knowledge bases and its integration in personalization models allows to reach up to an 85% accuracy in fake news detection. Moreover, in [Rubi15a] a system using syntax analysis is implemented through Probability Context Free Grammars (PCFG). Sentences are transformed to a set of rewrite rules (a parse tree) to describe syntax structure, for example noun and verb phrases, which are in turn rewritten by their syntactic constituent parts. Furthermore, at the discourse level, deception cues present themselves both in CMC communication and in news content. A description of discourse can be achieved through the Rhetorical Structure Theory (RST) analytic framework, that identifies instances of rhetorical relations between linguistic elements. Systematic differences between deceptive and truthful messages in terms of their coherence and structure has been combined with a Vector Space Model (VSM) that assesses each message's position in multidimensional RST space with respect to its distance to truth and deceptive centers [Rubi14]. At this level of linguistic analysis, the prominent use of certain rhetorical relations can be indicative of deception.

Moreover, Network Approaches using network properties and behavior are ways to complement content-based approaches that rely on deceptive language and leakage cues to predict deception. As real-time content on current events is increasingly proliferated through micro-blogging applications such as Twitter, deception analysis tools are all the more important. The use of knowledge graph supports a significant improvement towards scalable computational fact-checking methods. Queries based on extracted fact statements are assigned semantic proximity as a function of the transitive relationship between subject and predicate via other nodes. The closer the nodes, the higher the likelihood that a particular subject-predicate-object statement is true. There are several so-called 'network effect' variables that are exploited to derive truth probabilities [Ciam15], so the outlook for exploiting structured data repositories for fact-checking remains promising. From the short list of existing published work in this area, results using sample facts from four different subject areas range from 61% to 95%.

Success was measured based on whether the machine was able to assign higher true values to true statements than to false ones [Ciam15].

Currently, content-based techniques are still very popular, however there are a huge set of model-based techniques increasingly useful in real systems, thanks to the new techniques in parallelization, cloud computing and big data frameworks. These techniques are especially important in those scenarios that have to deal with a very specific domain or with a set of users with specific features. Some of the most representative model-based collaborative filtering (CF) techniques are Bayesian Belief Nets CF, Clustering CF, MDP-based CF, Latent semantic CF, Sparse Factor Analysis, and CF using dimensionality reduction techniques, such as Singular Value Decomposition SVD or Principal Component Analysis.

Ambition: The future ambition is to develop a set of content-based algorithms for rating on fake news detection. The comparison of users/profiles against item feature vectors based on similarity measures will allow predict whether the news is deceptive or not. Additionally, Content-based techniques can be significantly improved by mixing its prediction results with the extraction of multiple features as the ones given by demographics [Gupta15] to create ratings on the data/user sources.

Innovation Potential: The employment of content-based techniques will allow identifying fake news sources according to similar contents previously identified. Within the project lifetime, novel techniques such as genetic algorithms [Sad15] will be explored to filter news based on its contents. Additionally, hybrid approaches such as weighted combination and feature combination.

2.3) Text, including Natural Language Processing in a multi-lingual environment

State-of the-art: Modern machine learning for natural language processing is able to do things like translate from one language to another, because everything it needs to know is in the sentence its processing and on the other hand, identifying claims, tracing information through potentially hundreds of sources, and making a judgment on how truthful a claim could be based on a diversity of ideas- all that relies on a holistic understanding of the world, the ability to bridge concepts that aren't connected by exact words or semantic meaning.

For now, AIs that can simply succeed at question-and-answer games are considered state of the art. As recently as 2014, it was bleeding edge when Facebook's [FBAIR] AI could read a short passage about the plot of the Lord of the Rings, and tell if Frodo had the Ring or not.

The Stanford Question Answering Dataset [Squad], or SQuAD is a new benchmarking competition that measures how good AIs are at this sort of task. But parsing a few paragraphs of text for factuality is nowhere near the complex fact-checking machines AI designers are after. It is incredibly hard to know the whole state of the world to identify whether a fact is true or not. Even if there was a perfect way to encompass and encode all the knowledge of the world, the whole point of news is that we're adding to that knowledge.

The novelty of news stories means the information needed to verify something newly published as fact might not be available online yet. A small but credible source could publish something true that the AI marks as false simply because there is no other corroboration on the internet—even if that AI is powerful enough to constantly read and understand all the information ever published.

Some of the technologies for automated fact checking already exist in some form. Claim Buster [Claimb] is an Australian project [Guardi] that uses natural language processing (NLP) techniques to try to identify factual claims within a text. It won't automatically fact check them, but it can assist a journalist by pointing them to the most "checkable" statements.

We also have knowledge bases that provided structured data to query statements against. Wikidata [Wikidat], a Wikimedia Foundation project, provides it free to anyone who wants to use it.

Ambition: The goal is to explore how artificial intelligence technologies, particularly machine learning and natural language processing in a multilingual approach that might be leveraged to combat the fake news problem among all EU countries. We believe that these NLP technologies hold promise for significantly automating parts of the procedure human fact checkers use today to determine if a story is real or a hoax.

Assessing the veracity of a news story is a complex and cumbersome task. Fortunately, the process can be broken down into steps or stages. A helpful first step towards identifying fake news is to understand what other news organizations in all Europe are saying about the topic. This include a deep NLP architecture that can match semantic analysis of different languages. We believe automating this process could serve as a useful building block in an AI-assisted fact-checking pipeline.

Innovation potential: NLP Technologies help in creating a fake news detection system that aims to assist users in detecting and filtering out varieties of potentially deceptive news. The prediction of the chances that a particular news item is intentionally deceptive is based on the analysis of previously seen truthful and deceptive news. A scarcity of deceptive news, available as corpora for predictive modeling, is a major obstacle in this field of natural language processing (NLP) and deception detection.

2.4) Image analysis based algorithms

State-of the-art: Image analysis, in this context, refers mainly to techniques for image forgery and semantic analysis. While the former is an important task to detect if an image was artificially manipulated, the latter will help to correlate the content of an image to its context.

Many methods have been developed for image forgery thus far. The most usual attack been the move-copy one [Fridr03] where the attacker adds or subtracts from the image an object of interest. In order to detect such attacks, algorithms have been developed [Zhili17, Amerin11, Jian15, Cozz] in order to detect the slight changes that such operations will produce on an image. On the other hand, semantic analysis is trying to develop algorithms able to extract high level semantic information of an image such as identify the person within an image. It is important to verify which person or people are in an image in order to correlate with the given context. To do so, techniques such as face verification will be used. Face

verification is a technique trying to identify a person from its facial characteristics so as to map a facial image to a specific person. Thus far a multitude of algorithms and tools have been developed to cope with this problem [Yan14, Yi14, Junl14, Dong17, Gaur17] with a wide range of different methods trying to cope mainly with the vast variations that a person's face may have under different illumination conditions and poses.

Ambition: The future ambition is to go beyond the state of the art, in both domains, by developing tools able to tackle the above mentioned problems. For move-copy detection, novel deep learning algorithms need to be developed to enable to detect such attacks even from sophisticated image processing tools. The idea is to train a convolutional neural network (CNN) in order to detect differentiations on the edges of objects of interest within the same image. By correlating the edges of different objects on the same image, the artificially created ones will be detected. On the other hand, regarding face verification, new techniques need to be development for face verification "in the wild". To do so, deep learning techniques taking into account the context will be developed in order to achieve better face verification accuracy.

Innovation potential: Novel market for forgery detection in multimedia, fake news based image processing.

2.5) Video analysis based algorithms

State-of the-art: As in image analysis, video analysis in this perspective will be used to: 1) detect forgery in videos and 2) to semantically analyse the video so as to correlate it to its context. Forgery detection in videos is a very old and still active research area. Other than methods already used in the context of image based copy move detection, in videos many methods are using the motion as a feature to detect forgery [Hsu08, Subram12, jing09, Su09]. In these methods, the idea is to detect ghosts of the missing information (in the case of subtractions) and therefore to decide if a video has been forged. Another category of algorithms for forgery detection in videos is to model the noise and therefore detect key frames where the noise is altered which are a result of forgery [Ravi14, Waha14]. Such methods have been proven to work better in cases of CCTV cameras, but they lack to do so in common videos where the context is much more complicated (such as news videos). Finally, video semantic analysis, refers to techniques able to extract high level semantic entities from a video. Also known as video summarization [Lee12, Mund06], these techniques can provide high level semantic labelling of the videos that can therefore be used to correlate a video with its context. Moreover, the use of metadata in video summarization has been investigated with great success mainly in web videos where there is an abundance of metadata due to people interactions [Wang12].

Ambition: The main idea in forgery detection is the development of a recurrent neural network (RNN) able to correlate features in the temporal dimension so as to detect forged videos. By doing so, we passively integrate both image based technique and video ones. On the other hand, regarding video summarization, a CNN will be developed that will extract high level semantics from videos within context. To do so, we will train the network in a context dependent manner through transfer learning techniques that will enhance summarization capabilities.

Innovation potential: Novel market for forgery detection in multimedia, fake news based video processing.

2.6) Provenance and trust analysis for news propagation identification

State-of the-art: Collaborative or item based techniques to profile users, which can help to identify fake news generators are based analysis analyze a set of documents and/or descriptions of items previously rated by a user, and construct a model or profile of user interests based on the features of the objects rated by that user [Rubi15b]-[Ciam15]. The profile is a structured representation of user interests, adopted to recommend new interesting items. The recommendation process basically consists in matching up the attributes of the user profile against the attributes of a content object. The result is a relevance scale that represents the user's level of interest in that object/item/topic. If a profile accurately reflects user preferences, the effectiveness of an information access process is very high. As an example, it could be used to filter search results by deciding whether a user is interested in a specific WebSite or not and, in the negative case, preventing it from being displayed. These systems mainly comprise three steps: (a) A Content Analyzer– this component is in charge of extracting the main features of the sources ingested and represent the content of items (e.g. documents, Web pages, news, product descriptions, etc.) coming from information sources (e.g non-structured text. This representation is the input to the other system components. (b) A Profile learner– This module collects data representative of the user preferences and tries to generalize it to construct the user profile. Usually, the generalization strategy is realized through machine learning techniques and most recently through Deep Learning. (c) A Filtering component – This module exploits the user profile to suggest relevant items by matching the profile representation against that of items to be recommended.

Ambition: Both mentioned techniques (Content-Based and Collaborative Filtering) will be combined in order to overcome the possible drawbacks of each. Common problems associated to filtering systems such as the cold-start and limited coverage problems will be addressed by the development of hybrid approaches.

Innovation potential: The ambition is to develop Model-based Collaborative filtering algorithms. There are novel approaches relying on techniques such as Alternating Least Squares (ALS) and Matrix Factorization [Chen17]. Within the project, ALS technique will be incorporated due to its advantages in terms of parallelization and its effectiveness when dealing with non-sparse matrices.

3) Regulation / self-regulation

In order to cope with disinformation in the social media, there are many voices advocating for regulation of the social media to combat the fake news. However, there are also many others strong factors in discussion which are not in favor of this solution, calling rather for kind of light or self-regulation in the social media, as is also discussed in the high level expert group on fake news, established by European Commission [EC18].

One of the main postulates to be kept while discussion regulation in the social media is the freedom of speech as well as a minimum as possible interference in the regulation process from states, EC, and other public authorities [UN11]. Furthermore, the "hate speech", as one of the main problems in disinformation process within the social media discussions, is an fully emotive concept without an universal definition of it. Thus, it is complex to explicitly decide what is the hate speech or any other unlawful or false information with a potentially high negative impact [Art18].

Further specifics of the social media and spread of the false information are well-known issues on filter/bubbles or echo chambers, which do not necessarily intentionally support the fake news, but support it through limiting the social media users to gather complete information and in some cases even leading them to sources of the disinformation. Also, the news contributors in the social media are not professional journalist, which directly support creation of the false information along the business models related issues discussed above.

Form all these reasons, a kind of **self-regulation instead of strong (state) regulation in social media is considered as the most appropriate solution**. Primary target of the social media regulation should remain as set of measures ensuring right to seek, receive, and influence the (right) information by the consumers / social media networks participants.

Self-regulation can be defined as a combination of standards setting out the appropriate codes of behavior in the social media [UN11]. The self-regulation should entirely rely on voluntarily compliance with defined principles. A good example of self-regulation in media is mechanism of so-called press councils, which used to be established by printed media, providing corresponding codes of conduct (rules of behavior) applying for publishers, journalist, and wide public.

Self-regulation bodies to be established to implement the adopted self-regulation rules have to gain public trust and support along the following principles:

- Be independent from governmental and commercial organizations as well as any further groups of particular interests
- Be democratic, transparent, inclusive, ensuring a broad representation of relevant stakeholders in the self-regulation bodies and decision-making processes
- To define clear rules and mechanisms of all activities including the decision making
- To work fully in public interest and be accountable
- Limited degree of state / EC / public authorities support is possible; e.g. on legal definition of the established self-regulation mechanisms.

The most challenging issue is creation of an independent and efficient self-regulation mechanism and its bodies for the social media at international level, including its funding, which should be mainly, but not exclusively provided by the social media platforms.

As mentioned above, the role of the states and EC should be limited focusing on the following issues:

- Ensuring that an editor (also) in the social media is responsible for the published content
- To reaffirm and further develop principles of limited liability for hosting third party content
- To refrain from legislation on content regulation

4) Social IoT

IoT could be defined as a group of smart devices (cars, fitness trackers, TVs, etc.) fitted with sensors, software and that are able to connect to the network, store and exchange the data. In the next future, there will be more connected things than humans and these things will have to communicate together in order to synchronize themselves or to solve a problem. IoT scenarios will be replicated in many use cases requiring such IoT networking: health, logistics, energy, smart city, Industry 4.0, etc. (Figure 6).

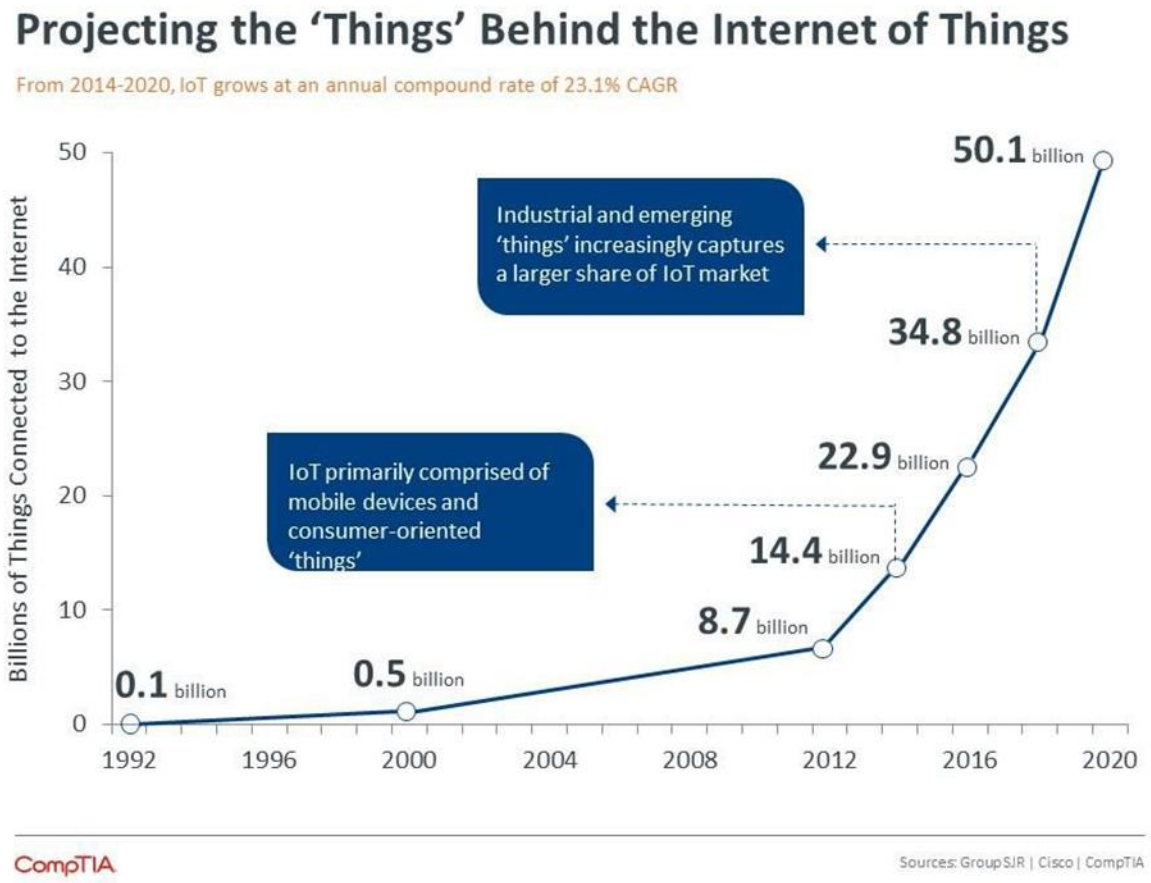

Figure 6: IoT evolution

The Internet of Things (IoT) integrates a large number of technologies enabling a variety of things or objects around us to interact with each other and cooperate with their neighbors to reach common goals. The convergence of the Internet of Things and the Social Networks worlds is gaining momentum. This is due to the growing awareness that a Social Internet of Things (Social IoT) paradigm could bring many (desirable or not) implications into a future world populated by intelligent objects impacting the everyday life of human beings. Social IoT include not only thing-to-thing or human-to-thing interactions, but also new roles that the IoT augmented everyday objects will play, such as mediating the human-to-human communication and/or supporting additional activities in everyday life.

Robots should also be considering as “special” IoT and the conjunction of IoT technologies and Artificial Intelligence (AI) will contribute to the creation of such Social IoT world where IoT will communicate together in order to address a specific task and will only come back to humans to report about the task achievement.

The evolution of the Internet of Things (IoT) is transforming our lives into a **Cyber-Physical-Social Hyperspace** and changing what it means to be social, thanks to smartphones, tablets, and all types of wearable devices, which are connecting people and things both directly and indirectly through various applications and platforms.

In the future many applications and services will require associated groups of things interacting among them, based on technologies such as swarm intelligence and swarm robotics. The establishment and management of relationships among things can occur with different levels of human intervention. In one case human is responsible only to set the rules of the things social interactions and then enjoy the services resulting from such interactions and groupings, while in the other case things just participate in the human social network built by their owners.

The physical things belonging to our everyday reality are at the same time witnesses and protagonists of the (hi)story of our places (territories, home and work environments,..) and of our social life and communities. If only they could tell stories about what happened to them and around them, the possibility of interacting with things in the person’s environment could provide people with a significantly enhanced experiences and services. We can identify different levels of “social” involvement of such intelligent and social things:

- Things posting information (about the state of environment,…) in the social networks of humans;
- Things interacting with humans and other things at the application layer in social networks;
- Things interacting socially with each other to build a dedicated communication network

In one kind of Social IoT space, where social network is a social network of humans and it is utilized by things as an infrastructure for service advertisement, discovery, and access, an individual can share the services offered by her/his smart objects with either her/his friends or their things. This kind of Social IoT is different from the vision in which the objects should interact spontaneously to offer value-added services to humans.

4.1) New social IoT models and technologies

In analogy with the social networks of human beings there is a need to study and define a notion of social relationship among things, making them intelligent and social. Empowering physical objects to share pictures, comments, and sensor data via social networks is just the one of the “easiest” way to integrate IoT and Social Networks.

One possible definition is that things come in social relationship, because and when their owners come in touch with each other during their lives (e.g., devices and sensors belonging to friends, classmates, travel companions, colleagues).

Several different technologies need to be extended and further researched towards the vision on intelligent and social things:

- **Intelligence and social abilities of the things** that allow them to interact with people and among themselves are based on reasoning and learning from the following kind of information:
  - Semantic information such as common-sense and general knowledge about things domain and environment (e.g. an ontology);
  - User behavior data during interaction;
  - Content associated with the things (e.g. photos or videos posted on/from the things).
- **People and things are both social entities**, able to manage and share knowledge and to establish relations with other things and people - social network thus maintains three types of dynamic relations: user-to-user (e.g. friendship, similarity, etc.), user-to-thing (e.g. ownership, potential interest, etc.), thing-to-thing (e.g. similarity, proximity, task, etc.).
- **Bidirectional interactions**: person and the intelligent thing may start a conversation
- **Natural interactions**: gently and playfully led by interest, curiosity and fun while fully exploiting intelligent and social things.
- **Content adaptation, personalization and aggregation**: the capability to filter, synthesize and mashup content in a meaningful way, ranging from the intelligent search, discovery and recommendations to the digital storytelling, which involve intelligent and social things.

4.2) New main Challenges related to Social IoT

The growing diffusion of connected objects will lead to more and more data being available and also sharable in social platforms. Therefore it is becoming even more important the protection of individual privacy and personal data above all in relation to sensitive data or related to minor.

Some of challenges related to Social IoT include:

- **User lack of control and information asymmetry**: users might find themselves under third-party monitoring and in situations of lack of control of the dissemination of their sensitive personal data such as hearth data collected and managed from Quantified Self related devices and applications;
- **Profiling**: analytics based on information collected in an IoT environment might enable the detection of the behavioral patterns of an individual with the consequence of possible impacts on the way the individuals behave, e.g. personal habits and lifestyles possibly detected in smart homes;

- **Repurposing of original processing:** data collected for a particular purpose may be requested by other parties for different purposes not respecting the original consent given by the user. Therefore it is important that, at each level (whether raw, extracted or displayed data), IoT stakeholders make sure that the data is used for purposes that are all compatible with the original consent given by the user (data subject). For example data collected by the accelerometer of the smartphone can be used to infer driving habits;
- **Quality of data subject's consent**: in some IoT scenarios, the user (data subject) may not be aware of the data processing carried out by specific objects, e.g. a smart watch may not be distinguishable from a normal swatch, so the owner could be unaware of the collection of her personal data and the possibility to have a growing insights combining different data. Classical mechanism to obtain individuals' consent may be difficult to apply in IoT scenarios, resulting in a low-quality consent. New ways of obtaining the user's valid consent should be considered, including implementing consent mechanisms through the devices themselves.
- **Security risks**: IoT may turn an everyday object (e.g., video cameras connected to the internet) into potential privacy and information security target. Security of the IoT should consider also the communication links, storage infrastructure and other inputs of the ecosystem. The integration of physical and logical components provided by a set of different stakeholders only guarantees the level of security provided by the weakest component.

4.3) Summary on Social IoT

Internet of Things (IoT) is already a reality, but it is merely at the beginning of a social, economic and cultural transformation. Basically, IoT could revolutionize our conception of the world and how we interact with it.

These advances will enable us to develop our capabilities further but posting new challenges to our society and how we relate to each other. New gadgets, devices, apps are continuously coming to the market that make our life, work and daily tasks easier. We already have smart homes managed by devices with artificial intelligence. This will also produce new ways of expressing our creativity extended to culture, leisure and art.

Social IoT will generate synergies between devices and people thanks to the information they exchange. All this devices generating and exchanging information will affect how we work and communicate with friends and relatives and how we spend our leisure time. The evolution of the Social IoT is about transforming our lives and spaces into a **Cyber-Physical-Social Hyperspace based on the continuous flow of enormous quantity of personal and sensitive data.**

5) Business models in social media

The concept of modern Internet based economy is relying on the fact that the online available information is abundant and its consumption is largely free of charge [Per16]. Furthermore, the most business models applied by the social media platforms today are based on end user attention; the more people are the platforms members or consuming information provided in the social media, the more advertising can be sold by the related social media stakeholders, where the advertising is in most of the cases the only revenue stream for the social media platforms.

On the other hand, the social media platforms allow practically to everyone to publish and share any kind of information world-wide and within minutes. Thus, if larger attention is needed, the information posted has to be very important, as dramatic as possible, very catchy for the end users independently on the content behind, must be tailored to wake-up attention, etc. With it, the Internet ecosystem and the social media are unintentionally offering opportunities for disinformation to easily spread and for the so-called fake news factories to gain from the attention based business models. These facts are affecting even so-called professional / good media and corresponding quality journalism behind these stakeholders is getting in danger as well.

Therefore, there is a need for alternative business models for social media, which might also be imposed by corresponding regulation measures. The challenge is to ensure competitiveness of the proper social media platforms, as news providers, versus so-called fake news/website factories. However, there is no recipe, or at least no easy one, to rapidly change business models in the social media and finally combat the fake news because revenues for the social media platforms, based on the today's models, are enormous.

To elaborate on possible directions while thinking about new and appropriate social media business model(s), the related evolution in news publisher models and aspects of data and algorithm-based economy are discussed below.

5.1) Evolution of news publisher models

The traditional news publisher business models have been started to be affected by new media since start of public Internet services around the year 1995. During the first 10 years of Internet (until 2005), the traditional news publisher did not pay particular attention to the new media and were focusing on optimization of the existing revenue streams at this time instead of elaboration on opportunities of the future revenue and business models. There were two reasons for acting in this direction; the financial situation of the news publisher at this time was still in a good shape and some of the publishers still enjoyed a kind of preferable or even monopoly positions in their areas of involvement – no motivation to change.

Gathering revenues from advertising is/was not a new filed for the traditional news publishers, which contributes significantly to the publishers' income together with the subscriptions, sails, etc. However, the nature of advertising in Internet and social media is of course different from classical newspapers and journals. Accordingly, the news publishers take the action and include advertising within their online

portals, which are nowadays maintained by near to all nest publishers. However, in the modern social media it is necessary to follow the latest trends and ways of advertising, such us so-called native advertisement, which is however not typical for standard websites but is well advanced across the social media platforms.

Beside the advertisement, further organizational and marketing measures could / should be taken by the news publishers, in order to come with challenges of the modern media and increasing impact of the social media networks [Panda17]:

- Separation of journalism and business (journalists and editors on one side and business and marketing staff on another) was widely adopted by the traditional news publishers, whereas modern and social media require tighter cooperation among these two pillars of the publisher
- In the past, journalists and editors rarely interacted with the readers, but in the social media, the journalists must be able and ready to further explain their positions articles through direct and timely discussions with the readers through various social media channels; blogs, posts, etc.
- In the today's Internet / social media there are too many rivals offering in principle the main products to the world-wide community. Therefore, an important challenge for the news publisher is how to become unique and provide special and good quality, in terms of the modern social media. An option along these lines is also to package other related offers along the news content and attract further customers

To get on speed with the newest media developments, the news publisher should directly use the social media platforms and all their features for distribution of their content. It does not necessarily mean they have to establish own social media platforms. Linking, cooperating with existing and new social media platforms, including cross-platform news distribution, is a must together with investigations, including needed research and innovation activities, on possible business and cooperation models of the future, which will better suit the user needs and be robust against disinformation in the modern digital society.

5.2) Data-based and algorithm-based economy

Value chains are being redefined in the new data-based and algorithm-based economy, value webs rather than value chains is becoming normal, and new types of partnerships in digital ecosystems will become drivers of value creation. In the simplest terms, we can state that digital ecosystem is an interconnected network of living and nonliving entities governed by rules or principles or algorithms.

The media sector current business models are being reshaped by challenging technology and market trends, and has already experienced digital transformation being a great example of new digital ecosystems in data-based and algorithm-based economy. Even healthcare might be an digital ecosystem made up of human actors like patients, doctors, nurses, etc., and nonliving things like medical

equipment, ambulances, hospitals and governed by rules or principles codified in legislation and leading practices but also it could be (partially) governed by algorithms applied on huge amount of data (medical, operational, content,..).

We live in a world where everything is or will be connected, software becomes embedded in almost everything and data is created almost everywhere becoming an essential input fueling algorithm-based economy. The tools that create, ingest, transmit, manage, store and secure data create a new set of ecosystem considerations and new types of partnerships. Ecosystems are not new in business, but they are different in the data-based and algorithm-based economy. Moreover, given the volume of data being created now, machine learning and artificial intelligence (AI) - based on algorithms that will become ever smarter and more sophisticated - are essential and critical to unlocking value out of such huge amount of data.

Converting massive amounts of data into actionable insights means that algorithms become a new competitive advantage and will prove to be central to the next wave of economic growth.

Given the opportunities and the complexities associated with, data, AI, and Cyber Security, a new digital ecosystem is required to survive and thrive in the algorithm-based economy. These shifts in technology are contributing to, if not driving, the digital transformation of companies, communities, and the economies of entire countries.

The data is already the basic element of many business models: for Google in the ranking algorithms, for Amazon in the recommendations algorithms, for Facebook in the news feeds. Thanks to the huge amounts of data accumulated on their platforms, the algorithms are able “to see” the correlations and provide meaningful results. But the data and the algorithms, for the apocalyptic, influence or even plan and program our choices, our consumer habits and even our cultural and political views. Data are sold and bought as a commodity, often without the consent of the person concerned. The platforms will continue to move the boundaries with ever more invasive techniques to get the full picture of users.

The threats to privacy and to the competitive market are now the same thing. On the Privacy side, the EU’s GDPR could become the reference standard. On the competitive market side, applying historical antitrust interventions could be practically difficult also due to the question of identifying the reference market, having competitors based in America or China. Some propose to block further vertical integrations of platforms. There is the possibility to consider their platforms as an essential facility and then to apply regulations to Google, Facebook and Amazon as if they were utilities.

We need a program that succeeds in limiting these concentrations without compromising the technological innovation and development, from which our future depends, fostering creation of infrastructures facilitating the circulation of data along the value chains and value webs.

6) Collaborative workflows

Achieving collaborative workflows requires embedding collaborative technologies deep into processes and incentivizing collaborative behaviors transforming the way organizations turn knowledge into action. Through the use of collaboration technologies companies can achieve impressive results that improve the efficiency in which work is done, while by the advent of social media this goal is accompanied by unprecedented means of sharing, externalizing and retaining knowledge as well as sharing the information anywhere (Figure 7). Innovative business collaboration techniques can improve company's productivity by 20 to 30% [HKA].

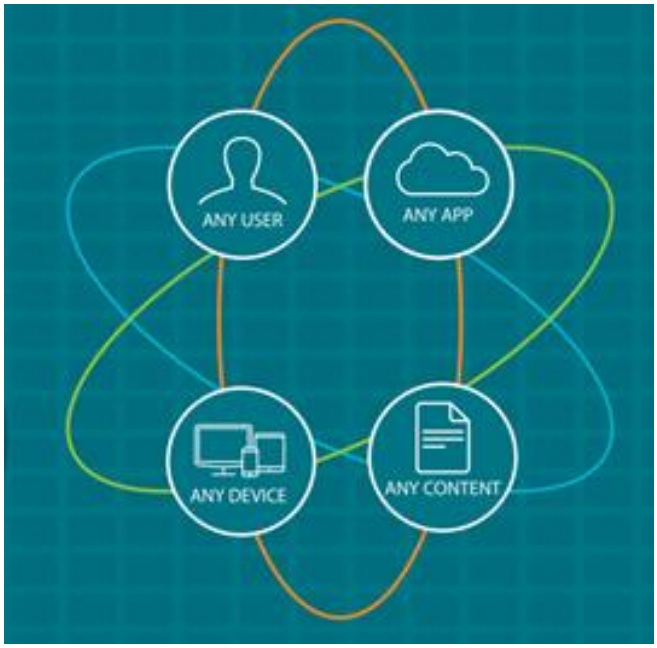

Figure 7: Access anywhere concept

Social media enables a new model of managing knowledge that involves formal and informal communication, collaboration using a variety of applications. Full potential of collaborative workflows will be achieved through mechanisms for sharing and collaboration, empowering users to spread their sources and to benefit from those of others. Social Media, by means of enhanced Platforms (SMeP) for the management of knowledge work (communication and collaboration), provides mechanisms to support the sharing of workflows within and across multiple communities. These platforms incorporate social media and networking functionalities for empowering cooperative efforts at both personal and organizational level. Thus, information and communication tools used traditionally in organizations to support collaborative work processes have started to be increasingly replaced by social media-enhanced platforms. These platforms can speed up knowledge conversion, improve team performance and can take collaboration and communication to a higher level within most companies. They can also provide an answer to global work trends as globalization, super mobility, cloud-based infrastructures, big data and

analytics, intelligent devices and distributed computing resources and the proliferation of context rich systems.

By adding social networking and crowdsourcing to companies' workflow through social media collaborative tools to boost collaborative behaviors, a new potential to improve organizational agility, increasing productivity, supporting decision making and sparking idea generation is quite easily added to the company work power. Social media-enhanced platforms are designed to provide conditions in which knowledge is shared and new know-ledge is created or exchanged through collaborative processes using social network, as innovation and knowledge creation are two strong interrelated concepts. [Liana]

The complete revolution brought by new work environments, the increasing importance of a deep analysis of the related human factors and this progressive socialization of workflows lead to a more complex learning of the methodologies to define the most efficient procedures and to achieve the best results. Visual tools to provide in advance information on the consequences of potential decisions and to support real-time decision-making are critical a need to be deployed besides the internal knowledge management solutions in the challenge of adapting to new ways of working inherently distributed and collaborative, including more and more frequently, both humans and computational systems in the mix. Thus, social media becomes a key element to develop new patterns of use, new possibilities for shaping new work practices and to integrate a more flexible, scalable and powerful knowledge management within the companies' workflows for the sake of achieving a new level in competitiveness.

Collaborative workflows are a key piece in the ongoing digital transformation reaching almost any corner of industry. They belong to the core challenge any business must rise to in order to reclaim their position in our increasingly mobile, digital, and competitive world. It's all about content, if you take into account the big data powered insights / analytics, information from ubiquitous sensors and devices of the internet of things, it creates a new world of content; and content is so important to our understanding, anything we can't express as content is something we can't share. It is the very core of business knowledge and business information. [BAR]

Social media platforms own the power to convert the connections into productivity. The answer is one of convergence, for now. Over the past few years, communication and collaboration tools have become sophisticated, easy to deploy and readily available. However, these tools still create disparate overall experiences. Social media can unify the framework and homogenize the experience, and are versatile enough to quickly evolve integrating new media contents even immersive and interactive.

Thus, It is necessary to work further in the integration of new kind of contents, and for sure, media content will arise again as the most disrupting way of creating, sharing and understanding about data and information, leading to richer and powerful capabilities and features in content management and transforming the way industrial processes are done. Moreover, that's a big opportunity to make a big impact on the way we leverage value creation.

References

[Art18] “Self-regulation and ‘hate speech’ on social media platforms”, ARTICLE19 report 2018

[BAR] Barroca, E. “The age of deep content”, posted on www.nuxeo.com/blog/welcome-age-deep-content/.

[Chen17] Jing Chen et al.” Efficient and Portable ALS Matrix Factorization for Recommender Systems”, Parallel and Distributed Processing Symposium Workshops (IPDPSW), 2017 IEEE International (2017)

[Ciam15] Ciampaglia, G., Shiralkar, P., Rocha, L., Bollen, J. Menczer, F., & Flammini, A. (2015). Computational fact checking from knowledge networks.

[Claimb] Online resource http://idir-server2.uta.edu/claimbuster/

[EC18] High Level Group on fake news, “A multi-dimensional approach tp disinformation”, European Commission 2018

[FBAIR] Online resource: https://www.facebook.com/FBAIResearch/posts/362517620591864

[Fridr03] Fridrich, A. Jessica, B. David Soukal, and A. Jan Lukáš. "Detection of copy-move forgery in digital images." in Proceedings of Digital Forensic Research Workshop. 2003.

[Guardi] Online resource https://www.theguardian.com/commentisfree/2016/apr/19/is-that-a-fact-checking-politicians-statements-just-got-a-whole-lot-easier

[HKA] Hamilton, M., Kass, A., Alter, A.E., “How collaboration technologies can boost business performance”. Accenture’s journal of high-performance business. Available at: https://www.accenture.com/us-en/insight-outlook-how-collaboration-technologies-are-improving-process-workforce-business

[Hsu08] Hsu, Chih-Chung, et al. "Video forgery detection using correlation of noise residue." Multimedia Signal Processing, 2008 IEEE 10th Workshop on. IEEE, 2008.

[Jian15] Li, Jian, et al. "Segmentation-based image copy-move forgery detection scheme." IEEE Transactions on Information Forensics and Security 10.3 (2015): 507-518.

[jing09] Zhang, Jing, Yuting Su, and Mingyu Zhang. "Exposing digital video forgery by ghost shadow artifact." Proceedings of the First ACM workshop on Multimedia in forensics. ACM, 2009.

[Junl14] Hu, Junlin, Jiwen Lu, and Yap-Peng Tan. "Discriminative deep metric learning for face verification in the wild." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2014.

[Lee12] Lee, Yong Jae, Joydeep Ghosh, and Kristen Grauman. "Discovering important people and objects for egocentric video summarization." Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on. IEEE, 2012.

[Liana] Liana Razmerita, “Collaboration Using Social Media: The Case of Podio in a Voluntary Organization”. 1-9. 10.1007/978-3-642-41347-6_1 (2013).

[Panda17] Panda R., Metha B., Karani A., « Business ,odels on social media », International Journal of Marketing & Financial Management, Volume 5, Issue 2, Feb. 2017, pp 34-42, ISSN: 2348-3954

[Per16] Perell, David, “Models of Internet Monetization”, Elon Journal of Undergraduate Research in Communications, Vol. 7, No. 1, Spring 2016

[Ravi14] Ravi, Hareesh, et al. "Compression noise based video forgery detection." Image Processing (ICIP), 2014 IEEE International Conference on. IEEE, 2014.

[Rubi14] Rubin, V. & Lukoianova, T. (2014). Truth and deception at the rhetorical structure level. Journal of the American Society for Information Science and Technology, 66(5).

[Rubi15a] Rubin, V., Conroy, N. & Chen, Y. (2015)A. Towards News Verification: Deception Detection Methods for News Discourse. Hawaii International Conference on System Sciences.

[Rubi15b] Rubin, V. L. Chen, Y.,& Conroy, N. J. (2015)B. Deception Detection for News: Three Types of Fakes. In The Proceedings of the Association for Information Science and Technology Annual Meeting (ASIST2015), Nov. 6-10, St. Louis

[Saez14] Diego Saez-Trumper. 2014. Fake tweet buster: a webtool to identify users promoting fake news ontwitter. In Proceedings of the 25th ACM conference on Hypertext and social media (HT '14). ACM, New York, NY, USA, 316-317. DOI=http://dx.doi.org/10.1145/2631775.2631786

[Shao16] Chengcheng Shao, Giovanni Luca Ciampaglia, Alessandro Flammini, and Filippo Menczer. 2016. Hoaxy: A Platform for Tracking Online Misinformation. In Proceedings of the 25th International Conference Companion on World Wide Web (WWW '16 Companion). International World Wide Web

[Squad] Online resource https://rajpurkar.github.io/SQuAD-explorer/

[UN11] Puddephatt A., “The importance of self-regulation of tzhe media in nupholding freedom of expression”, UNECSO report 2001

[Wikidat] Online https://www.wikidata.org/wiki/Wikidata:Introduction

[Yan14] Taigman, Yaniv, et al. "Deepface: Closing the gap to human-level performance in face verification." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition.2014.

[Yi14] Sun, Yi, et al. "Deep learning face representation by joint identification-verification." Advances in neural information processing systems. 2014.

[Zhili17] Zhou, Zhili, et al. "Effective and efficient global context verification for image copy detection." IEEE Transactions on Information Forensics and Security12.1 (2017): 48-63.