

Report on the R&D and the experimentation over the testbeds
related to the New Generation Network in Europe

(Summary)

NICT Europe Center
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GENERAL SUMMARY

The first part : the trend of the European Commission's R&D policy on New generation network, Future network and test-bed

The European Commission's activities on the R&D of Future network and test-bed for research and experiment

- 5G's R&D policy is the most remarkable policy of the European commission.
- On the 17 of December 2013, the Vice-President of the European Commission (and the European Commissioner for Digital Agenda), Neelie Kroes, signed an agreement with 5G Infrastructure Public-Private Partnership (5G-PPP) which is one of the PPPs between the EU and European public or private companies. Thus, the EU will contribute about 700 millions euro for 5G R&D by Horizon 2020. This is a big European grant 7 years programme for R&D. 5G-PPP aims to reinforce the EU's competitiveness in communication network sector and to stabilize employment in Europe. According to the European Commission, industry is its important driving force.
- In addition, the European Commission is very active for 5G R&D cooperation with non-European countries. On the 16th of June in 2014, Neelie Kroes and Mun-Kee CHOI, South Korean Minister of Science, ICT and Future Planning, agreed to work towards a global definition for 5G and to cooperate for 5G R&D. The following day, 5G infrastructure Association (5G-PPP private side organization) and 5G forum (South Korean 5G private organization) signed a MoU for 5G vision, requirements, system concept, frequency and global standards preparation.
- A part from 5G, the European Commission has reinforced its cooperation with non-European countries for the R&D and the federation of test-bed indispensable to do research on Future network : FP7 "SmartFIRE" project with South Korea, FP7 "FIBRE" project with Brazil (in joint call EU and Brazil) and "EU-China FIRE" project with China. In the latter project, the EU has contributed to most part of grant, thus this project can be considered as an approach from the EU to China for future cooperation.

Network technologies and test-beds in the Seventh framework programme (FP7) and Horizon 2020

- Around 152 projects have been launched under "Future Network", Objective 1.1, in FP7 for 7 years (2007 – 2013). They are supported to the amount of around 650 millions euro. For test-bed, 61 projects have been launched for 7 years under the "FIRE", Objective 1.6 or 1.7.
- In ICT working programme for 2014 – 2015 of Horizon 2020, ICT-5 "Smart Networks and novel Internet Architectures", ICT-6 "Smart optical and wireless network technologies" and ICT-14 "Advanced 5G Network Infrastructure for the Future Internet" have been set up for network technologies. European strong interest for 5G is evident because of the amount for ICT-14!
 - ICT-5 : 24 millions euro (budget) : the R&D of ICN (Information Centric Networks), NDN (Named Data Networking), PSN (Publish Subscribe information Networking), DTN (Disruption Tolerant Networking), beyond IP technologies etc.).
 - ICT-6 : 30 millions euro (budget) : optical network, femtocell, cognitive radio, usage of higher bands up to 90 GHz, hybrid combination of terrestrial and satellite infrastructures
 - ICT-14 : 125 millions euro (budget) : 5G R&D and test-bed for 5G
- ICN, which is one of the key new generation network technologies developed in NICT, will be supported in ICT-5. Test-bed for 5G technologies will be also supported in ICT-14.

- ICT-11 “FIRE+” has been set up for test-bed.
 - ICT-11 : 31,5 millions euro (budget) : for creation, reconfiguration and/or extension of experimental infrastructures in several areas (Mobile and Wireless, Cloud, Spectrum, Photonics, Internet of Things (IoT), Distributed Service Platforms, Sensors), leverage of Europe's Research and Education Network infrastructure (GÉANT) and developing the concepts of Experimentation-as-a-Service (EaaS) and Virtual Experimentation.
- The deadline of most of calls in ICT working programme for 2014 - 2015 is the 23rd of April in 2014, while the deadline of ICT-14 is the 25th of November in 2014.
- According to the European Commission, there were 37 proposals for ICT-5 and 88 proposals for ICT-6. The average amount of the budget for a project was 3 millions euro. There were a number of proposals on ICN, but architectural topic is getting displaced towards SDN/NFV. There were a strong move towards exploitation of millimetric bands, up to 250 GHz, and an emphasis on backhaul-front haul optimisation and integration, 5G “round the corner”.

The second part : Research organization and partnership of New generation network, Future Network and test-bed in Europe

5G-PPP

- 5G-PPP was found in December 2013. Its total budget is about 1,4 billions euro (EU part is 700 millions euro and private part is 700 millions euro). This partnership aims to have European industry driving the development of 5G standards and to develop and exploit at least 20% of the 5G SEP (standards essential patents).
- 5G infrastructure Association, found for 5G-PPP contract with the EU, is composed by European IT vendors (Alcatel-Lucent, Nokia Solutions and Network, Ericsson, Thales, etc), big European telecom operators (Deutsch Telekom, Orange, Telecom Italia, Telefónica, Telenor, etc), and European research organizations (CEA-LETI etc), some European SMEs and some non-European companies (DOCOMO, Samsung, Huawei, Intel and IBM). In fact, many of them have participated in FP7 METIS project too (Alcatel-Lucent, Nokia Solutions and Network, Ericsson, Deutsch Telekom, Orange, Telecom Italia, Telefónica, DOCOMO and HUAWEI). So, the relationship between METIS and 5G-PPP is very strong, and this FP7 project is a very influential project for 5G R&D in Europe.
- 5G-PPP's KPIs for 5G are these 7 points.
 1. Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010.
 2. Saving up to 90% of energy per service provided. The main focus will be in mobile
 3. Communication networks where the dominating energy consumption comes from the radio access network.
 4. Reducing the average service creation time cycle from 90 hours to 90 minutes.
 5. Creating a secure, reliable and dependable Internet with a “zero perceived” downtime for services provision.
 6. Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people.
 7. Enabling advanced user controlled privacy.

- 5G-PPP is complementary to FI-PPP which focus on Future Internet (FI) platform and service. An advanced communication networks like 5G is necessary for FI because the development of FI services needs to improve communication networks. 5G-PPP and FI-PPP are two European initiatives to realize European leadership in FI.
- But there are concerns on 5G-PPP. An European researcher doubts of 5G-PPP success because of FI-PPP's failure. According to him, FI-WARE project, one of the FI-PPP projects, won't have a sufficient result ensuring lack of competition.

DANTE, TERENA, NORDUNET and SURFNET

- Found in Cambridge in 1993, Dante (Delivery of Advanced Network Technology to Europe) is composed by European NRENs (National Research and Education Networks).
- TERENA (Trans-European Research and Education Networking Association) is a forum designed to reinforce innovation in the field of internet technologies, infrastructure and services for research and education community. Different types of organization have participated into this association like NREN, telecom operator, vender, internet provider, non-European organization etc).
- NORDUNET is a joint infrastructure composed by 5 Nordic countries' NREN (Danish DeIC, Finnish Funet, Icelandic RHnet, Norwegian Uninett and Swedish SUNET). Its headquarter is in Stockholm. NORDUNET has participated in ANA-100 with SURF, the Dutch NREN (found in Amsterdam in 1986).

European participants to FELIX project and OPENDAYLIGHT project

- FELIX is a Japanese - European project for developing a common framework to connect Japanese experimental facilities and European ones. European participants are PSNC (Poland), Nextworks (Italy), i2CAT (Spain), SURFNET (Netherland), EIXT (Germany) and iMinds (Belguim).
- OPENDAYLIGHT project is one of the collaborative projects of Linux foundation (in the US). Its objective is to realize SDN (Soft Defined Networking) and NFV (Network Functions Virtualization). Non-American participants are Ericsson (Sweden), 6WIND (France), QOSMOS (France), ADVA(Germany), Fujitsu (Japan), Midokura (Japan), HBC (China), Huawei (China) and ZTE (China).

The third part : The R&D of New generation network, Future network and test-bed in Europe

FP7 : METIS and TROPIC

- METIS is the largest current European project for 5G (26 millions euro of total budget : about 30 participants (coordinator, Ericsson) : from November 2012 to April 2015). Its main objective is to lay the foundation for, and to generate a European consensus on the future global mobile and wireless communications system. It provides valuable and timely contributions to pre-standardisation and regulation processes, and ensures European leadership in mobile and wireless communications. Many big European companies (Alcatel-Lucent, Nokia Solutions and Network, Ericsson, Deutsch Telekom, Orange, Telecom Italia, Telefónica, etc), some big European research organization (Frannhofer-Geselleschaft, Institute Mines-Telecom, KTH, RWTH Aachen University, Aalto-University etc), and non-European companies (DOCOMO and HUAWEI) are partners in this project. In addition, BMW, a big European automobile company, participates in this project. According to the presentation of Ericsson in European Conference on Network and Communications in June 2014, this project has focused on SDN and NFV rather than ICN.

- TROPIC project (about 4,5 millions euro of total budget : 11 participants (coordinator, Universitat Politècnica de Catalunya : from September of 2012 to February of 2015) aims to merge cloud computing with femtocell networking for better use of frequencies and energy. This project consists in developing 4G technologies further. So, it reflects the transition between 4G and 5G.

FP7 : OPENLAB, FED4FIRE and CI-FIRE

- OPENLAB project (about 7 millions euro of total budget : 20 participants (coordinator, UPMC), from September 2011 to February 2014) aims to expand ONELAB facilities operated by UPMC and federate heterogeneous test-beds for wireless, Internet of Things etc.
- FED4FIRE project (about 11 millions euro of total budget : 17 participants (coordinator, iMinds) : from October 2011 to September 2016) aims to federate test-beds by developing common tools for managing and monitoring them. 17 test-beds have participated into this project (from non-European countries too : Australian NORBIT test-bed, South Korean KOREN test-bed and American test-bed of Stanford University). The tools developed by FED4FIRE can be used free of charge.
- CI-FIRE project (600 4984 euro of total budget : 5 participants (coordinator, EURESCOM) : from October 2013 to March 2015) develops the use case and business model of test-bed.

ANA100G

- ANA100G (Advanced North Atlantic 100G) is an American – European project for research and education networking. Its main objective is to develop and test new applications or new network technologies like SDN in research and education networks between North America and Europe. American organizations (Internet2 and ESnet), two American vendors (Cinea and Juniper), and European organizations or project (NORDUNET, SURFNET and GÉANT) are part of this project.

The Forth part : Standardization of SDN and NFV in ITU and ETSI

- ITU (International Telecommunication Union) has accelerated standardization activities of SDN since the adoption of the Resolution 77 – Standardization work in ITU-T for software defined networking in November of 2012. JCA-SDN (Joint Coordination Activity on Software-Defined Networking) was found in June 2013. Its role is to coordinate standardization activities in ITU in supporting particularly IUT-T SG11 and SG13 (SG : Study Group). SG13 published “Recommendation ITS-T Y.3300 Framework of Software-Defined Networking” in February 2014 which gives a basis for further study of SDN by providing its definition, objectives, capabilities, requirements and high-level architecture.
- ETSI (European Telecommunication Standards Institute) has found NFV ISG (Industrie Specification Group) for NFV, and its first meeting took place in January 2013 in Sophia Antipolis. Many big telecom operators and IT vendors around the world have participated in this ISG. In addition, in March 2014, ETSI and Open Networking Foundation (ONF) announced strategic collaboration for SDN and NFV.

The Fifth part : the report on the European Conference on the Future Internet (ECFI)

The Sixth part : the report on the European Conference on Networks and communications (EUCNC)

The Fifth part and the Sixth part are dedicated to two big European conferences : the European Conference

on the Future Internet (ECFI) and the European Conference on Networks and communications (EUCNC).

- There were many sessions on 5G in the EUCNC in addition to 5G-PPP workshop, as if it was dedicated to 5G. The European Commission focused on 5G technologies in this conference.
- Chinese company, Huawei, and Korean company, Samsung, showed their 5G vision, thus China and Korea made their presence felt in EUCNC.
- Many researchers mentioned 5G technological characteristics : transfer speed, diminution of latency, D2D communications, improvement of energy consumption, small cell and extremely high frequency for better use of frequency, SDN, NFV and IoT including vehicle communication technologies.
- General European time line for 5G : commercialization in 2020, spectrum allocation in 2019, standardization in 2016, preparation of spectrum allocation in 2015. 2014 and 2015 are for collaborative research period.
- Found in the University of Surrey in the UK, 5G Innovation Centre (5GIC) is developing 5G technologies parallel to 5G-PPP. British authority, OFCOM, and some Japanese companies (Fujitsu and Sony) have also participated into 5GIC.