EU-China 5G – IoT Exciting Opportunities and Challenges

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How the EXCITING project will strengthen EU-China co-operation in IoT and 5G
EXCITING stands for **E**U-**Ch**ina **St**udy on **I**oT and **5**G and addresses the domains of IoT and 5G identified in the topic **ICT-37-2016 CHINA: Collaboration on Future Internet**, while also taking into account the importance of interoperability and standardisation across these domains.

Europe and China are at the forefront of technological advances in areas related to the Future Internet (especially 5G and IoT). While both parties share common technological objectives, there is still room for improvement in what concerns bilateral co-operation. As a result, **the main purpose of EXCITING is to support the creation of favourable conditions for co-operation between**

the European and Chinese research and innovation ecosystems, mainly related to the key strategic domains of IoT and 5G. The goal is to identify relevant and practical opportunities for future co-operation between these parties and make recommendations regarding the respective research and innovation ecosystems.

With respect to IoT, Chinese and European researchers have worked together on IoT in recent years by pioneering Europe-China IoT pilots such as the IPv6-based IoT6 transnational Pilot between MI, BUPT and BII supported by UL and Martel, and tests between Tsinghua university and UPMC. Several partners (HUAWEI, UL, MI) are directly active in the Alliance for Internet of Things Innovation (AIOTI), an industry-oriented initiative, sponsored by the European Commission to foster and promote the formulation of the future IoT research as well as innovation and standardisation policies. It is playing an essential role in the designing of IoT Large Scale Pilots, which will be funded by the Horizon 2020 (H2020) Research and Innovation Programme. The members of AIOTI will jointly work on the creation of a dynamic European IoT ecosystem. This ecosystem is building on the work of the IoT Research Cluster (IERC) and supports the innovation process across industry and business sectors of IoT, by transforming ideas into solutions.

The recent EU-China IoT White Paper on Standardisation calls for bilateral work such as (i) mapping IoT SDOs and Alliances to application areas (vertical and horizontal domains) for Horizontal/Telecom, Home/Building, Manufacturing/industry automation, Vehicles/Transportation, Healthcare, Energy, Cities, Wearables, Agriculture and food chain, (ii) IoT open source development as part of the standardisation landscape for Fields of

▶ Action, IoT Reference Architectures, Interoperability support - technical/semantic, Trust, security, privacy, and (iii) International standardisation policy support.

With respect to 5G, many Chinese universities, institutes and industrial companies have invested significantly on research into the technologies with the support of the Chinese government, which has already resulted in a number of achievements. In July 2015, HUAWEI announced the 1st 5G prototype equipment with a peak data rate of 10Gbps. In December 2015, China Mobile implemented a pre-5G Pilot project based on Massive MIMO (Multiple-Input Multiple-Output) technology with a transfer speed of more than 400Mbps in Zhejiang.

In Europe, the 5G PPP (Public-Private Partnership), has been launched as a joint initiative between the European Commission and the European ICT industry. The Commission is planning to invest €700 million and the industry will leverage this investment by a factor of 5, bringing the total investment into the 5G PPP to more than €4 billion, to rethink the infrastructure and to create the next generation of communication networks and services. The 5G PPP is aiming at securing Europe's leadership in the areas where Europe is strong or where there is potential for creating new markets such as smart cities, e-health, intelligent transport, education or entertainment & media. The 5G PPP initiative will reinforce the European industry to successfully compete on global markets and open new innovation opportunities[1].

The 5G PPP is planned to be organised in three or four phases, encompassing research (current stage), optimisation (2016-2017) and large scale trials (2019-2020). It aims to deploy 5G as from 2020, which will require before 2020 to develop a series of ground-breaking technologies, global standards and to agree on relevant spectrum bands.

The first call for projects has resulted in 18 Research and Innovation projects being selected, addressing a rich cross section of the research challenges leading to a 5G infrastructure by 2020. These projects started on 1st July 2015.

In September 2015, China signed an Agreement[2] with the EU on 5G to seek more co-operation on joint research, standardisation, spectrum, and the Internet of Things. The objective of this Agreement is to ensure China and Europe maintain an equivalent level of industrial transparency between the two parties. Under the declaration, China and Europe aimed to reach a consensus on the concept, basic functionalities, key technologies, and timeline for 5G by the end of 2015, or roughly five years ahead of the expected launch of commercial 5G networks. In addition, a multilateral MoU has been signed between the 5G Infrastructure Association (5GIA), IMT2020 from China, and other associations from Asia and North America, in order to organise global 5G events in a coordinated manner, on a rotating basis per continent. The first global event is planned in China in Q1 2016, and the second one will be held in Europe and organised by the 5GIA in Q4 2016 (probably in November)[3]. Some 5G PPP projects have also initiated specific technical interactions with China[4].

1.2 Objectives
As mentioned above, the overall objective of EXCITING is to support the creation of favourable conditions for co-operation between the European and Chinese research and innovation ecosystems, mainly related to strategic domains linked to the Future Internet (e.g. IoT and 5G), aiming to identify relevant and practical opportunities for future co-operation between these parties. The specific objectives of this project are:

Obj. 1: To investigate and document the **research and innovation policies[5] and ecosystems in China** and compare these with the European ones.
This objective will be met through a report on the research and innovation policies and ecosystem in China and a comparison with the European one. The report includes sources of funding, reciprocal openness and the mechanisms for participating.
Obj. 2: To investigate which **international standardisation bodies** are responsible and appropriate for the key strategic domains of IoT and 5G, given that these are areas where global approaches are needed.
This objective will be met through a report containing the international standardisation bodies and Study Groups for the key strategic domains of IoT and 5G, but also including relevant associations and fora.
Obj. 3: To investigate how **global interoperability testing** (with the focus on EU and China) is being used to validate research and innovation in the key strategic domains of IoT and 5G, to ensure prototypes can be turned into mature results/standards and successful deployments.
This objective will be met through a report identifying the appropriate interoperability testing events for IoT and 5G, together with information on how to participate.
Obj. 4: To investigate **practical opportunities for future co-operation on Large Scale Pilots for IoT and 5G** on a reciprocal basis.
This objective will be net through at least 5 opportunities being identified for future co-operations.
Obj. 5: To produce, based on the knowledge collected and results obtained during the project, **a roadmap showing how research and innovation ecosystems, policy, standardisation, interoperability testing and practical Large Scale Pilots should be addressed during the H2020 timeframe, and making recommendations for optimising collaboration between Europe and China for IoT and 5G**.
This objective will be met through a roadmap report (including recommendations) will be produced, addressing research and innovation policies and ecosystems, standardisation, interoperability testing and practical Large Scale Pilots evolution during the H2020 timeframe, to optimise collaboration between Europe and China for IoT and 5G.

1.2 Relation to the Work Programme
EXCITING relates to the Work Programme objective **"ICT-37-2016 – CHINA: Collaboration on Future Internet"** under the part of the Work Programme dedicated to "International ▶

► **Cooperation Activities"**. The Programme *encourages "the world's "best minds" to work with Europe's researchers and in European-funded projects and to enable the EU industry to benefit from ICT market developments internationally, especially in the most prominent emerging economies".* Furthermore, it stresses that "longer term partnerships need to be fostered with countries of strategic importance for the EU." Focusing on China and Europe, EXCITING relates and addresses both the challenges and scope of ICT-37 as highlighted in Tables 1-2 and 1-3 in Section 1.3 below.

1.3 Concept and approach, quality of the coordination and support measures
1.3.1 Concept
The concept of the project is to support co-operation opportunities between Europe and China, in particular for IoT and 5G, by studying and comparing the corresponding research and innovation ecosystems, identifying the opportunities and making recommendations for creating the appropriate conditions.

Partners have been selected for their excellent understanding of both the Chinese and European models for research and innovation support, standardisation, large scale pilots and knowledge of market introduction, including interoperability testing.

Collaboration in ICT research and innovation between the EU and China is not new and partners of the EXCITING project have good experience of past EU-China joint-research projects. However, the breadth and depth of the collaboration can be improved considerably, and ICT could find a stronger and more visible place among the key areas for EU-China collaboration.

This will be facilitated through a better understanding of the European and Chinese research and innovation ecosystems.

EUROPE'S R&I ECOSYSTEM
In Europe, research in ICT is performed on the one hand by academics, funded privately by industry, or publicly through regional, national or European Framework Programme (FP) *Research and Innovation Actions* within the European Commission's H2020 Framework Programme. On the other hand, ICT industrial companies, large and small, are investing between 10 and 20% of their turnover into research and development[6]. EU investments in ICT are increasing by about 25% under H2020 compared to FP7. This EU investment is supporting the whole chain from basic research to innovation that can deliver new business breakthroughs, often on the basis of emerging technologies. This investment adds to the funding provided at national level by most of the European countries, either through national programmes or via EUREKA at European level[7].

Europe has world-class researchers, entrepreneurs and companies, and the unique strength of its values, creativity and diversity, but its research and innovation performance needs to be boosted to master the many challenges ahead

and keep its place in a fast-changing world.

The Information and Communication Technologies (ICT) sector represents 4.8% of the European economy. It generates 25% of total business expenditure in Research and Development (R&D), and investments in ICT account for 50% of all European productivity growth. ICT underpins innovation and competitiveness across private and public sectors and enable scientific progress in all disciplines. Thus in H2020, ICT-related topics can be found in all priorities, from 'Excellence Science' to 'Industrial Leadership', to 'Societal Challenges'.[8]

Research and innovation activities on generic ICT technologies, either driven by industrial roadmaps or through a bottom up approach, are addressed in the 'Industrial Leadership' pillar, more specifically in the 'Leadership in enabling and industrial technologies' (LEIT) part of the Work Programme, under the section 'Information and Communication Technologies'. In particular, the topics addressed in the first two years of the Programme cover the ICT technology value chain in a comprehensive way, from key enabling technologies up to content and information management technologies, robotics and networking technologies. Several cross-cutting topics addressing cyber-security, Internet of Things and research on Human-centric Digital Age are included. All activities are complemented with support to innovation and take-up and international cooperation.

CHINA'S R&I ECOSYSTEM
In China, the R&I ecosystem is developing at a fast pace and has become a major new actor in the global economic system for knowledge production. Facing the challenges from some slowdown of economic growth, China is looking to drive the economy by promoting S&T and innovation instead of more investments. Innovation is extremely relevant in the context of China in terms of economic growth, competitiveness, comparative advantage, national security and a higher standard of living. The concept of the key national plan, the **13th Five-Year Plan**[9] (2016-2020), published in October 2015, promoted two important new initiatives: (i) **One Belt One Road** and (ii) **Made in China 2025:**

• **One Belt, One Road**[10] aims to materialise the New Silk Road Economic Belt (SREB) that will connect China's central and western regions to the huge markets of Eurasia and East Africa and also to build a new "21st Century Maritime Silk Road" that will connect China with other countries. The initiative is expected to help China to export its overcapacity production (consumer good, industrial goods and infrastructure construction) and also includes efforts to promote greater financial integration and use of the RMB (Chinese Yuan) by other countries.

• **Made in China 2025**[11] to realise the upgrade of the manufacturing industry and facilitate the country's transition from an exporter of manufactured goods to an exporter of capital and technology. China will implement the "Made in ►

► China 2025" strategy alongside an "Internet Plus" plan, based on innovation, smart technology, the mobile Internet, cloud computing, Big Data and the Internet of Things.

The Plan also emphasises the following sectors as its priorities: Information technology, High-end manufacturing, New-energy vehicles, Railway transport equipment, Biotechnology, Environmental protection and Modern agricultural machinery. Particularly, the guideline promoted further development of the "Network Economy" based on the new "Internet Plus" plan, which focuses on IoT, Big data and the Future Internet.

The research funding system, including all the funding programmes, is going to undergo dramatic changes. The main existing competitive funding mechanisms in China will be transformed, including the "973 National Basic Research Program" and the "863 National High-Tech Program", which have provided significant support for strategic basic science projects and technology development since 1997 and 1986, respectively. Competitive S&T related programs will be integrated into five categories: (1) National Natural Science Fund, (2) National S&T Major Project, (3) National Key R&D Program, (4) Technology Innovation Guide Fund, and (5) Infrastructure and Talent Program.

Regarding EU-China co-operation, the Chinese Ministry of Science and Technology (MoST) has co-operated with the European Commission Directorate General for Research and Innovation to establish a co-funding mechanism for funding resources. On December 14th 2015, MoST published a call for proposals for EU-China co-operation within H2020 with a total budget of 200 million RMB (28.57 million

Euros) in 2016 from the Chinese side to support projects in agro-food, bio-tech, ICT, aero-space technology, energy, health, transportation, water resource, energy-saving & low carbon, advanced manufacturing, new material, sustainable urbanisation and exchange programme for young scientists.

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2 http://europa.eu/rapid/press-release_IP-15-5715_en.htm
3 https://5g-ppp.eu/leading-5g-visionary-organizations-in-europe-usa-japan-south-korea-and-china-sign-multi-lateral-memorandum-of-understanding-for-global-5g-events/
4 https://5g-ppp.eu/the-first-sino-europe-5g-technical-workshop-co-organized-by-5g-norma-and-metis-ii-took-place-on-november-5th-2015/
5 Including the legal aspects of participation in reciprocal programmes
6 This R&I investment is lower for telecommunications operators.
7 http://www.eurekanetwork.org/. About 65% of the investment into EUREKA from Member States is for ICT.
8 https://ec.europa.eu/programmes/horizon2020/en/area/ict-research-innovation
9 China's Five-Year Plan (2016-2020): http://english.gov.cn/news/top_news/2015/11/04/content_281475227485632.htm
10 One Belt, One Road: http://csis.org/publication/building-chinas-one-belt-one-road
11 Made in China 2025: http://csis.org/publication/made-china-2025