



# 5-Alive

## 5G: A Leadership Vision for Europe

### D2.1: Evaluation of 5G-PPP KPIs

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#### Abstract

*This Deliverable gives an overview of the 5G-PPP Key Performance Indicators (KPIs) and analyses to what extent the first set of projects of the 5G Initiative within the 5G PPP plan to contribute towards achieving them. The Deliverable also sketches the process related to assessing the contribution of each individual project and of all projects aggregately to the KPIs in quantitative terms.*

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## Executive Summary

This Deliverable gives an overview of the 5G-PPP Key Performance Indicators (KPIs) and analyses to what extent the first set of projects of the 5G Initiative within the 5G PPP plan to contribute towards achieving them. The Deliverable also sketches the process related to assessing the contribution of each individual project and of all projects aggregately to the KPIs in quantitative terms.

The key performance indicators are defined in the contractual arrangement of the 5G PPP, and are structured into i) Business-related KPIs, ii) Performance KPIs and iii) Societal KPIs. As stated in the contractual arrangement, the Commission intends to regularly monitor the progress towards achieving these partnership objectives.

It is a task of the Private Side, i.e. the 5G PPP Infrastructure Association, to provide evidence regarding the progress towards achieving the agreed KPIs. A dedicated Activity on 5G KPIs has thus been setup by the Association for which Alcatel Lucent is in charge of. The Activity's objective is the organization of the PPP KPIs work with the appropriate team of experts from the different projects, monitoring the progress on KPIs and reporting the progress and issues to the 5G Infrastructure Association for further actions.

According to the ToR of the KPI Activity, the activity comprises 3 main steps:

1. Ensure detailed understanding of the KPIs, definition of the system model, methodology, metrics and reference values
2. Assessment of the performance of both the individual projects solutions as well as the aggregated programme performance, combining the projects solutions
3. Evaluate orientation of the follow-up Phase priorities based on KPI prioritization

The work on technology-related KPIs will mainly be contributed by 5G projects, consequently be addressed in the Technology Board, but in tight synchronization with the Association Activity.

Substantial support to the KPI activities has been provided by the 5-Alive Support Action, e.g. by organising in May 2015 the collection of input and preparation of a first overview of KPI addressing and coverage by the Phase 1 5G projects. Following that, all 18 projects were asked again in October 2015 by 5-Alive / Euro-5G to re-assess which of the KPIs they address and how strongly (i.e. Low, Medium, High). Furthermore, for each KPI addressed each project should state by what activities, measures or technologies and concepts it will contribute towards the KPI achievement.

The survey showed that all 4 *Performance KPIs* are well addressed.

For the *Societal KPIs* it shows that all projects will strongly contribute towards S3 i.e. a European competitive offer. A bit less but still well addressed are the KPIs S2 and S4, i.e. reduction of energy consumption and stimulation of new services, while there seem only limited addressing of user controlled privacy and 5G skills development curricula KPIs.

The *Business-related KPIs* are all quite equally and well addressed, which shows that the projects also have clear commitment to these more overall and strategic KPIs.

## List of Authors

Organisation	Authors	Main organisations' contributions
Eurescom	Uwe Herzog	Document editorial and contributions to all sections

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# 1 INTRODUCTION

This Deliverable gives an overview of the 5G-PPP Key Performance Indicators (KPIs) and analyses to what extent the first set of projects of the 5G Initiative within the 5G PPP plan to contribute towards achieving them. The Deliverable also sketches the process related to assessing the contribution of each individual project and of all projects aggregately to the KPIs in quantitative terms.

The further content is structured as follows:

## 2) 5G PPP Key Performance Indicators

This section gives an overview of the KPIs defined for the 5G PPP

## 3) Process for monitoring the progress towards KPI achievement

This section describes the stakeholders involved in the KPI monitoring process and sketches the planned process

## 4) 5G-PPP Phase 1 projects relevance to KPIs

Section 4 provides the results of a survey done with the projects active in Phase 1 of the 5G PPP, in terms of to what extent their activities contribute to achieving the KPIs.

## 5) Conclusions

This section draws some conclusions.

## 2 5G PPP KEY PERFORMANCE INDICATORS

A contractual arrangement to setup a public-private partnership in the area of advanced 5G Network Infrastructure has been made between the 5G Infrastructure Association and the European Union. This document lays the foundation of the 5G PPP. In this arrangement it has been agreed that “the Parties will regularly inform and consult each other, as appropriate, in particular in order to monitor the progress of the partnership towards its objectives and to assess the impact of its activities and the leverage of additional investments” [1].

In order to facilitate monitoring of the progress, a number of key performance indicators have been included in the contractual arrangement. The KPIs are in three main categories: Related to business aspects, related to performance aspects and related to societal aspects. Below the list of KPIs is shown, as listed in the contractual arrangement:

### **Business-related KPIs:**

- Leverage effect of EU research and innovation funding in terms of private investment in R&D for 5G systems in the order of 5 to 10 times;
- Target SME participation under this initiative commensurate with an allocation of 20% of the total public funding;
- Reach a global market share for 5G equipment & services delivered by European headquartered ICT companies at, or above, the reported 2011 level of 43 % global market share in communication infrastructure.

### **Performance KPIs:**

- Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010;
- Reducing the average service creation time cycle from 90 hours to 90 minutes (as compared to the equivalent time cycle in 2010);
- Very dense deployments to connect over 7 trillion wireless devices serving over 7 billion people;
- Secure, reliable and dependable Internet with a "zero perceived" downtime for services provision.

### **Societal KPIs:**

- Enabling advanced User controlled privacy;
- Reduction of energy consumption per service up to 90 % (as compared to 2010);
- European availability of a competitive industrial offer for 5G systems and technologies;
- New economically-viable services of high societal value like U-HDTV and M2M applications;
- Establishment and availability of 5G skills development curricula in partnership with the EIT.

In the arrangement it is said that the Commission will regularly monitor the progress towards achieving the partnership objectives, for the duration of the contractual arrangement and for three years after its end, in particular on the basis of evidence to be provided by the Private Side.

## **3 PROCESS FOR MONITORING THE PROGRESS TOWARDS KPI ACHIEVEMENT**

### **3.1 Activity on 5G PPP KPIs**

As stated in the contractual arrangement, it is a task of the Private Side, i.e. the 5G PPP Infrastructure Association, to provide evidence regarding the progress towards achieving the agreed KPIs. A dedicated Activity on 5G KPIs has been setup by the Association for which Alcatel Lucent is in charge of. The Activity's objective is the organization of the PPP KPIs work with the appropriate team of experts from the different projects, monitoring the progress on KPIs and reporting the progress and issues to the 5G Infrastructure Association for further actions. The Terms of Reference (ToR) of this Activity have been released in June 2015 [2]; they are included in this Deliverable under Annex A.

According to the ToR of the KPI Activity, the activity comprises 3 main steps:

4. Ensure detailed understanding of the KPIs, definition of the system model, methodology, metrics and reference values
5. Assessment of the performance of both the individual projects solutions as well as the aggregated programme performance, combining the projects solutions
6. Evaluate orientation of the follow-up Phase priorities based on KPI prioritization

An initial assumption during the 5G PPP definition phase was that the Working Groups of the 5G Initiative could be organized according to the KPIs, in order to enable a structured approach regarding the work on individual KPIs. This was however not implemented. Instead, the WGs were structured according to the topics which projects were mostly interested in information exchange and alignment of activities. As it currently appears there are some KPIs (or parts of them) which seem not addressed at all by any WG. For example, none of the WGs focuses specifically on Energy Efficiency or Capacity. This shows that the Association-led KPI Working Group will have to ensure that all KPIs are included in the monitoring and that respective teams that perform the work are formed.

One of the conclusions from the 5G PPP projects meeting organized on 01/07/15 in Issy was that the work on technology-related KPIs shall mainly be contributed by 5G projects, consequently be addressed in the Technology Board, but in tight synchronization with the Association Activity where the overall responsibility resides.

### **3.2 Relevance of KPIs to 5G Initiative Working Group activities**

Further for a where KPI progress could be discussed are the Working Groups of the 5G Initiative. Below table gives an overview of how the more technical KPIs are in scope of the three Working Groups of the 5G Initiative (i.e. the project-initiated WGs). The information has been discussed and agreed with the respective WG leaders.



Performance KPIs		Relevance (High/Medium/ Low / N.A.)		
		5G Architecture WG	Network Mgmt., QoS and Security	Software Networks WG
P1	Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010.	High	Medium	High <sup>1</sup>
P2	Reducing the average service creation time cycle from 90 hours to 90 minutes.	High <sup>2</sup>	Medium	Medium
P3	Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people.	High	Low	Low
P4	Creating a secure, reliable and dependable Internet with a “zero perceived” downtime for services provision.	Low	High	Medium

Societal KPIs		Relevance (High/Medium/ Low / N.A.)		
		5G Architecture WG	Network Mgmt., QoS and Security	Software Networks WG
S1	Enabling advanced User controlled privacy;	Low <sup>3</sup>	High	-
S2	Reduction of energy consumption per service up to 90% (as compared to 2010);	Low	Medium	Medium <sup>4</sup>
S4	Stimulation of new economically-viable services of high societal value like U-HDTV and M2M applications;	High <sup>5</sup>	Medium	Medium

Table: Relevance of the (more technical) KPIs to the Working Groups of the 5G Initiative

Substantial support to the KPI activities has been provided by the 5-Alive Support Action, e.g. by organising in May 2015 the collection of input and preparation of a first overview

<sup>1</sup> the focus is on 2nd part of the KPI “more varied service capabilities compared to 2010”

<sup>2</sup> Control and orchestration are investigated as architecture aspects, relevant for this KPI.

<sup>3</sup> UE is part of the architecture design and the architecture needs to enable security.

<sup>4</sup> The relevance of this KPI to the WG needs still clarification

<sup>5</sup> The architecture needs to enable new 5G services.

of KPI addressing and coverage by the Phase 1 5G projects, and finally by preparing a comprehensive and detailed overview of the state of play and results released with this Deliverable D2.1.

## 4 5G-PPP PHASE 1 PROJECTS RELEVANCE TO KPIS

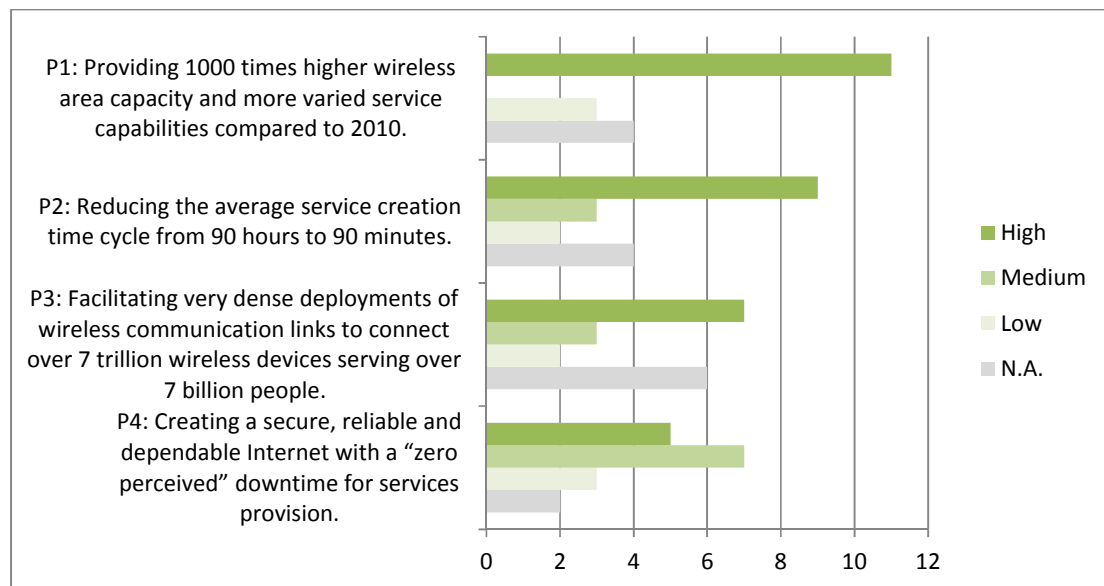
This section gives an overview of what KPIs are in scope for which of the 5G projects, and how each individual project plans to address them, i.e. what are the expected contributions from each project towards achieving them.

As said in the previous section, a first initial overview on how the 18 projects (RIA and IA) of 5G PPP Phase 1 will address KPIs has been prepared in May 2015 by 5-Alive and the result was presented at the 5G Projects workshop in Brussels, 27 May 2015. The overview is included in Annex B of this Deliverable for reference.

The initial mapping from May 2015 was prepared prior to the actual kickoff of project activities on 1 July 2015<sup>6</sup>. It was clear that this could not be more than a first sketch. Consequently, all 18 projects were asked again in October 2015 by 5-Alive / EURO-5G to re-assess which of the KPIs they address in general, and how strongly the respective KPIs are addressed (i.e. Low, Medium, High). Furthermore, for each KPI addressed each project should state by what activities, measures or technologies and concepts it will contribute towards the KPI achievement.

Below charts give an overview of how strongly the KPIs are addressed by the projects, i.e. how much they plan to contribute with their project work towards achieving the KPIs of the 5G PPP (high / medium / low / N.A.).

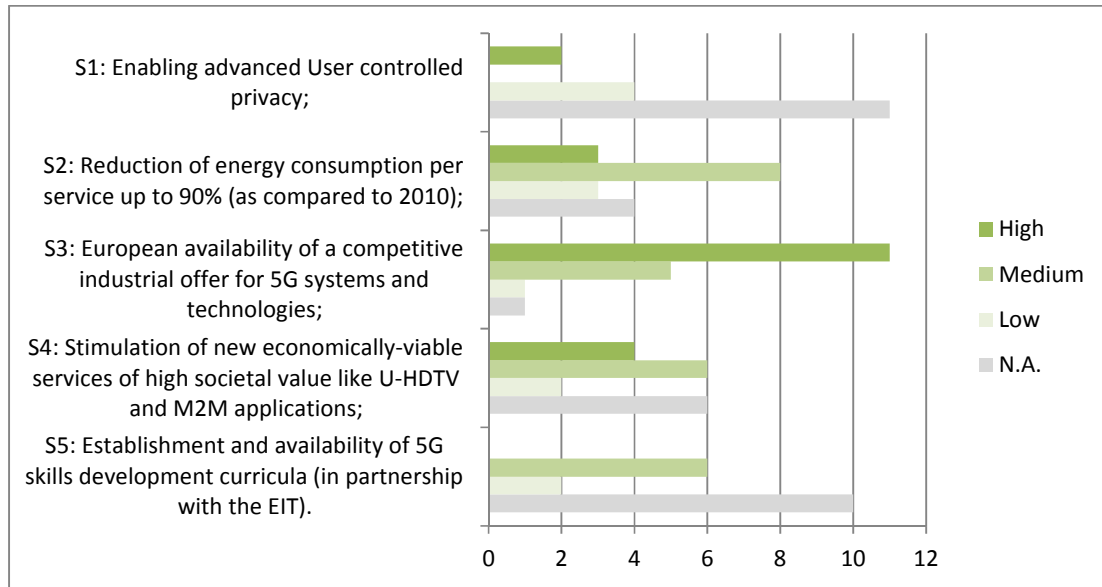
### Performance KPIs:



The chart shows that all 4 Performance KPIs are well addressed, although going down the chart the number of projects considering the KPI of “high” relevance declines, but at the same time the number of projects considering the KPI of “medium” relevance increases, so that the total of “high” + “medium” is nearly constant for all KPIs.

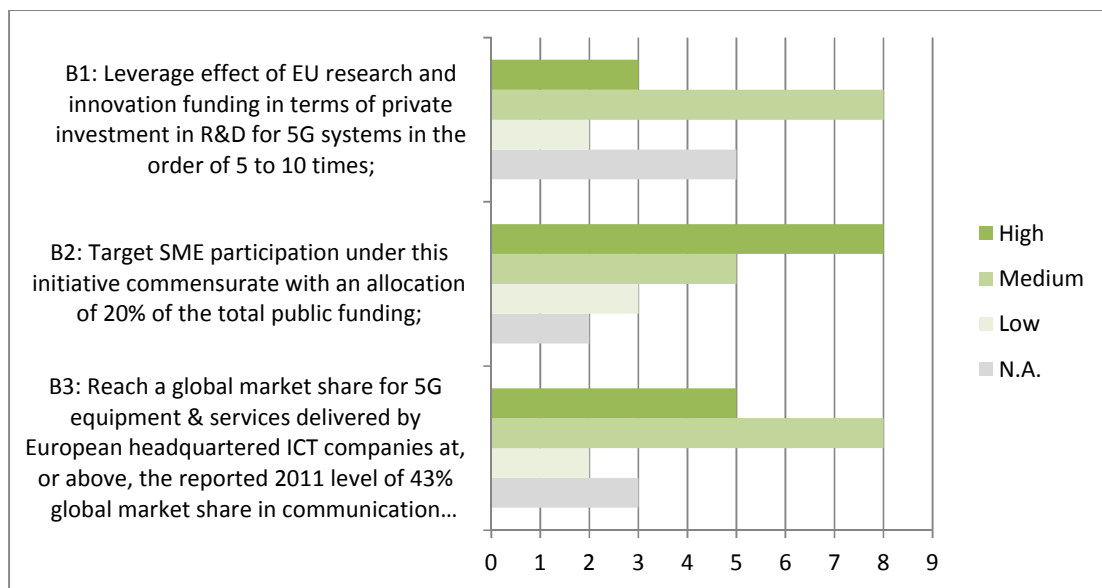
<sup>6</sup> 5G-ENSURE started only on 1 November 2015.

**Societal KPIs:**



For the societal KPIs it shows that all projects will strongly contribute towards S3 i.e. a European competitive offer. A bit less but still well addressed are the KPIs S2 and S4, i.e. reduction of energy consumption and stimulation of new services. On the other hand, there seems little contribution towards user controlled privacy (only 2 projects indicated “high” and none “Medium”!) which indicates a clear gap. The other remaining indicator S5 received no high relevance at all and only six “medium”. The “5G skills development curricula” seems rather a side interest, if at all. From the discussions it seems that this “partnership with EIT” seems to confuse projects as it is not clear whether that exists and they could just use it or whether the projects would have to setup a partnership which could cause concerns of additional overhead required in the already very busy project activities.

**Business-related KPIs:**



The Business-related KPIs are all quite equally well addressed which is good to see, as one could not take for granted that the rather technology-oriented projects see or recognise their commitment to more overall and strategic KPIs as these Business-related KPIs are. Still, from reading the detailed project responses it appears that it is not always easy for projects to imagine what specific actions they could do as a project to contribute to their achievement.

On the next page an overview of the responses from the 18 projects is shown.

The detailed project responses to this survey on which above charts are based could not be included here as this is a public Deliverable. However, they have been included in a separate document for further use in the KPI-related activities in EURO-5G and the 5G PPP.

VirtuWind
SUPERFLUIDITY
SPEED-5G
SONATA
SESAME
SELFNET
mmMAGIC
METIS II
FlexGware
FANTASTIC 5G
COHERENT
COGNET
CHARISMA
5G-Xhaul
5G-NORMA
5Gex
5G-ENSURE
5G-Crosshaul

**Relevance and impact on 5G-PPP KPIs**

	5G-Crosshaul	5G-ENSURE	5Gex	5G-NORMA	5G-Xhaul	CHARISMA	COGNET	COHERENT	FANTASTIC 5G	FlexGware	METIS II	mmMAGIC	SELFNET	SESAME	SONATA	SPEED-5G	SUPERFLUIDITY	VirtuWind
<b>Performance KPIs</b>																		
P1	High	Low	High	High	High	N.A.	High	High	High	High	High	N.A.	Low	N.A.	High	High	N.A.	
P2	Medium	Low	High	Medium	High	High	N.A.	N.A.	N.A.	Low	Medium	High	High	N.A.	High	High	High	
P3	High	Low	High	High	Low	N.A.	Medium	High	High	High	Medium	N.A.	N.A.	N.A.	High	Medium	N.A.	
P4	Medium	High	High	Medium	Medium	High	N.A.	High	Low	Medium	Tbd	Medium	Medium	Low	N.A.	Medium	High	
<b>Societal KPIs:</b>																		
S1	N.A.	High	N.A.	Low	High	N.A.	N.A.	N.A.	N.A.	Tbd	N.A.	N.A.	N.A.	Low	N.A.	N.A.	Low	
S2	Medium	Low	Medium	Low	Low	Medium	Medium	High	High	High	Medium	N.A.	N.A.	N.A.	Medium	Medium	N.A.	
S3	High	Medium	High	High	N.A.	Medium	High	Medium	High	High	High	Low	Medium	Medium	High	High	High	
S4	Medium	Medium	Medium	Medium	Medium	N.A.	N.A.	High	High	High	High	Low	N.A.	Low	N.A.	Medium	N.A.	
S5	N.A.	Low	Medium	Medium	N.A.	N.A.	N.A.	Medium	N.A.	Medium	Medium	N.A.	N.A.	N.A.	N.A.	N.A.	Low	
<b>Business-related KPIs:</b>																		
B1	High	Medium	Medium	Medium	Medium	N.A.	N.A.	Medium	N.A.	High	High	Low	N.A.	Low	Medium	Medium	N.A.	
B2	High	Low	High	High	Medium	N.A.	High	Medium	Medium	Medium	Low	High	High	Low	High	Medium	N.A.	
B3	High	Medium	High	Medium	N.A.	Medium	Medium	Medium	High	N.A.	High	Low	Low	N.A.	Medium	High	Medium	



## 5 CONCLUSIONS

This report summarises the status and activities that have been performed to date regarding the monitoring of the progress towards the agreed objectives (KPIs) of the 5G Infrastructure PPP.

The survey done with the 18 projects shows that most of the KPIs are well addressed, but also revealed that there are a few gaps or aspects that need clarification or amendment.

The presented results can facilitate the further work. In a next step, the details in the responses from the projects need to be analysed in order to evaluate if they go in the same direction, overlap, are orthogonal or potentially contradict / are not compatible. The result of that should be also useful feedback to the projects and Working Groups. Moreover, suitable metrics and parameters should be selected that can be used to measure the projects' individual contribution and how they combine to an aggregated result, and setting that in relation to the KPI, which themselves might partly still need better understanding too.

Resulting from the above sketched work, a first estimate on the potential KPI attainment could be concluded. However, for a more profound and realistic assessment, the results of the planned trials and experiments towards the end of phase 1 projects will be needed.

## References

- [1] Contractual arrangement to setup a public-private partnership in the area of advanced 5G Network Infrastructure between the 5G Infrastructure Association and the European Union, p. 5, 17 December 2013.
- [2] Terms of Reference (ToR) of the KPI Working Group of the 5G PPP Infrastructure Association, version released on 05/06/2015



## ANNEX A TERMS OF REFERENCE OF THE 5G KPI ACTIVITY

Release date: 05/06/2015 (this is the latest version available at the time of preparing this Deliverable)

### 1. Activity objectives

- Organization of the PPP KPIs work with the appropriate team of experts from the different Projects, monitoring the progress on KPIs and reporting the progress and issues to 5G Infrastructure Association for further actions.
  - Step 1 with Association and Experts from Projects – KPI Teams:
    - Detailed definition and understanding of the KPI.
    - Definition of the system model, methodology (E2E, might include reference scenarios) and metrics (considering existing models from relevant fora).
    - Definition of the reference values (e.g. traffic growth assessment).
  - Step 2 with Association, KPI Teams and all related Projects:
    - Assessment of the performance of Projects solutions (benefits of architectures, technologies, components, devices, algorithms and protocols...).
    - Assessment of the Program performance combining Projects solutions.
  - Step 3 with Association and all related Projects:
    - Evaluate potential orientation of project based on KPI prioritization.
    - Evaluate orientation of the follow-up Phase priorities based on KPI prioritization
- Monitoring for the 5G Infrastructure Association of the progress on PPP KPIs, in tight connection with PPP technical projects (over Phases).
- Interactions with the future KPIs study to be contracted by EC (future EC tender).

### 2. Activity organization

- Facilitator: Ingrid van de Voorde.
- Participants: 5G Infrastructure Association and 5G Infrastructure PPP project members.
- Meetings: Regular phone conferences or Physical meeting as appropriate, possibly collocated with other PPP/WG meetings.
- Collaborative environment: Reflector to be developed, Online repository to be developed.
- Activity start:
  - Creation of initially 2 main KPI Teams:
    - Team focused on PHY and energy

- Team focused on service creation
  - depending on the defined WGs, we will evaluate whether this activity could become part of the scope of a WG

### 3. Main deliverables

Reports on KPIs methodology, metrics and monitoring

# ANNEX B COVERAGE OF KPIS BY 5G PROJECTS (PRELIMINARY OVERVIEW AS OF MAY 2015)

A first initial overview of how the 18 projects (RIA and IA) of 5G PPP Phase 1 will address KPIS has been prepared and presented at the 5G Projects workshop Brussels, 27/05/2015.

	SONATA	5gex	VirtuWind	5G-Xhaul	CHARISMA	COGNET	COHERENT	METIS II	FANTASTIC 5G	mMAGIC	FlexISware	5G-NORMA	XHAUL	SELFNET	SESAME	SPEED-5G	SUPERFLUIDITY	5G-ENSURE
<b>Relevance and impact on 5G-PPP KPIS</b>																		
<b>Performance KPIS</b>																		
P1	Low	N.A.	High	High	High	High	High	High	High	High	High	Low	N.A.	N.A.	High	High	High	N.A.
P2	Medium	N.A.	Medium	Low	High	Medium	High	High	Medium	High	Medium	Medium	Low	T.B.D.	Medium	Low	Low	Low
P3	High	High	Medium	High	T.B.D.	T.B.D.	T.B.D.	N.A.	Medium	Low	Medium	Low	High	High	N.A.	Medium	Medium	Medium
P4	Low	High	Medium	Medium	High	T.B.D.	Medium	Medium	T.B.D.	Low	Medium	Low	Medium	High	N.A.	Medium	High	High
P5	N.A.	N.A.	High	Low	T.B.D.	Medium	High	High	Medium	High	High	High	Low	T.B.D.	Low	Medium	T.B.D.	T.B.D.
P6	N.A.	Low	Low	High	T.B.D.	T.B.D.	T.B.D.	N.A.	N.A.	N.A.	T.B.D.	N.A.	N.A.	T.B.D.	N.A.	Low	High	High
<b>Societal KPIS:</b>																		
S1	N.A.	N.A.	Low	High	T.B.D.	T.B.D.	T.B.D.	N.A.	N.A.	N.A.	T.B.D.	N.A.	N.A.	N.A.	N.A.	N.A.	Low	High
S2	Medium	N.A.	Medium	Low	High	Medium	High	High	Medium	High	Medium	Medium	Low	High	Medium	Low	Low	Low
S3	High	High	High	T.B.D.	Medium	High	High	High	High	High	High	High	High	T.B.D.	High	Medium	Medium	Medium
S4	Low	N.A.	Medium	Medium	T.B.D.	Medium	High	High	High	Medium	T.B.D.	T.B.D.	Medium	High	N.A.	High	Medium	Medium
S5	Medium	Low	Medium	N.A.	T.B.D.	T.B.D.	T.B.D.	Medium	Medium	N.A.	T.B.D.	T.B.D.	Low	High	N.A.	Low	Low	Low
<b>Business-related KPIS:</b>																		
B1	Medium	T.B.D.	Medium	Medium	Medium	T.B.D.	High	Medium	High	N.A.	High	Low	Medium	T.B.D.	Medium	High	T.B.D.	T.B.D.
B2	High	N.A.	High	Medium	T.B.D.	High	T.B.D.	High	Low	Medium	High	High	High	High	High	Medium	Medium	Medium
B3	Medium	Medium	T.B.D.	T.B.D.	Medium	Medium	T.B.D.	High	High	High	High	T.B.D.	High	T.B.D.	High	Medium	Medium	Medium