

5G Standardisation

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The views expressed in this article are those of the authors and shall not be considered as official statements of the European Commission.

Introduction

Importance of 5G Connectivity

The widespread availability of 5G connectivity is an essential foundation of the ongoing digital transformation. President Juncker in his State of the Union address in September 2016⁽¹⁾ stressed that we need more and better connectivity for all citizens and businesses, explaining why the Commission is proposing to fully deploy 5G across the European Union by 2025.

A society built on citizens' ability to connect to anything from anywhere in order to manage their daily lives is only possible if connectivity is reliable and ubiquitous. Without first-class communication networks, there will be no Digital Single Market⁽²⁾.

The importance of very high capacity networks and 5G in particular was highlighted in the 5G Action Plan⁽³⁾ that the Commission adopted in September 2016: "5G is seen as a game changer, enabling industrial transformations through wireless broadband services provided at gigabit speeds, the support of new types of applications connecting devices and objects (the Internet of Things), and versatility by way of software networks allowing innovative business models across multiple sectors (e.g. transport, health, manufacturing, logistics, energy, media and entertainment). While these transformations have already started on the basis of existing networks, they will need 5G if they are to reach their full potential in the coming years. The Commission strategy for the Digital Single Market (DSM) and the Communication "Connectivity for a Competitive Digital Single Market: Towards a European Gigabit Society"⁽⁴⁾ underline the importance of very high capacity networks like 5G as a key asset for Europe to compete in the global market."⁽⁵⁾

5G will essentially provide higher data capacities and speeds, but also enable real-time communication and connect a massive amount of objects and machines. It is therefore an essential element for Artificial Intelligence and cloud development by providing more real-time data collection and processing and enabling distributed computing. The use of 5G is a critical enabler of such innovation catalysers.

5G standards in the context of the Digital Single Market

An important policy objective of the Commission is to foster the emergence of global industry standards under EU leadership for key 5G technologies as announced already in the Communication on ICT Standardisation Priorities for the Digital Single Market (DSM)⁽⁶⁾. This objective has

(1) https://ec.europa.eu/commission/priorities/state-union-speeches/state-union-2016_en

(2) VIOLA R. : 5G in Italy White Book, Introduction

(3) EUROPEAN COMMISSION: 5G for Europe: An Action Plan, COM(2016)588

(4) EUROPEAN COMMISSION, COM(2016)587

(5) EUROPEAN COMMISSION, COM(2016)588 §1. Timely deployment of 5G: a strategic opportunity for Europe.

(6) EUROPEAN COMMISSION: ICT Standardisation Priorities for the Digital Single Market, COM(2016) 176

also been framing the 5G Public Private Partnership⁽⁷⁾ launched by the Commission with industry in 2013, with a 40% target for European industry control of standard essential patents (SEPs).

The 3rd Generation Partnership Project⁽⁸⁾ (3GPP) is the key global standardisation body for mobile communication network standardisation, carrying out the 5G standardisation process.

This article seeks to describe the state of play regarding 5G standardisation and propose elements of analysis for a European approach, taking into account the latest developments in 3GPP.

5G Standards: the 3GPP

The 3GPP is a collaboration between groups of telecommunications Standards Development Organisations (SDOs), known as the Organisational Partners. There are seven Organisational Partners, *ETSI* (Europe), *CCSA* (China), *ATIS* (USA), *ARIB* (Japan), *TTC* (Japan), *TTA* (Korea), *TSDSI* (India).

The initial scope of 3GPP was to develop the subsequent releases of the third-generation (3G) mobile phone system specification (beyond Release 99), as a follow up to the GSM specifications. The scope has been enlarged since then to include LTE and related “4G” standards (Release 8 to Release 14 mainly) and “5G” standards (Release 15, Release 16 and beyond). It also embraces architectural work for fixed-mobile integration and convergence, as this is a priority of several operators.

The Organisational Partners invite Market Representation Partners to take part in 3GPP. The main Market Representation Partners are *4G Americas*, *5G Automotive Association*, *CDMA Development Group*, *GSM Association InfoCommunication Union*, *IPV6 Forum*, *Next Generation Mobile Networks* (NGMN) *Small Cell Forum* (formerly Femto Forum) *TETRA and Critical Communications Association* (TCCA), *UMTS Forum*. The *5G Infrastructure Association* (private side of the 5G PPP) became part of this list in 2017.

RAN (Radio Access Network), SA (Service and System Aspects) and CT (Core Network and Terminals) are the most important 3GPP Technical Specifications Groups (TSG). The three TSGs organise 4 meetings per year, usually co-located), alternated between Europe, Asia and America.

5G Research: the 5G-PPP

Early reflection about the evolution of mobile communication networks “beyond 4G” started soon after the first deployment of a 4G commercial network in Sweden, in 2010. In those days, it was already apparent that the very fast growth of mobile traffic, between 50 to 100% increase on a yearly basis, as well as the prospects to serve innovative Internet of Things (IoT) applications would drive further R&D in the mobile communication domain.

Taking note of these developments, the European Commission initiated visionary EU-funded research activities already in 2012. At the Mobile World Congress in 2013, Commissioner Kroes challenged the industry to come up with a structuring European approach for leading edge R&D in 5G network technologies and systems. This eventually led to the setup of the European 5G Public Private Partnership (5G PPP). The 5G PPP is implemented under the European Horizon 2020 programme with about € 700 Million of public support over the 2014-2020 period. The private sector contribution is matching that amount by a factor of at least five. Altogether, this represents the largest 5G R&D initiative in the world.

(7) www.5G-PPP.eu

(8) www.3gpp.org

Piggybacking on these intense technological efforts, and taking stock of fast international developments, Commissioner Oettinger made a formal call to the European industry at the Mobile World Congress in 2016 in view of developing an ambitious 5G deployment roadmap for Europe. Industry responded with a 5G manifesto⁽⁹⁾ and the Commission adopted the 5G Action Plan on 14 September 2016 as part of a comprehensive connectivity package setting out the European ambitions for a Gigabit Society.

These initiatives materialise the importance of 5G networks for Europe. They are considered by the European Commission as a strategic asset for the digital society and to support the digital transformation of the industry and the public sector⁽¹⁰⁾.

The 5G Standardisation process

3GPP officially started the 5G standardisation process in September 2015, with an inception workshop in Phoenix that brought together more than 500 participants. Since then, it has been intensively working in order to timely deliver the 5G standards. 3GPP delivered first the “early drop” in December 2017, as an early version of the standard allowing the Korean administration to claim that the 5G trials showcased at the winter Olympic games of February 2018 in Pyueon Chun, Korea, were “standard compliant”. An important feature of the standard according to industry was that migration from the early drop version towards the full-fledged Release 15 version could be implemented through software upgrades only, hence preserving deployment investments needed to support early showcasing implementations.

During 2018, Release 15 was finalised and Release 16 was launched in June, with the plenaries approving the main package of study and work items with ambitious completion target dates. Release 15 is mainly focused on broadband use cases and includes low latency whilst ultra-reliability remains open for further enhancements. Release 16 is covering the complementary use-cases, notably related to industry applications and massive density of IoT devices.

Release 16 is targeting to address by the end of 2019 a larger extent of 5G use cases, by expanding its capabilities to address these use cases, while at the same time making the standard more efficient. Following the freeze of both 5G Non-Standalone and 5G Standalone specifications in 2018, there is an ongoing effort to ensure full functional integrity and interoperability of change requests to these specifications, especially in light of the imminent first deployments. There is a lot of industry interest in the 5G NR specifications, on whether the requests for changes and fine tuning are backwards compatible or non-backwards compatible and possible consequences for network deployment plans and chipset/device plans.

When implemented, these technologies will provide the tailored ‘backbone’ wireless infrastructure needed to support upcoming 5G-enabled hardware and services – including autonomous vehicles and IoT and many other applications and services. Full capability is though not expected before the approval of Release 16, early 2020. The first Release 16 compliant products are expected to hit the market only afterwards.

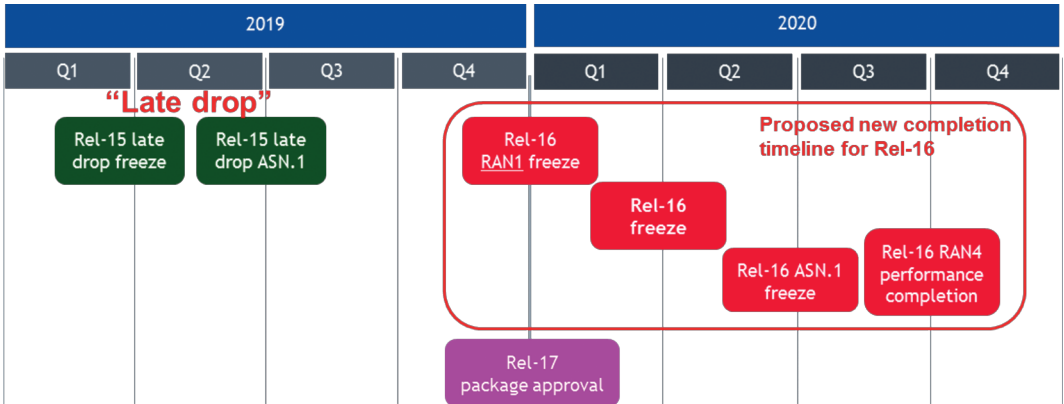
This would require an increased cooperation/coordination between TSG RAN and TSG SA. In fact both groups endorsed a plan⁽¹¹⁾ that identifies coordination expectations for focus areas that have both RAN and SA aspects in Release 16. There will be follow up at future TSG meetings both on these items and any additional focus areas that emerge.

(9) <https://ec.europa.eu/digital-single-market/en/news/commissioner-oettinger-welcomes-5g-manifesto>

(10) BARANI B. & STUCKMANN P., *Leading-edge 5G Research and Innovation: An undivided commitment of Europe*, 5G in Italy White Book

(11) 3GPP document with reference SP-180581

Approval of further urgent items at a later stage remains still possible. Release 16 marks a 5G expansion, covering, among others vehicle to X, industrial IoT and ultra-reliable low-latency communication (URLLC) enhancements. The overall 5G standardisation timing, agreed at RAN/SA/CT plenaries #82 (December 2018) is shown in the graph:



Source: 3GPP RAN chairman, www.3gpp.org

European 5G Standardisation Policy Framework

Pursuant to the digital single market strategy, the Communication on ICT standardisation priorities identifies 5G standards as key to competitiveness and the interoperability of global networks.

5G standardisation is among the actions of the 5G Action Plan which calls for the availability of the initial global 5G standards by the end of 2019, and promotes a holistic standardisation approach.

The European Parliament endorsed the 5G Action Plan⁽¹²⁾, calling for efforts on standardisation to be stepped up with a view to ensuring that Europe plays a leading role in setting technology standards allowing for the deployment of 5G networks and services.

In the Ministerial Declaration of Tallinn⁽¹³⁾ (July 2017) European Member States emphasised the need for 5G global interoperability in order to make 5G a success for Europe. Global standards are of paramount importance to ensure the competitiveness and interoperability of telecommunication networks. To this end, Member States underlined the need for a comprehensive and inclusive approach to 5G standardisation as a priority for the Digital Single Market, in line with the Communication on ICT Standardisation Priorities for the Digital Single Market.

To this end, European interest is to make sure that 5G standardisation does not only focus on short term industrial interests related to deployment of super broadband (eMBB) use cases but includes a comprehensive specifications in support of industrial use cases by "vertical" industries, in support of the wider EU policy aiming at an accelerated digitisation of the EU industrial fabric. In that context, Connected and Automated Mobility (CAM) is considered as a flagship 5G use case to catalyse 5G take off in Europe by 2025.

(12) EUROPEAN PARLIAMENT: ITRE report on "internet connectivity for growth, competitiveness and cohesion: European gigabit society and 5G"; (2016/2305(INI)), Rapporteur: Michal Boni.

(13) Ministerial Declaration "Making 5G a success for Europe" signed during the informal meeting of competitiveness and telecommunications ministers on 18 July in Tallinn.

Main outcomes of EU 5G action

Whilst the 5G standardisation process is still ongoing, it has been assessed that several hundreds of industry contributions to 3GPP originate from results of projects supported under the 5G PPP initiative, notably for what concerns i) the Radio Access Network architecture (RAN) and ii) the Service oriented architecture of the new core network, notably for the Standalone option.

From a European perspective, it is important that EU policies and the DSM strategy are taken into account in 5G standardisation and that a sufficient presence of European companies can be maintained whilst enlarging it to new stakeholders, notably the verticals, that are today little present in 3GPP debates. An inclusive standardisation process is indeed a prerequisite for a global approach to standards coping with a certain divergence of market needs in the different regions. To seize the strategic opportunities for the strong industrial sectors in Europe, the standardisation agenda needs to address further important use cases other than higher capacity and data rates.

In this context, the Commission facilitates contributions by the 5G Public Private Partnership and supports the organisation of 3GPP meetings in Europe, enabling the active participation of a broad range European delegates, from key industrial players, but also SMEs, academia and research institutions.

Furthermore, in 2017 the Commission urged the standardisation bodies and the concerned industrial actors to step-up their efforts for the rapid development of 5G standards addressing more immediate market needs while driving a clear strategy for a 5G global standard bringing benefits to a wide range of industrial use cases, in line with the EU strategy targeting 5G developments in support of “vertical” industries and of the wider objectives of digitising the European industry.

The ongoing effort for Interoperability and its impact

After completion of every release of the 3GPP specifications there is an ongoing process to fix bugs in the standards. The process uses Change Requests (CRs) submitted by member companies to the RAN working group meetings. CRs are discussed, often modified to address feedback from other companies, and then agreed or rejected. The agreed CRs are approved by the TSG RAN/SA plenary meetings and then included in the next version of the specifications.

The impact of the rushed standardisation process to deliver a first specification already by the end of December 2017 is now more visible, as the huge number of CRs indicates that the released standard requires some fine tuning. 3GPP already recognised that by proposing in 2018 a “late drop” that should be the finalised debugged specification. Taking into account the inflation of needed actions, it has also been decided to even delay the late drop by 3 months (see graph), which will have an impact on the 3GPP submission towards in time the ITU process planned for the end of 2019. Possible restrictions of the submitted specifications are under study at 3GPP level.

Altogether, the 3GPP process has managed to maintain a high level of efficiency, in spite of an unprecedented complexity that the organisation has had to face to develop the 5G standard in time. 3GPP and the various working groups have had to process more than 60000 contributions between 2015 and 2018, with meetings sometimes reaching more than 700 participants. This was notably the case of the RAN 1 working group dealing with physical layer aspects, the domain where most of the SEPs are to be found and hence extremely important from an IPR point of view. Taking into account the global debates on SEPs⁽¹⁴⁾ and the various industry debates on the valuation of such patents, it is of utmost importance that the essentiality of patents submitted to SDOs

(14) EUROPEAN COMMISSION: Setting out the EU approach to standards essential patents, COM(2017)712.

may not be questioned, in view of minimising the possibility of later disputes and of guaranteeing a fair price towards the end consumer.

Concluding remarks

In 2018, the 3GPP celebrated its 20 years having delivered 3G releases, 4G and 5G standards. The achievements announced in 2018, finalising the first phase of 5G standards and launching the second are particularly important. To this end, the European contribution via 5G PPP, the leading research programme is of particular importance.

However, this very intense process might lead to some delays in implementations of Releases 15 and 16. The European Commission is following the developments, attentive that the inclusive standardisation process remains inclusive and is addressing all relevant use cases beyond higher data rates.