Opening 5G

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Abstract:

Open-source software has made a significant impact in the extremities of current networks, namely in the terminals due to the Android ecosystem and in cloud infrastructure due, in part, to the OpenStack ecosystem (http://www.openstack.org/). When it comes to the radio-access networks that provide the communication links between the two extremities, however, current networks are deployed with proprietary equipment governed by very strict intellectual property agreements between multinational corporations based on open standards developed by the 3GPP. In recent years, we have witnessed the emergence of 'radio-hackers', who are challenging conventional equipment vendors by developing open source, software defined radios using off-the-shelf components and general purpose computing equipment. For commercial deployment, solutions such as openBTS or Osmocom are based on and limited to second generation (2G) standards primarily due to the fact that patents on 2G mechanisms have expired. Similar open source implementations are emerging for third (3G) and fourth generation (4G) networks (openUMTS, OpenAirInterface, OpenLTE, srsLTE) where patents are still a major concern. The majority of these implementations are used for the purpose of non-commercial prototyping. In order to leverage the efforts of these two communities, EURECOM has recently created the OpenAirInterface (OAI) Software Alliance (OSA) – www.openairinterface.org – a separate legal entity from EURECOM that aims to federate an open-source ecosystem for the core (EPC) and access network (EUTRAN) of fourth (4G) and fifth generation (5G) 3GPP cellular systems with the possibility of interoperating with closed-source equipment in either portion of the network. The ecosystem is already comprised of academics, major players from the wireless industry and radio-hackers. The OSA is striving to become a tool used by both industry and academia for using community driven development to accelerate innovation in 5G wireless technologies, and to bring the huge economic success of the open-source model to this part of information technology. It will also ensure a much-needed communication mechanism allowing academia to have a more direct impact on the complex real-world systems controlled by major industrial players in the wireless industry.

In the context of the evolutionary path towards 5G, there is clearly the need for open-source tools to ensure a common research, development and prototyping framework for rapid proof-of-concept designs. The OSA targets a reference implementation of 'Release 14 LTE' based on the current 4G implementation and to progressively add enhancements from 3GPP study items defining the future 5G standard. The latter will experiment with the idea of using an open source community to prototype mechanisms throughout the standardization process which could result in a direct impact of the community on the final form of the standard.

Open source licensing for radio access networks

The OSA software packages used to deploy an operator's core network, the Enhanced Packet Core or EPC, are collectively known as openairCN while the access network software for base stations and terminals goes under the name of openair5G. The combination of these two sets of software packages currently provides a standard compliant implementation of a subset of Release 10 LTE for user equipment (UE), enhanced Node-B or basestations (eNodeB), Mobility Management Entity (MME), Home Subscriber Station (HSS), Serving Gateway (SGw) and Packet Data Network Gateway (PGw) on standard Linux-based computing equipment (Intel x86-64 and ARM architectures). The EPC is quickly being integrated with other open-source software packages providing telecommunication services and solutions for network management (e.g. openIMS, Clearwater IMS, OpenDayLight) on the generic cloud-computing platform OpenStack. To ease integration with OpenStack software packages, and because revenues from the EPC are less dependent on intellectual property agreements, openairCN is distributed with a standard Apache V2.0 license, which is quite common in cloud-computing software. The access network software openair5G, on the other hand, is freely distributed by the OSA under the terms stipulated by a new open-source licence, the OAI Public License, catering to the intellectual property agreements used in 3GPP and allowing contributions from 3GPP members holding patents on key procedures used in the standard. The OSA is working closely with ETSI to harmonize the software licence with the intellectual property policy of 3GPP. The end result is that groups can use the software as any Apache V2.0 software for non-commercial purposes (e.g. for study and research) while for commercial exploitation of the community software, users are bound to respect intellectual property agreements associated with the 3GPP standard as with proprietary hardware and software.

Strategic research areas

The OSA has defined the six following strategic areas:

- 5G MODEM
- Software-Defined 5G System
- Heterogeneous Networks
- Large-Scale Emulation
- Test and Measurement
- RF Platform

5G MODEM refers to access layer mechanisms including the physical layer and access protocols. Key areas already being introduced into OAI are related to mechanisms in support of the internet of things (IoT) such as new waveforms and protocols supporting both broadband radio access for smartphones as well as efficient transport of small and sporadic payloads from future connected objects. The software-defined 5G system concerns the 'Softwarisation' of hardware and networking functions and comprises areas such as network function virtualisation (NFV), cloud or virtual radio access networks (CRAN), software-defined networking (SDN) and mobile edge computing (MEC). Heterogeneous networks correspond to the harmonization of different radio-access networks under a common 5G framework, in particular the joint control of 802.11 systems with 3GPP standards and the efficient use of unlicensed spectrum. Large scale emulation refers to the use of OAI software to deploy mock networks in a simulated non-real-time or emulated real-time environment and aims to look for synergy with other

network simulation tools such as NS3. Test and measurement concerns the use of OAI software in realtime testing systems to facilitate the diverse 5G network elements (radio units, server units, core networking elements) which will predominantly become integrated into a cloud computing environment. Finally, RF platforms refers to the interfacing and support of various off-the-shelf and commercial RF platforms by the OAI tool suite.

Creating global research partnerships

OAI is now a collaborative effort spanning the globe and, on the European level, will provide community-based tools to H2020, Celtic+ and, more importantly, to projects in the second and third phases of the 5GPPP. Many members of the OSA and the more general OAI community are using and further developing the tools in this context. The North American partners in the community are integrating the tools into similar project frameworks pertaining to next generation wireless networking. An existing and vibrant user base in Asia also provides valuable insight into different use cases and network deployment scenarios. The OSA is currently setting up testing sites in these three continents to satisfy the needs of their growing communities. Through the OSA, these communities can help make OAI a strong voice in the 3GPP world.

BIO: Raymond Knopp is professor in the Communication Systems Department at EURECOM. He received the B.Eng. (Honours) and the M.Eng. degrees in Electrical Engineering from McGill University, Montreal, Canada, in 1992 and 1993, respectively. From 1993-1997 he was a research assistant in the Mobile Communications Department at EURECOM working towards the PhD degree in Communication Systems from the Swiss Federal Institute of Technology (EPFL), Lausanne. From 1997-2000 he was a research associate in the Mobile Communications Laboratory (LCM) of the Communication Systems Department of EPFL. His current research and teaching interests are in the area of digital communications, software radio architectures, and implementation aspects of signal processing systems and real-time wireless networking protocols. He has a proven track record in managing both fundamental and experimental research projects at an international level and is also General Secretary of theOpenAirInterface.org open-source wireless radio platform initiative which aims to bridge the gap between cutting-edge theoretical advances in wireless communications and practical designs.