



5GMOBIX

5G for cooperative & connected automated
MOBility on X-border corridors

D4.1

Report on the Corridor and Trial Sites Plans

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ABBREVIATIONS

Abbreviation	Definition
AD	Autonomous/Automated Driving
APP	Application
CBC	Cross Border Corridor
CCAM	Cooperative, Connected and Automated Mobility
CN	China
CPM	Collective Perception Message
DE	Germany
DSDA	Dual Sim Dual Active
EDM	Edge Dynamic Map
EPC	Evolved Packet Core
ES	Spain
FI	Finland
FR	France
GDPR	General Data Protection Regulation
GR	Greece
GRX	GPRS roaming exchange
HD	High Definition
HO	Handover
ITS	Intelligent Transport System
KPI	Key Performance Indicator

KR	Korea
MCS	Manoeuvre Coordination Service
MEC	Multi-access/Mobile Edge Computing
MIMO	Multiple-Input and Multiple-Output
ML	Machine Learning
mmWave	Millimetre Wave
NSA	Non-Standalone Architecture
NL	Netherlands
OBU	On Board Unit
PLMN	Public Land Mobile Network
PT	Portugal
QoS	Quality of Service
RAN	Radio Access Network
RSU	Roadside Unit
SA	Standalone Architecture
TR	Turkey
TS	Trial Site
UCC	Use Case Category
US	User Story
V2X	Vehicle to Everything
WP	Work Package
X-border	Cross-border
5G NR	5G New Radio

EXECUTIVE SUMMARY

This document entitled “D4.1: Report on The Corridor and Trial Site Plans” presents the work performed within the task “T4.1 Trial methodology and cross site coordination” in the workpackage “WP4 Trials”. This work was performed in cooperation with all the 5G-MOBIX Cross Border Corridors (CBC) and Trial Sites (TS).

The objectives of WP4 are to set-up, organize and coordinate the 5G trials in order to ensure the collection of consistent and useful data for WP5 (“Evaluation”); to help cross-trials cooperation and support from local trials to cross border corridors (cross tasks activities). WP4 will cover the overall set up, organization and execution of the trials by providing a cross-trials coordination and methodology for trials execution and data collection (Task 4.1) and by ensuring the deployment at local level of the concept developed in the other Work Packages of the project (Tasks 4.2 to 4.9).

WP4 prepares and executes the trials with local specificities following 5G-MOBIX methodology to guarantee a global evaluation.

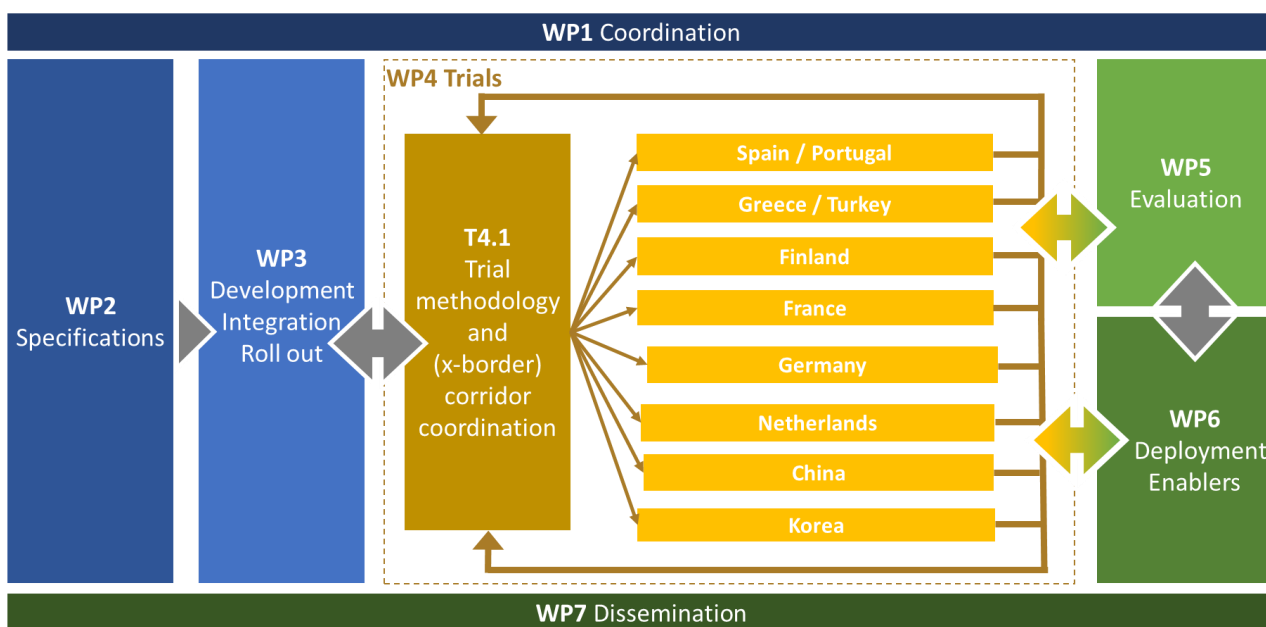


Figure 1 WP4 work and tasks structure detailed

The aim of this deliverable D4.1 is to provide the CBCs and TSs with a **global and common trialling methodology** to be applied for the different trial phases. This deliverable adopts a top-down approach in order to guide and supervise the progress of the preparation of the trials and their execution and provide guidance to the tasks T4.2-T4.9. **This methodology will then be adapted by each CBC and TS depending on their specificities** (will be described in D4.2 [1]) and depending on how the TSs contribute to the CBCs

trials. This deliverable also presents the tools that will be used to monitor and supervise the trialling phases and to ensure their efficiency.

The document is structured with five main sections. After describing its purpose and intended audience, the deliverable highlights the different 5G features technologies that will be trialled by each trial sites during their user stories testing. Section 3 describes the overall methodology that will be applied by each CBC and TS during the preparation and the execution of the trials, included a time planning that has been coordinated at the consortium level and which takes into account the inputs integration from local test sites to CBCs. This part is followed by a presentation of the tools that will be prepared and used by each CBC and TS to help prepare and monitor the progress of the trials. Finally, the document is concluded by a summary of the main elements of the deliverable.

1. INTRODUCTION

1.1. 5G-MOBIX concept and approach

5G-MOBIX aims to showcase the added value of 5G technology for advanced Cooperative, Connected and Automated Mobility (CCAM) use cases and validate the viability of the technology to bring automated driving to the next level of vehicle automation (SAE L₄ and above). To do this, 5G-MOBIX will demonstrate the potential of different 5G features on real European roads and highways and create and use sustainable business models to develop 5G corridors. 5G-MOBIX will also utilize and upgrade existing key assets (infrastructure, vehicles, components) and the smooth operation and co-existence of 5G within a heterogeneous environment comprised of multiple incumbent technologies such as ITS-G5 and C-V2X.

5G-MOBIX will execute CCAM trials along cross-border (x-border) using 5G core technological innovations to qualify the 5G infrastructure and evaluate its benefits in the CCAM context. Aligned to identified cross-border issues, the Project will also exercise a set of user stories executed at inland corridors that would bring new telecom, application security, privacy or regulatory issues outside the ones considered at the cross-border corridors.

5G-MOBIX will first analyse the general telecom, application, security, data privacy and regulatory issues present at the cross-border corridors.

From there, 5G-MOBIX declares a set of advanced CCAM use cases stressed at cross-border areas needing advanced connectivity provided by 5G, and the required features to be enabled to meet the identified issues. These advanced CCAM use cases and the specific features and technologies of 5G networks will be mainly tested across the trials on 5G corridors in different EU countries as well as in Turkey, China and Korea. A set of complementary user stories will focus on different telecommunication infrastructures, perform data computation in different communication sides, apply different connectivity models across the actors or stress a specific 5G platform tier, while they propose solutions still valid for issues applicable in cross-border areas, but not covered in the cross-border evaluation sites, expanding the project results.

The trials will also allow 5G-MOBIX to conduct evaluations and impact assessments and to define business impacts and cost/benefit analysis. As a result of these evaluations and international consultations with the public and industry stakeholders, 5G-MOBIX will identify new business opportunities for the 5G enabled CCAM and propose recommendations and options for its deployment.

Through its findings on technical requirements and operational conditions 5G-MOBIX is expected to actively contribute to standardisation and spectrum allocation activities.

1.2. Purpose of the deliverable

The present document, D4.1 “Report on The Corridor and Trial Site Plans”, is delivered as part of WP4 and aims at preparing the Cross-Border Corridors (CBC) and Trial Sites (TS) for the execution of the trials that will take place later within the lifetime of the project.

In WP4, the first step is to ensure the readiness of both CBCs and TSs to carry out the trialling phase which is done by defining the specifications for the organization, installation, and overall preparation of the CBCs and TSs. In addition, all kinds of characteristics of the CBCs and contributions from local trial sites need to be considered, from the 5G network and vehicles to the road and digital infrastructures, but also the participants and the data collection process, so that problems that may arise during the trialling phases can be identified early enough and mitigation actions can be applied. To do so, a checklist had been proposed which aims to control and inspect the preparation and implementation at 5G-MOBIX CBCs and TSs.

The **overall aim of this deliverable** is to **present the generic methodology** that will be used by the trial sites and cross-borders corridors to execute their trial plans. Here, a terminological distinction needs to be made between “testing” and “trialling” as the first process is the operational process of verification (implemented in WP3 and through T3.6 “Verification” [2]) while trialling is closer to the evaluation process as the results and data collected during the trials are directly linked to WP5 needs. Hence, WP4 trialling activities are to be distinguished from the testing activities generated by WP3, and they can properly start after WP3 verification and integration phases.

This generic methodology gathers several monitoring elements such as a general checklist, generic trials plans, timelines and other documents and tools that will be filled in by each TS and CBC in order to monitor their progress before and during the execution of the trialling activities.

The aim of this whole methodological process is to come up with detailed plans for the operation of each site while keeping the expected impacts that are targeted from the trialling activities in mind.

1.3. Intended audience

This is a public document (PU) hence, it will be used publicly to inform all interested parties about 5G-MOBIX trialling activities. However, as the generic methodology is set up to supervise the preparation and the progress of the trials and their execution, it first addresses the cross-border corridors and trial sites leaders. Secondly, for the needs of the project it would be of interest mainly for WP5 and WP6 partners, associated with the evaluation and exploitation respectively, but also for WP3 ones, dealing with the deployment of the different system components.

1.4. Covid-19 impacts

Due to the 9-month project extension and due to the COVID-19 situation introducing lockdown measures, the plans and calendar presented in this deliverable had been adjusted in concertation with project partners

and to be better aligned with the progress of WP3 (“Development, Integration and Rollout”). The plans presented here take in account the estimation made by the partners and Trial sites leaders at M19 (May 2020) for the organisation of the trialling sessions, and have been updated in January 2021 (M27), to be as accurate as possible in the preparation of the trials and in their execution.

2. 5G-MOBIX: 5G TECHNOLOGIES TRIALLING FOR CCAM

In 5G-MOBIX, there are 2 Cross-border Corridors (Spain-Portugal and Greece-Turkey) and 6 local Trial Sites amongst which 4 are located in Europe (France, Finland, Netherlands and Germany) and 2 in Asia (China and South Korea).

5 Use Case Categories (UCC) (and their consecutive user stories (US)) will be implemented at the trial sites and cross-border corridors in the framework of WP4 to showcase the benefit of **5G technologies for CCAM**. In addition to these local tests, the Trial sites will also contribute to the X-border trials by bringing contributions (hardware or software) that will help address the Cross-border issues (defined in WP2). The list and descriptions of the cross-border issues and their consecutive solutions will be further explored in Deliverable D6.1 [3].

Table 1 below gives an overview of the different 5G technologies and features that will be trialled at each site and corridor during the trials. More details are presented in deliverable D4.2 [1] along with the planning of the trialling sessions.

Table 1 5G Features, technologies and solutions

5G Features/ technologies/solution	ES-PT	GR-TR	DE	FI	FR	NL	CN	KR
Seamless cross border (S1) handover with 5G EPC		X						
Seamless cross border (S1) handover with evolved packet core	X							
Seamless cross border handover with 5GC						X		
Multi SIM (DSDA)			X	X	X		X	
Predictive QoS					X			
Satellite using NTN-based NG-RAN					X			
Session and Service Continuity (SSC) mode 2 or 3	X					X		
Service continuity with multiple edges and an ePC	X							
Network Slicing				X		X		
Local Breakout Roaming with 5G EPC	X	X						
Home Routed Roaming with 5G EPC	X	X						
Local Breakout Roaming with 5G Core	X					X		
Home Routed Roaming with 5G Core	X							
Local breakout for UPF				X				
Edge computing	X	X	X	X	X	X	X	
MEC broker interconnection	X		X			X		
inter-PLMN connectivity using the Internet (i.e., using the public IPX interconnection points of each country - towards the Internet)		X						
inter-PLMN connectivity using a leased line		X						

PLMN direct interconnect as alternative to current GRX based interconnections	X							
National roaming with seamless handovers			X	X				X
PC5/Uu hybrid networking			X					
5G NR mmWave for V2X (UU) connectivity					X		X	X
Location services using mmWave 5G NR						X		
QoS sustainability while roaming and during inter-PLMN HO						X		
Radio slicing						X		
Multi operator slicing						X		
Evaluation of ML for predictive HO and APP state transfer		X						
Data Privacy / GDPR mechanisms in place	X	X						
Data Security mechanisms in place	X	X						
UL throughput maximization		X						

Please note that this matrix is an overview of the 5G elements that will be used for 5G-MOBIX trials, and the complete details and descriptions or variations of these technologies are available in D4.2 [1].

These 5G features will be tested within 5 use case categories and their consecutive User stories, which have been defined in WP2, and presented in the table below:

Table 2 5G-MOBIX User Story classification considering the main UC category of each User Story [4]

Trial site	Advanced Driving	Vehicles Platooning	Extended Sensors	Remote Driving	Vehicle QoS Support
ES-PT	Complex manoeuvres in cross-border settings		Complex manoeuvres in cross-border settings	Automated shuttle remote driving across borders	Public transport with HD media services and video surveillance
	Automated shuttle remote driving across borders		Public transport with HD media services and video surveillance		

GR-TR		Platooning with "see what I see" functionality in cross-border settings	Extended sensors for assisted cross-border crossing		
			Platooning with "see what I see" functionality in cross-border settings		
DE		eRSU-assisted platooning	EDM-enabled extended sensors with surround view generation		
FI			Extended sensors with redundant Edge processing	Remote driving in a redundant network environment	
FR	Infrastructure-assisted advanced driving				
NL	Cooperative Collision Avoidance		Extended sensors with CPM messages	Remote driving using 5G positioning	
CN	Cloud-assisted advanced driving	Cloud-assisted platooning		Remote driving with data ownership focus	
KR				Remote driving using mmWave communication	Tethering via Vehicle using mmWave communication

3. OVERVIEW OF THE EARLY TRIALS AND FULL TRIALS METHODOLOGY

This section describes the overall methodology of the trial activities at the CBCs and TSs. After giving some definitions of the terminology used by the methodology and by WP4, a macroscopic time plan as well as a more detailed time plan for the CBCs are provided along with a description of the agile-like trial approach to be implemented within the proposed methodology.

3.1. Definitions

- **Deployment/integration.** The deployment phase is considered as the necessary foundation to testing, assessment and demonstration, and is the main work performed by WP3. It aims at deploying and integrating the different components enabling the CCAM use case categories already identified in deliverable D2.1 [4] for the different 5G-MOBIX trial sites and cross border corridors. It will encompass all the processes involved in getting the several user stories, 5G technology, vehicles, roadside and cloud infrastructures, and applications up and running properly in their environment.
- **Early trials.** Phase between deployment/integration and the trials whose purpose is to prepare the actual trials. In this process, several iterative improvements will take place to ensure interoperability between CBCs and TSs. The aim is to use the feedbacks collected to make some upgrades before the full trials and before validated the benefits of 5G for the identified use case categories and user stories.
- **Full Trials / Trialling phase.** Phase occurring once the early trials are successful. This phase involves data collection for the evaluation of the KPIs identified in D2.5 [5]. During trials, there will be different categories of collected data, depending on the need for the evaluation defined by WP5:
 - **Data for technical evaluation:** During the full trials, specific data (log files) are going to be collected to be able to evaluate the technical performances of the different technologies and solutions implemented in the corridors and trial sites.
 - **Data for user evaluation:** During the full trials, real test users will be involved. The users considered can be previously selected by following a defined recruitment process and they will contribute to the user evaluation by filling in questionnaires and surveys or through interviews conducted after experiencing a test. The goal is to evaluate acceptability and acceptance rates of different kinds of mobility solutions.
 - **Data for impact evaluation:** During the full trials, identified measurements are going to be collected to assess the potential business, environmental and societal impacts of the systems and applications demonstrated in the cross-border corridors and in trial sites.
- **Test cases.** Specific traffic situations that may be encountered by (automated) vehicles on the road. It includes information on the environment, the presence of other types of vehicles, users, and the vehicle (number, driving mode, etc.). The defined scenarios provide the basis for the trials.

- **Iteration.** Period (day, several days, full week) during which early and full trials sessions are organised on the trial sites for a specified user story. For the execution of the trials, several iterations will be done to support statistical confidence.

3.2. Methodology description and planning overview

3.2.1. Trialling methodology

Figure 2 below gives an overview of the methodology that will be applied during 5G-MOBIX trials. Moreover, it depicts the different tools used to implement the methodology and how they will be used.

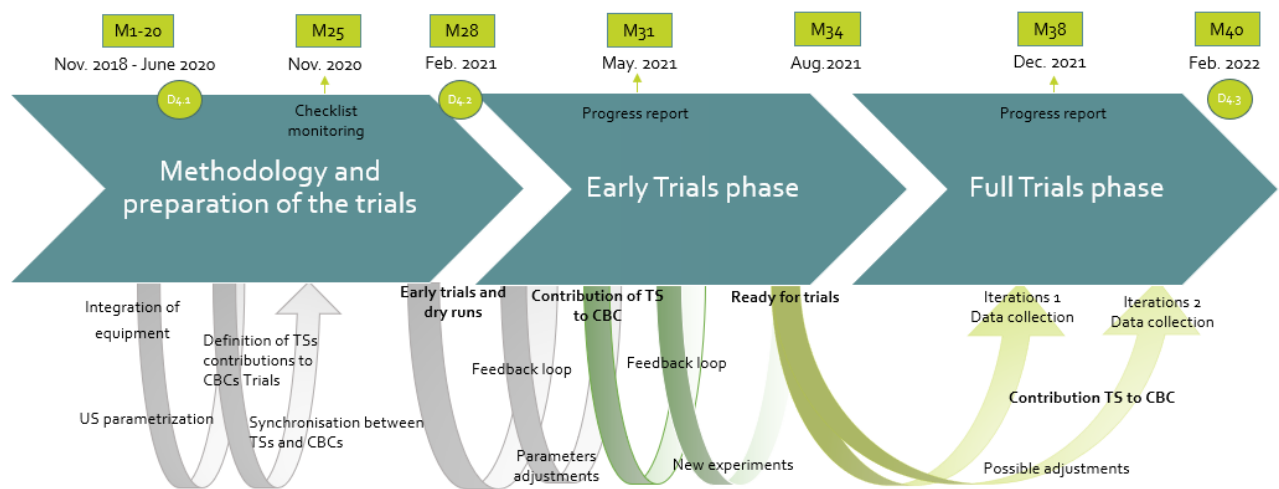


Figure 2 Implementation of the methodology of WP4

The methodology and preparation of the trials phase is running in parallel of the work performed in WP2 and WP3 (deployment and integration) and occurring until M27. During this period, the different 5G equipment, vehicles and roadside infrastructure will be deployed and integrated before the early trial sessions start. In parallel, through WP4 work, a checklist (see Section 4.1.1 Checklist) will be filled in by the trial and cross-border sites leaders in November 2020, in order to monitor the progress of the parametrization and the integration of all the necessary components.

Once the CBCs and TSs are ready, the early trials phase starts from M28 (Feb 2021) until the summer 2021 (M34) and after the first sessions of dry runs, the feedback gathered through a first progress report (see Section 4.2.2 Progress reports) in May 2021 will allow some parameters adjustments (such as transmission power of gNB, sensors configuration etc.). Moreover, **agile-like approach will be taken through several testing iterations in order to carry out the predefined tests** (defined during T3.6 “Verification”) and test the systems functionalities. **If necessary, adjustment will be made to the components** until the results are successful and mature enough to launch the full trials phase.

The full trials phase will evolve from the early trials, with a transition starting in M32, and will last until M40. Different iterations will be also carried out to perform trials and allow a proper data collection. CBCs and TSs will foresee multiple iterations in order to collect the required KPIs as defined by WP5. The trial plans (see Section 4.1.2 Trial plan) will help define the several iterations planned. The second progress report, filled in by the cross-border corridors and trial sites leaders in December 2021, will allow some adjustments and reparameterization if necessary, between the different iterations.

Figure 2 also aims to point out the fact that WP4 is at the cross phase between WP3 and WP5: the work ongoing in WP3 on the deployment and integration of the components will be cross checked during the preparation of the checklist before the beginning of the trials. In the same way, the work of WP5 will be essential for the execution of the trials, to gather and collect the correct amount and type of data. To ensure good communication, cross-WP workshops and discussions are regularly organised between WP3, WP4 and WP5 leaders.

3.2.2. Planning overview

3.2.2.1. Macro planning at WP4 level

This planning has been constructed considering the ongoing activities of WP3 and is aligned with them. Due to the 9-month extension of the project, the new roadmap has been adjusted but it may still be subject to evolution during the activities of WP4. The main phases have already been identified and as highlighted in Figure 3 below, the activities of WP4 are divided in three main phases: the preparation of the trials activities, the early trials phase and the full trials phase.

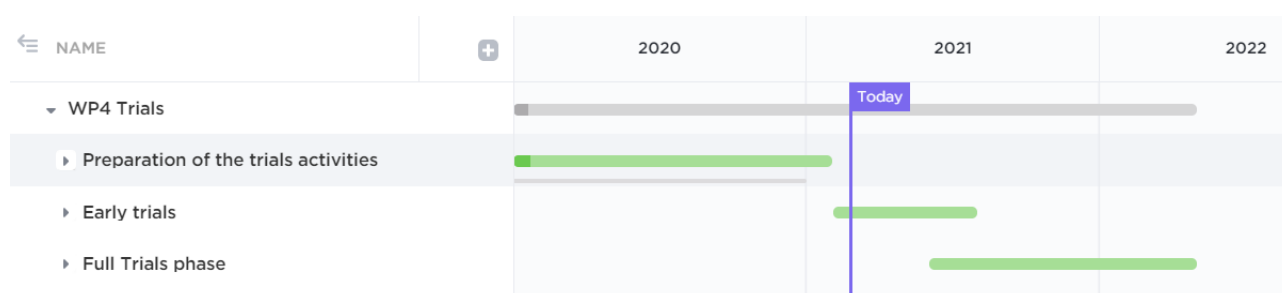


Figure 3 WP4 timeline from M18 (May 2020) to M41 (March 2022) and the 3 phases roadmap

The CBCs and TSs early and full trials take place through a period of one year and 2 months approximately, from February 2021 until March 2022 including several test iterations with intervals that may vary between the different CBCs and TSs and use cases and depending on the contribution of the TSs to the CBCs. Throughout this trials period several demos will be performed.

3.2.2.2. Phase 1: Preparation of the trial activities (M1-M27)

During phase 1 “Methodology and preparation of the trials” the **overall methodology for the execution of the trials is defined**. The Trial sites leaders while defining their contributions to CBCs trials are synchronising with CBCs. **This phase is running in parallel to the deployment and integration activities** (linked to WP3) and are described in D3.1 [6].

After the end of Phase 1, at M28 deliverable D4.2 “Report on the methodology and pilot site protocol” will be ready. This document will collect details on the trial plans for each site, including the detailed 5G technologies that will be trialled, the different contribution of TSs to the CBCs trials and the planning of these activities.

3.2.2.3. Phase 2: Early trials phase (M28-M34)

During this phase “Early Trials” several scenarios of user stories will be tested on the CBCs and on the local trial sites with the objective to prepare the next phase “Full trials” (Phase 3). As part of WP3 work, all TSs will have performed their integration and initial tests on the hardware and software transferrable to CBCs before starting the Early trials phase and before bringing their contributions to CBCs. During this phase, one Progress report will be filled in by the sites to monitor the progress of the early trials and allow adjustments or upgrades thank to the support of WP3. This second phase overlaps with the following phase (Phase 3 “Full trials”) to allow all the necessary adjustments to be correctly addressed.

3.2.2.4. Phase 3: Full trials phase (M32-40)

The full trials phase is the phase during which we will showcase and assess the potentials of 5G and understand the impact and challenges when combining 5G communication with foreseen use case categories in autonomous driving (on CBCs). Data will be collected, cleaned, and uploaded to the central test server in order to be used by WP5 “Evaluation”. As shown in the figure, **phase 2 and phase 3 can overlap depending on the planning of each CBC and local trial site**.

At the end of the full trials, in M40 deliverable D4.3 “Report on the corridor and trial site test activities” will be ready. This deliverable will document the trialling activities carried out in the corridors and trial sites.

According to the latest version of the project Gantt Chart, taking in consideration a 9-month extension, WP4 ends in M41. This month will allow Trial sites and CBCs to correctly finalise their trials and reports, as well as giving any necessary support to the WP5 “Evaluation” needs.

This macro timeline gives a frame for each CBC and TS to implement their early trials and their full trialling phase. **Each site has implemented this macro timeline and has adapted it to its own specificities**. Of course, the information contained in this timeline are dynamic, meaning they can evolve and be adapted when necessary, especially depending on the sanitary situation.

The following two sections give an overview of the time planning for the two CBCs in May 2020, and last updated in January 2021. The overview of the time planning corresponding to the TSs can be found in the annexes.

3.2.3. ES-PT CBC time planning

The following section presents the general timeline for the preparation of the trials activities as well as their execution in the CBC ES-PT. This timeline is aligned with WP4 general roadmap. The inputs of the contributing TSs also appear in the timelines below but may be subject to modifications later, depending on the progress of WP3 and of the project. More details on the content of the integration plans will be available in D4.2 [1] as well as results of the interactions and coordination plans between the sites and the corridors.

3.2.3.1. Preparation of trials activities

The ES-PT consortium is working under two different but connected ways. On the one hand, many discussions and agreements are taking place involving the road operators and officers, in order to obtain the authorizations needed for performing the trials in the agreed roads. The result of these discussions will define the way of carrying the early and full trials. On the other hand, four discussions are taking place simultaneously with FR, FI, NL and DE regarding the collaborations between their TS and the ES-PT CBC. These discussions aim at defining in detail the integration, trialling and evaluation procedures for the concrete contributions made to the CBC. Once these open calls (both with TS and road authorities) have reached an agreement, a timeline has to be designed in order to fit the CBC individual tests and the contributions tests for each stage: testing, trialling and evaluation. This timeline and results of these discussions will be presented in D4.2 [1].

Regarding the spectrum allocation, a reorganization of the spectrum is expected to occur in early 2021, both in Spain and Portugal. This reorganization may affect the frequency bands being used by Telefónica and NOS.

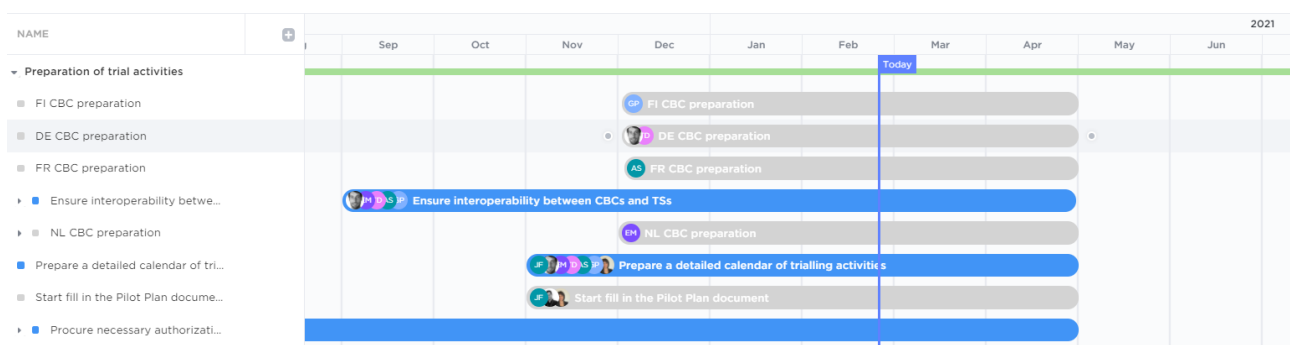


Figure 4 ES-PT CBC - Preparation of trials activities

3.2.3.2. Early trials phase

In the early phase of trials, is expected to make the first tests of the system as a whole. In this way, having already tested individual systems and functionalities along with the integration and verification phases, this is the time for checking the performance of each user story scenario as it will be in the full trials.

For this phase, each user story is tested first individually (without TS intervention) to check that everything is working fine. Afterwards, TS contributions will be integrated and verified. It is important to note that all these tests will take place in the same periods of time.

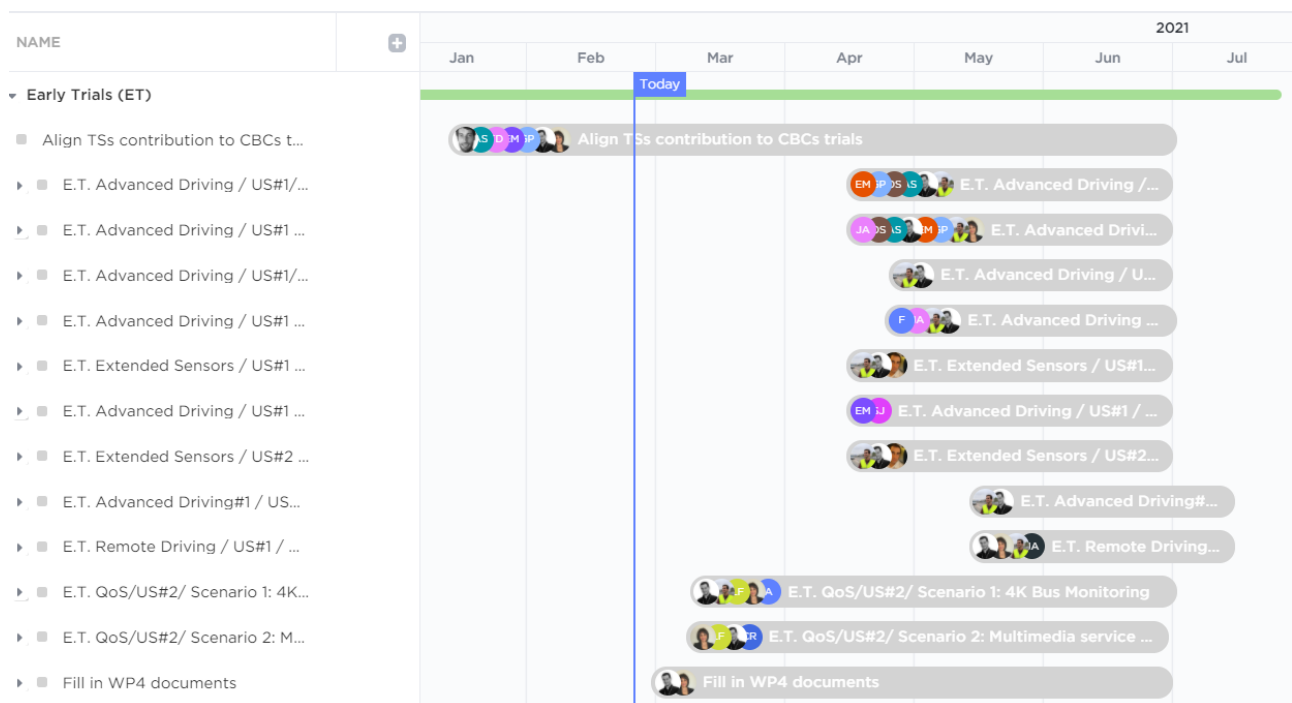


Figure 5 ES-PT CBC Early Trials phase

3.2.3.3. Full trials phase

The full trials test the protocols and scenarios for each user story defined along different tasks, so that the proper KPIs are obtained from the trials in a standardized way.

From May 2021 to February 2022, full trials will take place with the collaboration of TSs for obtaining the needed data and KPIs to be later evaluated within the WP5 tasks context. During these trials, some support may be needed from the involved partners in order to fix any issue that may appear, to calibrate equipment or devices for each trial, and so on.

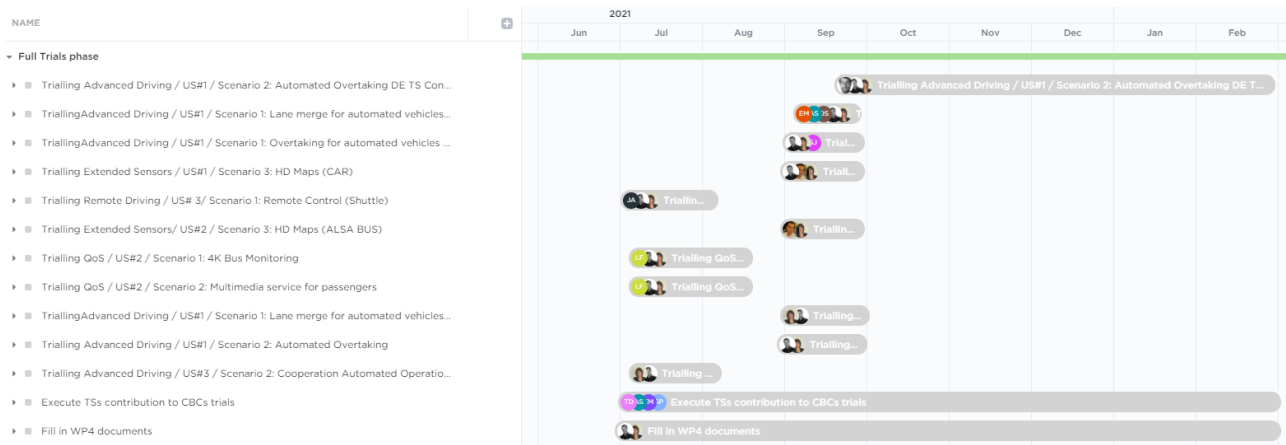


Figure 6 ES-PT CBC - Full Trials phase

3.2.4. GR-TR CBC time planning

The following section presents the general timeline for the preparation of the trials activities as well as their execution in the CBC GR-TR. This timeline is aligned with WP4 general roadmap. As for the ES-PT CBC, complete details on the integration plans are documented in D4.2 [1] along with the results of the coordination plans between the sites and the corridor.

3.2.4.1. Preparation of trials activities

The Greece-Turkey cross-border corridor is characterized by a hard border with tight security controls, requiring vehicles to stop and drivers to step out of their vehicles for paperwork, which might be accompanied with x-ray screening when passing from Turkey to Greece, depending on the specific rules/conditions set at the systems for border monitoring. Thus, the involvement of the Turkish customs agency in the process of carrying out the truck routing in customs area user story is of utmost importance, where general information about the new border area that is being constructed on the Turkish side and the plans for this zone, which is expected to be operational at the end of 2020 or early 2021, has already been received from the authorities during the site visit in July 2019.

When getting prepared for the trials activities, Ipsala border construction and civil works monitoring is a key element because it will help prepare a detailed calendar of trialling activities, with which it will be possible to start fill in the Trial Plan document, indicating the most suitable time frames for moving the vehicles from the Ford Otosan plant to the borders to perform the full trials. Since the user stories to be tested by the GR-TR partners are of a cross-border nature, permissions from the public authorities on both sides of the border is necessary, with procure necessary authorization for performing the trials at the borders being a must for the hard borders under consideration. The platooning with see-what-I-see functionality user story benefits immensely from the Finnish partners in the consortium, who develop the client and server pair that are essential components of the streaming service, and hence FI trial site contribution preparation is part of this phase, aiming to have the final applications ready for the early trials.

In a nutshell, the GR-TR consortium is mainly focused on obtaining the required permissions/consent from the relevant Greek and Turkish public authorities (road operators and customs agencies) in order to perform the trials at the cross-border area, and on scheduling the FI TS contribution to the GR-TR CBC as shown in Figure 7. Specifically, there are ongoing regular discussions between FI TS and GR-TR CBC aiming to define in detail the integration, trial, and evaluation procedures for the concrete contributions of the FI TS to the GR-TR CBC.

Regarding the spectrum allocation, Turkcell (TR) has requested and obtained a trial license while COSMOTE (GR) is expected to make use of an existing frequency license owned by its mother company, OTE S.A. It should be noted that in Greece, 5G spectrum auction is planned to take place during Q4/2020, the outcome of which might have an impact on the frequency bands planned to be used by COSMOTE.

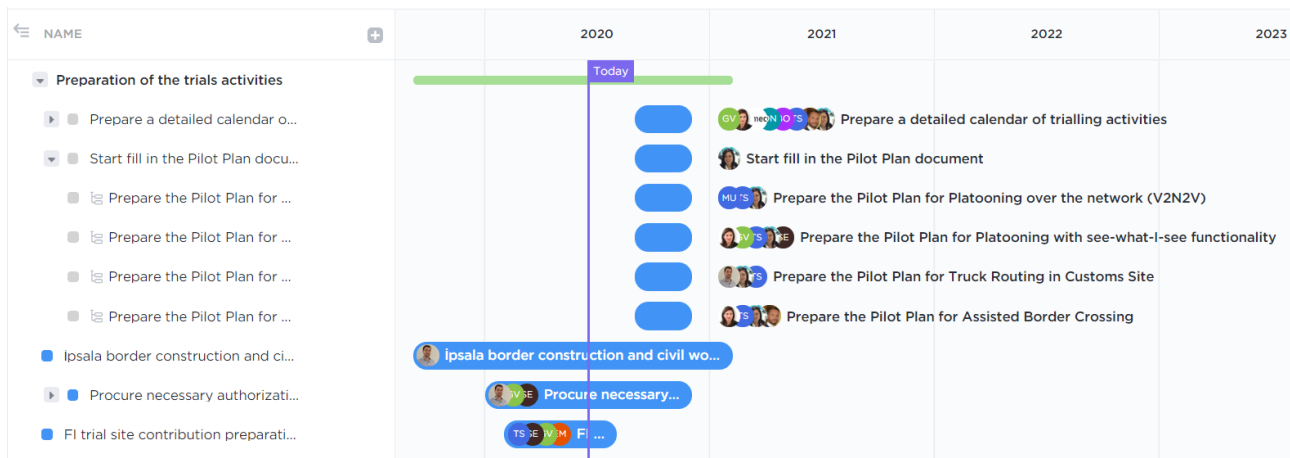


Figure 7 GR-TR CBC- Preparation of trials activities

3.2.4.2. Early trials phase

During the early trials phase, all the functionalities developed in WP3 for the vehicles, 5G networks, OBUs, RSUs and applications will be brought together for the first time to better understand whether these work as expected in a coherent fashion. In continuation of WP3 testing and verification procedures, this phase aims to check and evaluate the performance of each user story scenario. In the GR-TR corridor, the contribution of the FI trial site to the see-what-I-see application is an integral part of the development process, and the deployment of the components from the FI partners (LEVIS server and client) will have already been performed in the previous phase. While each user story will be tested to check that everything is working properly, the FI TS contribution will be integrated and verified.

In case of any issue identified, a set of corrections and enhancements should take place. As it is likely that some of the partners will have to revisit their designs, solutions and/or configurations based on the outcome of the trials, the time spent at the local test location, the Ford Otosan plant, is expected to be larger than the cross-border corridor. Measures will be taken to prevent frequent changes of location, which might disrupt the flow of the four sets of tests that use the same two trucks.

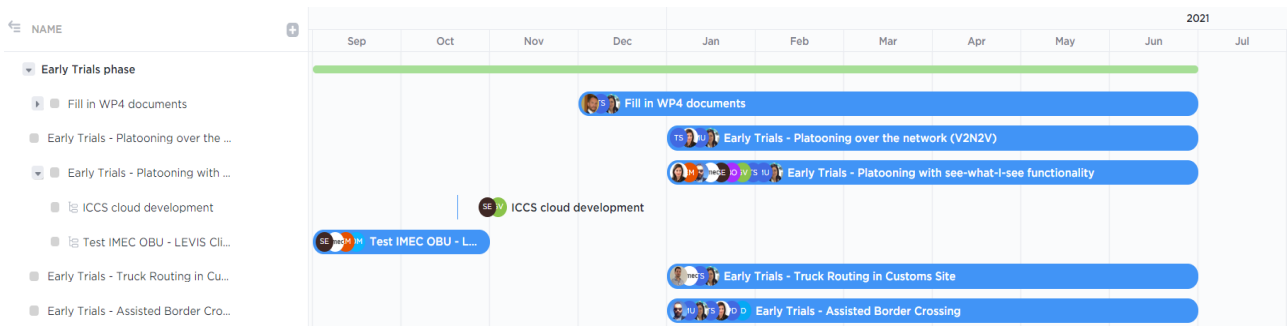


Figure 8 GR-TR CBC - Early trials phase

3.2.4.3. Full trials phase

Following the early trials phase, the full trials phase will begin, with the collaboration of FI TS for obtaining the needed data and KPIs to be later evaluated within the WP5 tasks context. The protocols and scenarios for trialling each user story will have already been defined previously along different work packages and tasks so that the proper KPIs can be obtained in a standardized way from the trials.

The full trials correspond to the phase, where the GR-TR partners have stabilized the trialling in terms of the expected performance for all of the user stories as well as the planning and organisation of the activities to ensure efficiency of the resources needed in the tests. At this stage, the collected data will be ready to feed the work package on evaluation (WP5). Still, some adjustments may need to be made to correct and/or fine tune the behaviour of the equipment, systems, or solutions in order to accommodate the data collection mechanism.

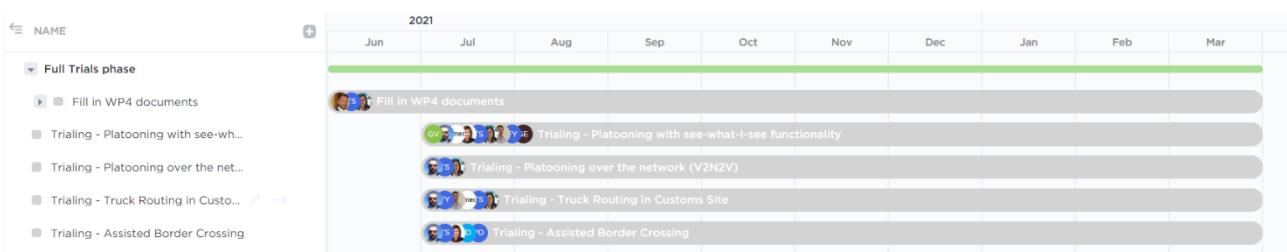


Figure 9 GR-TR CBC - Full trials phase

4. TOOLS TO IMPLEMENT THE METHODOLOGY

The **common methodology** illustrated in Figure 2, will be **implemented thanks to the different tools** that we spread into two chronological categories:

- Tools used to monitor the preparation of the trial activities (M14-M27).
- Tools used to monitor the execution of the trials (M28-M40).

4.1. Monitoring of the preparation of trial activities phase (M14-M26)

4.1.1. Checklist

In order to correctly address the requirements and specifications for each use case category and user stories, a checklist document has been created based on the work performed for the CBC Trial site Specification Collection. This checklist will be filled in before the execution of the trials by each site, in order to monitor the progress of the preparation of the early trials and full trials and it will be presented in D4.2 [1]. It aims to check that all details and actions are ready for execution at M27 and to identify and solve pending issues if there are any.

More precisely, this checklist gives updates on the progress of the authorization's status (roads, 5G frequencies), of the 5G network installation, on the road side and cloud infrastructures and on the vehicle equipment. This checklist also monitors the interoperability between CBCs and TSs equipment, particularly by checking the V2X message versions adopted by CBCs and TSs.

4.1.2. Trial plan

WP2 and WP3 have defined each implemented CBC and TS use case categories and user stories as well as specified the development and the integration of the different components required to enable their application. Thus, one task prepared during T4.1 is the creation of a Trial plan document, that categorizes the needs and specifications of the CBC/TS per UCC and US. These trial plans have been updated in concertation with WP3 and WP5 partners to allow a better coordination between the trials and evaluation needs.

This tool aims to describe for each CBC/TS and per UCC or US their scenarios, needs, dates, places, and duration of each iteration. All cross-border corridors and trial sites leaders will be invited to fill in the final templates for each use case category and user stories before M27.

This exercise allowed WP4 partners and T4.1 to prepare a detailed planning of the trials starting from M27 until the end of the WP4, including local tests, trials at the borders, the different TSs contribution to X border, and demos.

These plans will be presented in more details in D4.2 [1], including updates depending on the COVID-19 situation.

4.1.3. Pilot protocol

Within the context of preparing the trials, CBCs and TSs will have to provide a set of documents that are needed to roll out the iterations with different technical and operational conditions. The documents are particularly to ensure the trial sites comply with national laws and protect users (e.g., drivers) and data privacy. The set of documents is listed in the table below:

Table 3 Pilot protocol list of documents

Type of document	Comment
1. Approval / authorization for demos	The document ensures that the trial site complies with national laws and that all necessary permits are in place. The authorization is provided by the national or local authorities.
2. Recruitment process	Form explaining how the users (e.g., drivers) will be recruited.
3. Consent form	The consent form is used with test users participating in the user stories. The consent form assures that GDPR issues are correctly handled in the CBCs and TSs. The consent form describes the purpose of the tests, in which information is collected from the test users, the potential risks, and how the collected information is used in the project. In addition to privacy issues, the consent form also addresses issues related to the physical participation in the trials.
4. Project factsheet	The project factsheet briefly describes the 5G-MOBIX project and is used during the briefing phase of test users.
5. GDPR data processing record template	This document identifies the data controller and processors and describes GDPR related processes as defined in the template of D1.4 Data Management Plan [7].
6. Data Protection Impact assessment	A DPIA is a process designed to describe the processing, assess the necessity and proportionality of a processing and to help manage the risks to the rights and freedoms of natural persons resulting from the processing of personal data (by assessing them and determining the measures to address them).
7. Image right	The purpose of this form is to collect the user's agreement to use the pictures or videos recorded during the demos. Each CBC and TS taking

	picture/videos from the users has to provide such a form. The information in the document can be integrated to the consent form.
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4.2. Early and full trials supervision

4.2.1. Detailed calendar

Each CBC and TS will continuously update their trials planning. Especially since the pandemic situation is still evolving. So far at M28 (date of the resubmission of this document), the trials time planning does not need to be shifted in time due to the COVID-19 pandemic.

Thanks to both the Trial Plan and the ClickUp management tool used at consortium level, a detailed calendar for each CBC and TS as well as for the contribution of TSs to CBCs will be generated and presented in D4.2 [1]. This will give an overview of the specific periods during which the trials will be executed, for each use case category and user story, with which 5G features and technologies as well as all the foreseen iterations.

4.2.2. Progress reports

A follow-up will be done to monitor the progress of the early and full trials and to ensure a perfect efficiency in their execution. To do so, two progress report documents developed by T4.1 will be filled in within the tasks T4.2 to T4.9 in May 2021 (M31) and in December 2021 (M38). These two timeslots have been selected since they intervene at the middle of each trialling phases, allowing T4.1 partners to have a mid-term feedback on each phase and thus to adjust the coordination if necessary.

These reporting documents will cover the advancement of the CBCs and TSs tests and integrate high level information on:

- Trialling advancement at CBCs/TSs (special attention will be devoted to the evolution of the COVID-19 pandemic and its possible effects on the trials activities).
- TSs contributions to CBCs
- The advancement and resolution of the cross-border issues (defined by WP2)
- Data collection (defined by WP5)

4.2.3. Data collection

This section focuses on the data collection process in compliance with WP3/5 requirements/tools for all kinds of evaluation activities and explains how the collection of different types of data during is organised the trials.

D2.5 [5] and D5.1 [8] on KPIs data collection , indicate which data need to be addressed by the different evaluation topics. Thanks to this, WP4 leaders will ensure that the needed type and amount of data are collected during the tests and trials phases, based on the tools delivered by T3.5.

- **Data to be collected for Technical evaluation.** WP4 role is to ensure that relevant test data will be collected on each CBC and TS in accordance with T5.2 requirements.
- **Data to be collected for Users acceptance evaluation.** In order to organise an efficient data collection regarding the user's acceptance KPIs, some key documents and protocols will be prepared in advance and given to the users collaborating in CBC/TS user stories trials. Some steps will need to be rigorously followed such as:
 - Recruitment process.
 - Administrative and mandatory documents to be prepared and signed by users.
 - Interviews and questionnaires (prepared by WP5; adapted to local sites if needed in collaboration with WP4 test and trial sites leaders).

More details on the information required to correctly organise this data collection can be found in section Pilot protocol 4.1.3.

- **Data to be collected for Impact assessment.** Still in relation with the work of T2.5, KPI and evaluation data specifications, the impacts assessment KPIs will need to be correctly monitored and prepared before collection for both the objective (technical evaluation for instance for business, environmental impacts etc.) and subjective (user evaluation for instance for societal impacts) data needed.

This part is strongly linked with WP5 and with the definition of the KPIs in deliverable D2.5. As these tasks are still ongoing, WP4 and T4.1 will keep tracks on the KPIs definition evolution in order to orient the preparation of the data collection during the trials.

4.2.4. Coordination of the experts and management tools

In order to successfully address the needs and the coordination of the tests and trials, an efficient communication and coordination is required by each CBC/TS and their experts. This coordination will be facilitated thanks to different communication methods and tools.

- Biweekly calls are organised by T4.1 to check the progress and propose action plans to be undertaken until the next call and meeting minutes are produced and stored on the SharePoint of the project. This biweekly schedule might be intensified when approaching the trialling phase, when the synchronisation between CBCs and contributing TSs might need more alignment or when the CBCs and TSs will have to report their progress while executing the trials.
- To facilitate the work of WP4, regular telcos are also organised cross WPs, mostly to align between WP3, WP4 and WP5.
- The Technical team supports and guides technical discussions and helps in the orientation of the project.
- (Virtual) Workshops and experts' meetings will be organised to facilitate communication and address potential difficulties that will appear during the next phases.

5. CONCLUSION

This deliverable presents a generic and common methodology for the preparation and execution of the 5G-MOBIX trials that will be used as a guide to monitor and supervise the progress of the trials of the different implemented use case categories and user stories within 5G-MOBIX CBCs and TSs. In addition, this methodology will ensure delivering proper results to WP5 and WP6 for data evaluation and consultation's study respectively.

To set up this methodology, this deliverable describes, through a top-down approach, the implementation of this common methodology and the different tools that will be used to supervise it. It also aims to generate a macro calendar for each CBC and TS, as detailed as possible. This adaptation of WP4 timeline to each CBC and TS, also aims at showing the contribution of TSs to CBCs as specified in WP3 T3.1.

This generic methodology should now become CBCs and TSs specific and will be more detailed in the deliverable D4.2 in M26 once each site has adjusted it to its specificities and will provide more details on the ongoing process of the preparation of the trials.

However, at CBCs and TSs level, the methodology has already started to be implemented, and as seen in the figures extracted from the online management tool ClickUp, the preparation of the trials phase is already well advanced.

6. REFERENCES

- [1] *5G-MOBIX Deliverable D4.2, "Report on the methodology and pilot sites protocol", February 2021.*
- [2] *5G-MOBIX Deliverable D3.6, "Report on trial readiness verifications", April 2021.*
- [3] *5G-MOBIX, Deliverable D6.1, "Plan and preliminary report on the deployment options for 5G technologies for CCAM", May 2021.*
- [4] *"5G-MOBIX Deliverable D2.1, "5G-enabled CCAM use cases specifications", April 2019".*
- [5] *5G-MOBIX Deliverable D2.5, "Initial Evaluation KPIs and Metrics", October 2019.*
- [6] *5G-MOBIX Deliverable D3.1, "Corridor and Trial Sites Rollout Plan", May 2020.*
- [7] *5G-MOBIX Deliverable D1.4, "Data management plan", April 2019.*
- [8] *5G-MOBIX Deliverable D5.1, "Evaluation Methodology and Plan" February 2020.*

7. ANNEXES

Annex 1 – Trial sites timeline overview

The figures below give an overview of the WP4 timeline application to the TSs and some elements of description of the TSs.

7.1. DE Trial site

The DE Trial site is located in the city centre of Berlin, with TUB, GT-ARC, Valeo, Vicomtech and Fraunhofer as local partners, and is based on a deployment that has been created by TUB in the scope of past and on-going national projects. DE TS follows the general WP4 timeline that has been updated taking into considerations the delayed works in WP3 due to the pandemic and resulting shift of trialling activities. That said the DE TS timeline comprises three trialling phases, namely preparation, early trialling, and full trialling. In the following section, we provide an overview of the currently on-going preparation phase and the plans for the early and full trialling phases.

7.1.1. Preparation of trials activities

Following the available WP2 specifications and after WP3 development, deployment and integration activities will be fully concluded towards the end of 2020, the trial site will be ready for the DE TS (early) trialling activities. Apart from these aspects a wide range of organizational aspects have to be covered in order to prepare for the trialling and to ensure smooth operations during trialling activities. TUB has organized telcos involving the DE TS partners to coordinate the activities and to ensure the readiness of the site. During the preparation phase authorizations are checked and obtained if needed and legal aspects such as GDPR issues are covered, so that the trialling activities can be conducted in conformance with the local regulations. Based on the current timeline the preparation of trials will conclude in the end of January 2021, as depicted also in the Figure 10 below generated from the ClickUp tool. An important activity in the preparation phase is the alignment between the DE TS and the ES-PT CBC, which ensures the interoperability of DE TS's contribution to the ES-PT CBC. For this purpose, relevant matters will be discussed also in alignment telcos taking place with the relevant partners from all countries.

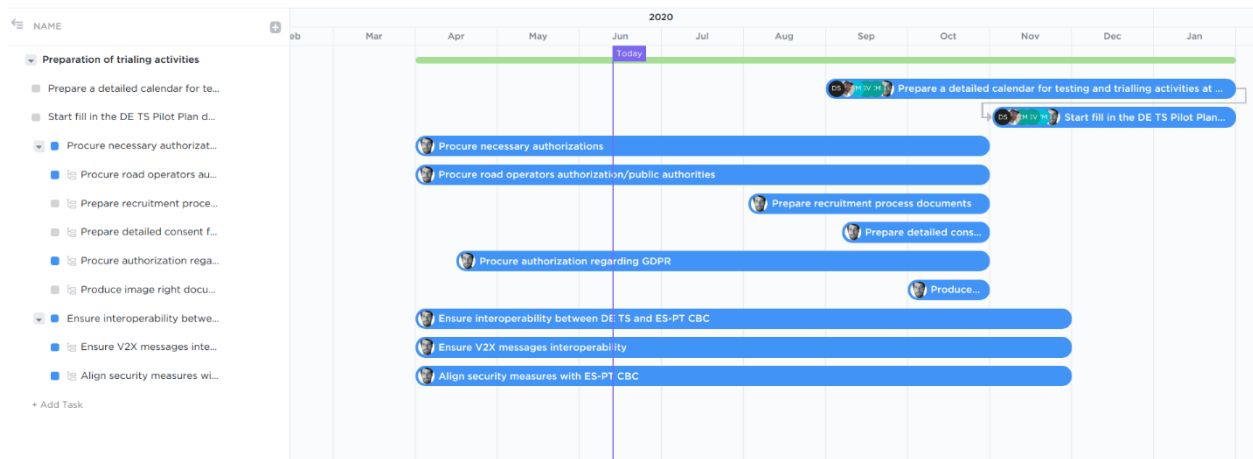


Figure 10 DE TS - Preparation of the Trials activities

7.1.2. Early trials phase

The early trials phase at the DE TS is set to start in January 2021 with both use cases for extended sensors and eRSU-assisted platooning. In the early trialling rescheduled iterations of the early trials will take place with adjusted parameters in each iteration, until the outcome reflects the expected results. Similar to the preparation phase, specific efforts will be made in the early trials phase in order to align the DE TS contribution to the ES-PT CBC. The timeplan for the DE TS early trials, associated tasks and assignees are managed in the ClickUp tool as depicted below.

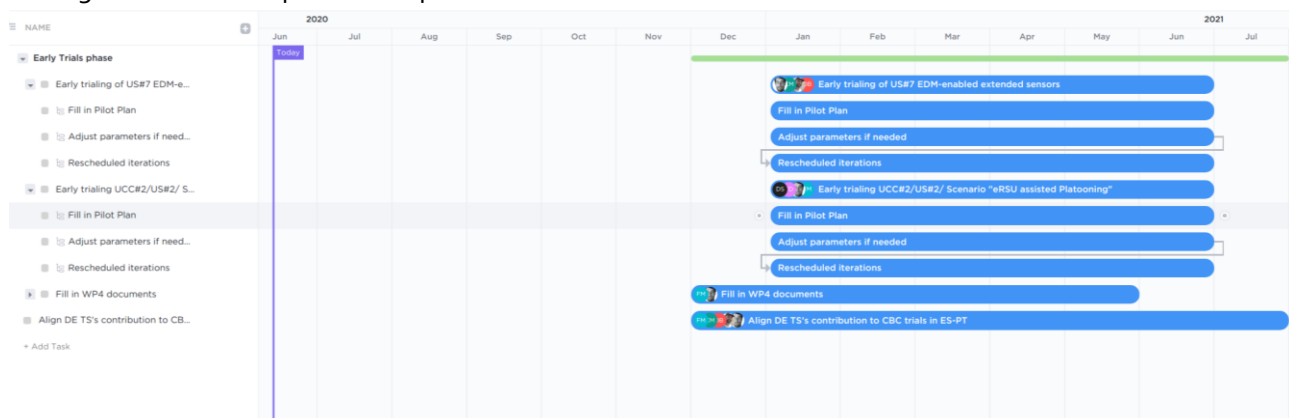


Figure 11 DE TS - Early Trials Phase

7.1.3. Full trials phase

When the early trialling phase has been successfully concluded, the full trialling is set to begin at the DE TS. The early and full trialling phases are foreseen to partly overlap, depending on the progress and required number of re-iterations due to parameter changes in the use cases to close off the early trialling stage. The foreseen tasks and activities, as well as the timeline of the trialling phase for both DE TS use cases, are managed in the ClickUp tool as shown in the picture. The full trialling phase also comprises the execution of trialling at the ES-PT CBC with the contributed extended sensors use case.

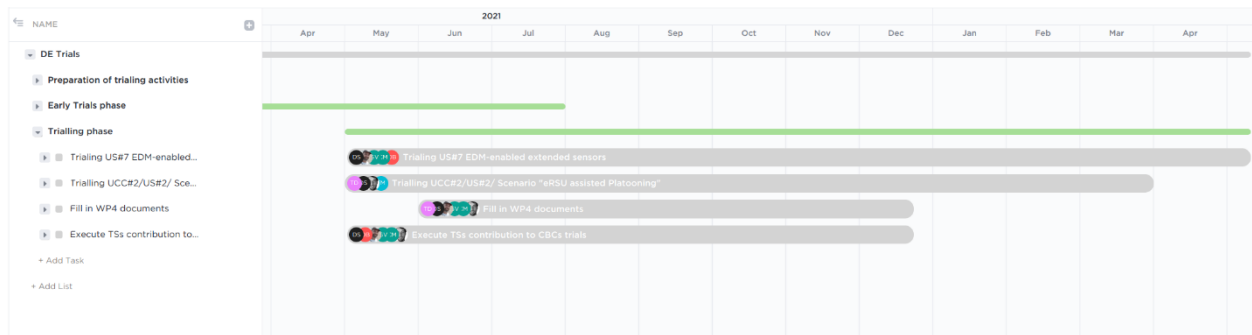


Figure 12 DE TS - Full Trials phase

7.2. FI Trial site

In the FI trial site, the local partners include AALTO and SENSIBLE⁴. In addition, the FI trial site is receiving contributions from partner DEKRA regarding evaluation activities.

7.2.1. Preparation of trials activities

Following the planning and integration activities, respectively from WP2 and WP3, the FI trial site has one site deployed and functional and a second site in under preparation. These deployments are self-funded by past and ongoing national projects or AALTO own resources. MEC and cloud servers are already deployed and in testing phase. Concerning the automated L₄ vehicle, this is provided by SENSIBLE⁴ and possess all sensory and automated driving capabilities in place. Finally, mobile multi-SIM OBUs were procured or developed, integrated into the automated vehicle, and tested. The site is testing a multi-SIM SA OBUs, developed by AALTO, and based on 5G modems from Quectel. For the trials with vehicles, the site is using a multi-SIM OBU developed by Goodmill. This OBU is operating in NSA mode but it will to SA by Q2 2021. Frequencies have been requested and approved before the start of the project. The road authorizations are also approved. DEKRA is providing evaluation tools which are being integrated in different systems at the FI trial site. In addition, AALTO is having regular discussions with ES-PT and GR-TR CBCs about the FI contributions to both CBCs trials. The timeline of the preparations will not be severely affected by the covid-19.

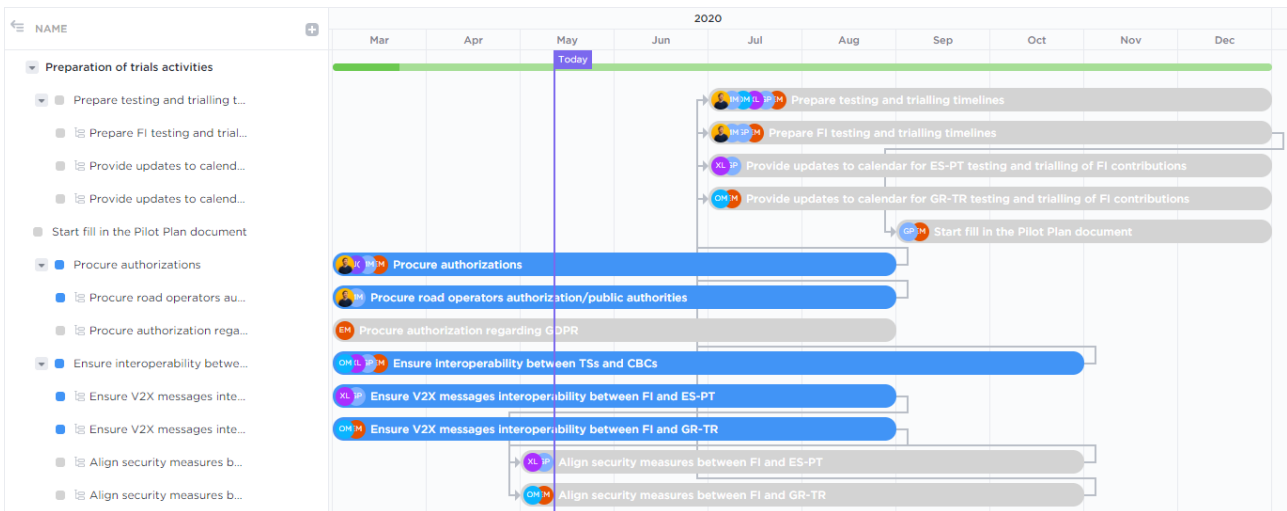


Figure 13 FI TS - Preparation of trials activities

7.2.2. Early trials phase

The FI trial site will have three (3) contributions to CBC, two to ES-PT and one to GR-TR. Contributions to ES-PT include a MEC service discovery protocol for obtaining resources from the network while changing PLMNs, and a multi-SIM OBU solution. Contribution to the GR-TR consists of the LEVIS server for video streaming while vehicles change PLMNs. The FI trial site, coordinated by AALTO, is having regular teleconferences with both CBCs to align efforts and improve descriptions (including specifications and requirements) for integration of the contributions. The timeline of the contributions will not be severely affected by the covid-19.

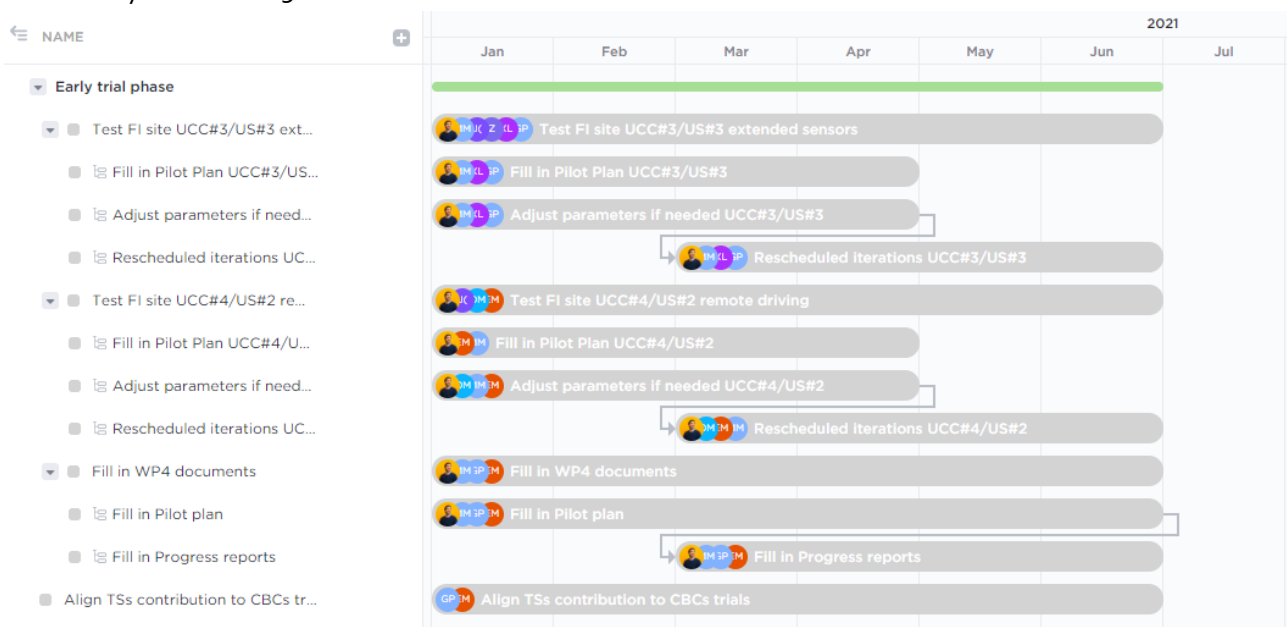


Figure 14 FI TS - Early trials phase

7.2.3. Full trials phase

The planning of actual trials, at the FI trial site as well as the ones where the FI trial site will contribute at both CBCs, are in early phase. These planning activities will be supported on updated and detailed descriptions of local developments as well as CBC contributions following the guidelines of task T3.6, namely sequence diagrams. These diagrams are iterated with CBCs in order to improve the understanding on the cross-border network characteristics.



Figure 15 FI TS - Full trials phase

7.3. FR Trial site

7.3.1. Preparation of trials activities

In the FR site, local partners are composed of: VEDECOM, AKKA, CATAPULT, Orange/Ericsson, and Bouygues. In this first phase of trials preparation, several efforts have been made to prepare the FR trial sites for trials activities. Following the planning and integration activities, respectively from WP2 and WP3, the FR trial site is composed of two sites: The first one is VEDECOM closed site in Versailles, and the second one is at UTAC/CERAM facilities called TEQMO. During this phase, VEDECOM has organised multiple meetings and telcos with different FR TS partners to coordinate and prepare trials. These discussions have focused on the readiness of the sites and logistics aspects: many discussions and agreements have taken place involving the telecom operators and road operators in order to obtain the needed authorizations for performing the trials with feedbacks from road operators.

Therefore, several trialling premises have been installed in the TS: 5G base stations of both Bouygues and Orange are already installed in TEQMO centre since M12. The procurement of roadside sensors was carried out in M19.

On the other hand, the acquisition of the 5G frequency at TEQMO site for Bouygues Telecom will be delayed since the ARCEP (national agency for frequency allocation in France) has announced that the 5G auction will be delayed until July(M21), or even September 2020 (M23), which will obviously include an additional delay between 3 and 6 months.

Moreover, actions regarding the selection and obtaining spectrum band for the NR 5G network have been carried out. The goal of these meetings with the national telecommunications regulator (ARCEP) is to get those band needed for tests.

VEDECOM has also led the discussions with the ES-PT CBC regarding the collaborations on transferable assets to the CBC. These discussions aim to define in detail the integration, trial and evaluation procedures for the concrete contributions of FR TS to the ES-PT. Currently these contributions are clearly defined, and a timeline will have to be designed in order to organise different activities related to integration testing, trialling and evaluation of these contributions in the ES-PT CBC.

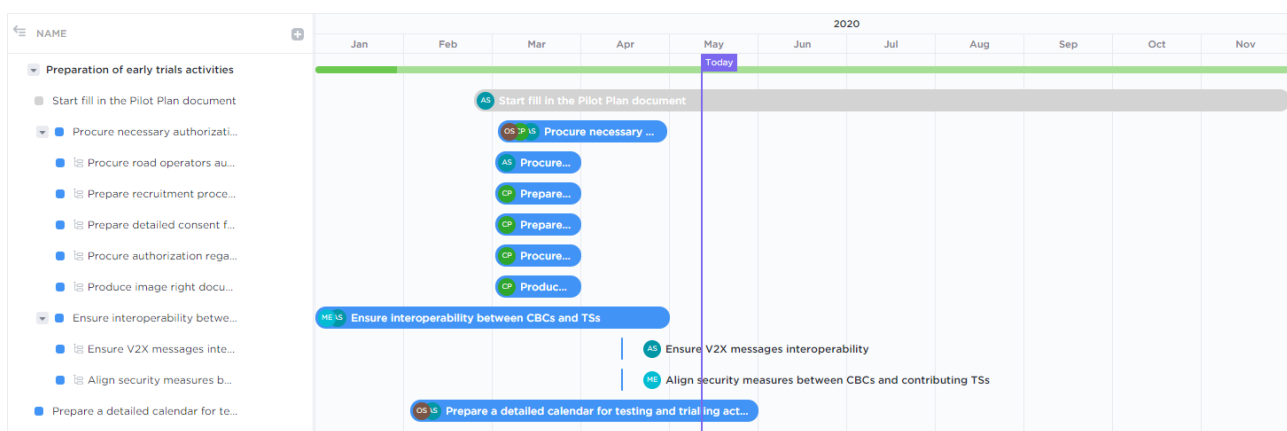


Figure 16 FR TS - Preparation of trials activities

7.3.2. Early trials phase

During the early phase of trials, first tests of the system as a whole is expected to be carried out. As individual components of the system have been already tested, integrated, and verified during WP3 timeline, this phase aims to clearly check the performances of each user story scenario.

In addition, a first testing of the FR TS contributions to the ES-PT CBC will be executed to check that everything is working fine.

The FR TS will have two contributions to the ES-PT CBC: the first transferable asset will be a Connected Car and Smart Router with Satellite Bearers. The connected car will be integrated into the ES-PT advanced driving user story in order to explore the interoperability of a “foreign” car with the local network and vehicles and to benchmark the seamless handover solution for a user story with stringent URLLC requirements. The second contribution is a Multi-PLMN OBU Solution in order to benchmark handover

latency parameters and service continuity in a Multi-PLMN OBU solution integrated into a connected vehicle that will be developed in the FR TS. The expected results include 0 milliseconds of disconnection period for the application flow of the remote driving user story.

The FR TS, coordinated by VEDECOM, is having regular teleconferences with ES-PT CBC to align efforts and improve descriptions (including specifications and requirements) for integration of the contributions. The timeline of the contributions will be severely affected by the covid-19.

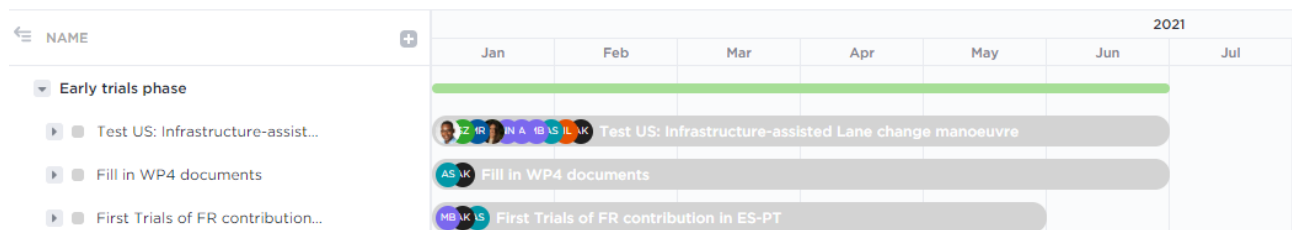


Figure 17 FR TS - Early trials phase

7.3.3. Full trials phase

Once the early trial phase is finished, a set of enhancement will be made to the software as well the hardware components based on the obtained results and comparison to expected behaviour. Then, the full trials phase will begin during which “official” trials will take place. This latter will require that the protocols and scenarios for trialling each user story are clearly defined, so that the proper KPIs can be obtained in a standardized way from the trials.

During this phase, the FR TS partners will also contribute to the full trials in the ES-PT CBC through the transferable assets that has been already tested in the early trials phase.

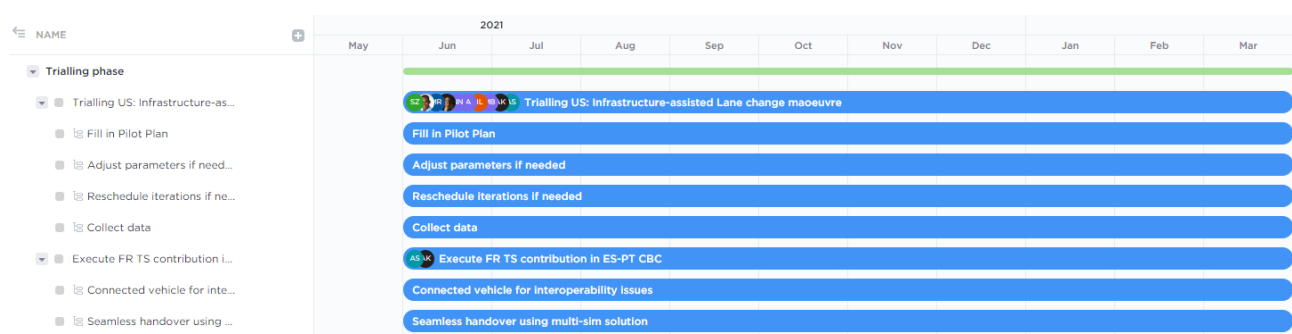


Figure 18 FR TS - Full trials phase

7.4. NL Trial site

The NL trial will be conducted at the motorway A270/N270 connecting the cities of Eindhoven and Helmond in the Netherlands as well at the campus of Technical University of Eindhoven and a closed area close to the Automotive campus in Helmond. Three user stories, namely Cooperative Collision Avoidance, Extended

Sensors with CPM and Remote Driving using 5G positioning in use case categories of Advanced Driving, Extended Sensors and Remote Driving, respectively, will be trialled at the NL trial site.

7.4.1. Preparation of trials activities

One of the main tasks in the preparation phase is to obtain necessary authorization for using the 3.5Gh frequency as well as authorization from road operators. License for 5G network for the three networks from KPN, TNO and TUE has been secured. Since the user stories, Cooperative Collision Avoidance, and Remote Driving will be trialled in a closed site, road exception is not needed for the participating AD vehicles from VTT, TUE and Siemens. For the Extended Sensors with CPM user story, Siemens is pursuing a road exemption for their vehicle to drive in the motorway A270/N270. TNO's vehicle will only be driven as connected vehicle for this user story.

NL trial site has initiated several discussions with ES-PT sites to agree on contribution to cross-border corridor, including the components to transfer, the scenarios to evaluate and data logging and KPIs for evaluation. Further discussion on standardization of messages and interconnecting MECs to ensure interoperability between CBCs and TSs are progressing.

As described in the D3.1 [6], one of the components transferred to ES-PT CBC is the Manoeuvre Coordination Service running in the MEC, which is developed in the context of the user story Cooperative Collision Avoidance in NL. In the follow up discussions with ES-PT CBC, it has been identified that to benchmark the outcomes of in-vehicle decision-making approach versus the infrastructure decision-making approach, it will be better to consider the Overtaking user story in ES-PT rather than the Lane Merge scenario since integrating MCS support in an over taking scenario is straight forward extension to the Cooperative Collision Avoidance user story in NL. Additionally, comparison of the 5G functionalities of ES-PT (in NSA-NSA mode and two MECS) with NL trials set-ups such as NSA - SA and SA-SA networks (with several MECs, one or multiple PDU sessions, slicing and other features) in the context of a Lane merging application is also planned.

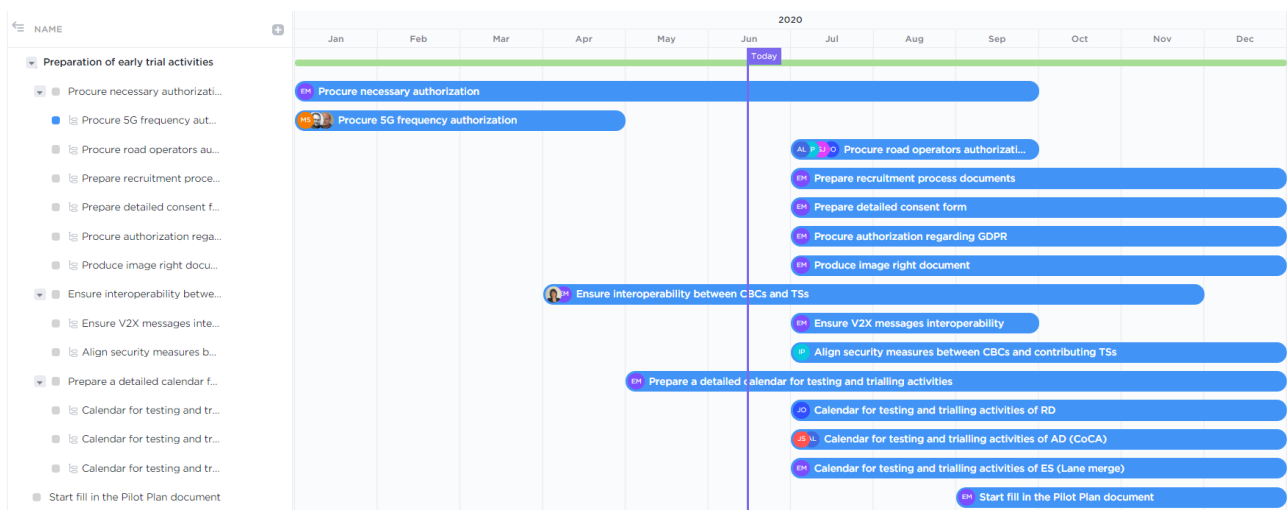


Figure 19 NT TS - Preparation of trials activities

7.4.2. Early trials phase

In the early phase of trials, the performance of the three user story scenarios will be checked at the NL-trial site as well the components transferred to the ES-PT will be integrated and verified according to the early trial plan of ES-PT. Interoperability issues between ES-PT and NL sites will identified and rectified in this period.

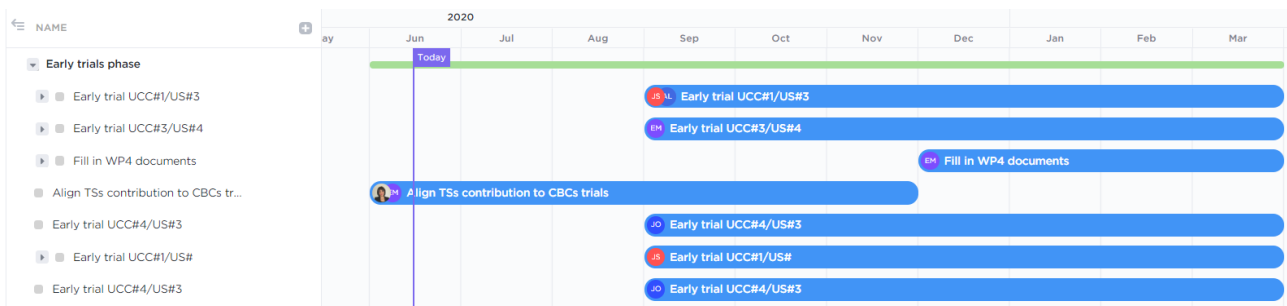


Figure 20 NL TS - Early trials phase

7.4.3. Full trials phase

After the early trials the full trials will start at NL trial site and at ES-PT CBC. Most of the user stories as well as user-story agnostic communication performance trials will be carried out in TNO and KPN networks, except for the localization trails (using 5G in the Remote Driving) which will be trialled in TUE network. In general, trials at NL site will be performed according to the general timelines set in this deliverable, i.e. M31 – M40. However, the trials with KPN network maybe finished in the second quarter of 2021 to get a consistent evaluation results, as KPN expects to roll-out an upgrade of their 5G SA core network at that period.



Figure 21 NL TS - Full trials phase

7.5. CN Trial site

7.5.1. Preparation of trials activities

In the CN trial site, SDIA has completed the initial tests of 5G modules and IoV devices, and the results showed that these devices could run smoothly with 5G. The OBUs on the self-driving trucks of CNHTC had been debugged to run smoothly; The RSUs and 5G base stations on the QLTI highway had been installed; and DDET has developed MEC applications and cloud platform in urban areas based on SDIA devices.

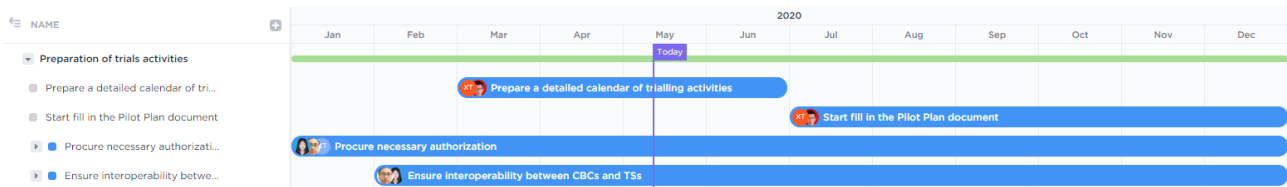


Figure 22 CN TS - Preparation of trials activities

7.5.2. Early trials phase

DUT made the test plan and carried out the initial simulation tests, which help to develop and implement field test plans in the CN trial site. DDET will test cloud and MEC applications following field test plans. And the extra tests of CNHTC's self-driving trucks will run at the QLTI highway next year. Activities in the CN site in two commercial networks with commercial PLMNs (China UNICOM, China MOBILE) may contribute to ES-PT CBC.



Figure 23 CN TS - Early trials phase

7.5.3. Full trials phase

The actual trials at the CN trial site are still in early phase. The timeline of the contributions will not be severely affected by the covid-19.



Figure 24 CN TS - Full trials phase

7.6. KR Trial site

7.6.1. Preparation of trials activities

In the KR TS, there are three local partners (Korea Automotive Technology Institute (KATECH), Electronics and Telecommunications Research Institute (ETRI), SnetICT), and one vehicle manufacturer (Renault Samsun Motors (RSM)). In the preparation phase of WP4, several efforts have been done to prepare the KR trial site. The KATECH has constructed urban type proving ground (300m X 300m) supporting WAVE based V2X communication link, optical communication cable to support 5G NR communication link around the proving ground. The proving ground is equipped with various test roads and infrastructures such as four controllable traffic lights, one GPS blocked tunnel, two roundabouts, Belgian road, etc. ETRI developed mmWAVE based 5G NR (Non-stand-alone) with a narrow communication beam width of 18 degrees and deployed it in the proving ground. SnetICT provided the 5G core network system and designed communication system to support mmWAVE based 5G NR in the proving ground.

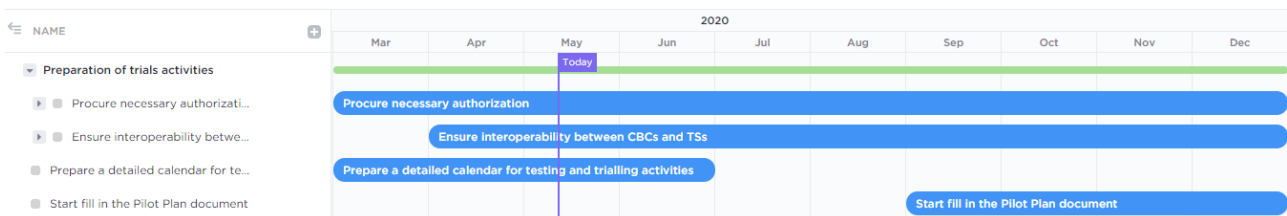


Figure 25 KR TS - Preparation of trials activities

7.6.2. Early trials phase

The KATECH had been developing a remote-controlled vehicle supporting 5G OBU with RMS. Brand-new SUV 'XM3 of the RSM' is used as a test vehicle and various advanced driving assist system such as blind-spot detection system, forward-collision warning system, lane detection system, around view monitoring system, etc were equipped in the test vehicle. Totally eight cameras are equipped on the test vehicle; four cameras to stream one around-view image, and four cameras to stream front, left-right, and rear image.

During the early trial phase, individual test and system integration are expected to be carried out. As an individual test, KATECH has tested a remote-controlled vehicle, and video streaming functionalities. ETRI has been developing mmWAVE 5G NR with a wider range of beam width of more than 36 degrees which is

applicable in the real road test and 5G OBU. SnetICT has been developing a 5G core network and network slicing technology to target low latency of less than 10 ms. KR TS partners are now preparing first system integration and demonstration within the next few months, but the timeline is slightly delayed by the COVID-19.

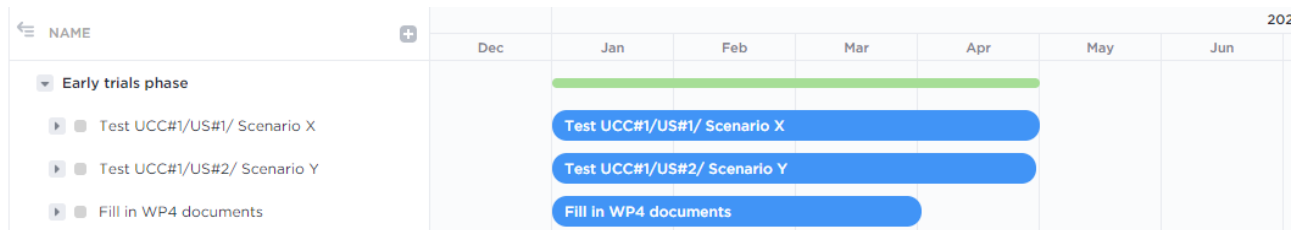


Figure 26 KR TS - Early trials phase

7.6.3. Full trials phase

Once the early trial phase is completed, KR partners will analyse test results and compare them to the expected result. Based on this analysis, some enhancements of the whole system will be made in the remote-controlled vehicle part as well as the 5G communication part. After that, the full trials phase will be begun. As a first stage of the full trials, KR TS will prepare the first demonstration to KR government and the final stage of the full trials.

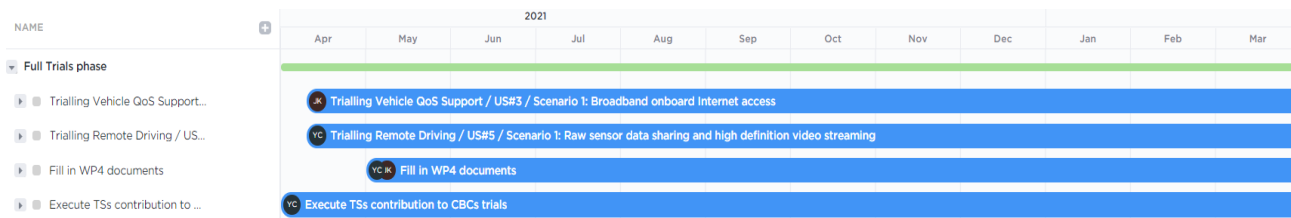


Figure 27 KR TS - Full Trials phase