



Milestone 30 - Definition use cases and location including a deployment plan for C-ITS elements for all pilot sites

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Table of contents

1.	Introduction.....	3
2.	Pilot site 1 – C-ITS deployment on the Austrian core network corridors.....	5
	Pilot overview.....	5
	Location	5
	Use Cases covered by the pilot.....	6
	Schedule and Demonstration plan	7
3.	Pilot site 2 – Development of Hybrid C-ITS specifications together with Austrian telecom providers (including test track CCAD in Graz).....	8
	Pilot overview.....	8
	Location	9
	Use Cases covered by the pilot.....	9
	Schedule and Demonstration plan	9
4.	Pilot site 3 – City of Graz	10
	Pilot overview.....	10
	Location	10
	Use Cases covered by the pilot.....	11
	Schedule and Demonstration plan	11
5.	Pilot site 4 – City of Vienna.....	13
	Pilot overview.....	13
	Location	13
	Use Cases covered by the pilot.....	15
	Schedule and Demonstration plan	16
6.	Pilot site 5 – City of Salzburg	17
	Pilot overview.....	17
	Location	18
	Use Cases covered by the pilot.....	18
	Schedule and Demonstration plan	19
7.	Summary.....	20

Title:

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1. Introduction

Within the C-Roads 2 project in Austria the pilots focus on the one hand side on the hybrid communication implementation and core network roll-out and on the other hand side on urban area applications. Within this milestone report the Austria pilot sites are described related to their location and the use cases, which are planned to be implemented, are listed. A deployment plan shows a rough time schedule for the implementation of the single pilot sites.

The importance of the Austrian C-Roads pilots is linked to two factors:

- the strong interdependencies between the Austrian Infrastructure networks and the TEN-T networks (including the interface to urban areas) in Europe, given that less than 20% of regular road transport flows of trucks on Austrian road networks has its origin and destination in Austria
- the Austrian C- ITS strategy of the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) which sets the single C-ITS development steps till 2020 in an organisational framework, including the cooperation with other public entities and industrial stakeholders.

The Austrian C-Roads pilots will encompass pilot sites in the Vienna area (including the urban interface), the motorway section from Vienna to Salzburg (including the urban interface to Salzburg), as well as in Tyrol and the greater Graz area (including the urban area).



Figure 1: Overview of the Austrian C-Roads 2 pilots

The Austrian pilots consist of five pilot sites:

- Pilot site 1: C-ITS deployment on the Austrian core network corridors
- Pilot site 2: Development of Hybrid C-ITS specifications together with Austrian telecom providers (incl. test track CCAD in Graz)
- Pilot site 3: City of Graz
- Pilot site 4: City of Vienna
- Pilot site 5: City of Salzburg

These are explained in more details in the following chapters.

2. Pilot site 1 – C-ITS deployment on the Austrian core network corridors

Pilot overview

Pilot Site 1 – a full C-ITS deployment on the Austrian core network corridors is an ongoing effort that started in the original C-ROADS action and is continued and brought to conclusion here. This deployment is building on the core elements of the European C-ITS Corridor project in Austria (ECo-AT) and extends them to a full network of C-ITS stations, with 175 roadside stations equipped until 2021 and the possibility to extend that number to 525 in the following 3-5 years.

First steps in C-ITS were taken in 2016, when a pilot area (“ECo-AT Living Lab”) around Vienna with 24 ITS-G5 Roadside ITS stations was open and operational for stakeholders, resulting in six official test cycles and cross border tests.

Bases on the results of that lab and the resulting ECo-AT specifications and of course the harmonization efforts of the C-ROADS platform, a hybrid C-ITS deployment (ITS-G5 and Cellular) on the whole Austrian motorway network, including Day-1 and Day-2 use cases has been issued end of 2018, with the intention to have an operational system until the end of 2019.

With the Delegated Regulation on C-ITS not materializing in 2019, the tender was put on hold between the first stage (=applicant qualification) and the second stage (=description of services to be rendered) to reassess the situation. After the formation of the “C-ITS Deployment Group” (<http://c-its-deployment-group.eu/>) and its successful statement on continued deployment in late 2019, the Austrian ministry and ASFINAG decided to continue with the national tender with a new time frame, starting C-ITS Deployment in late 2020 with a fully operational system until 2021.

For official C-ROADS testing in 2020, an additional tender was issued to update parts of the ECo-AT Living Lab to the current level of C-ROADS specifications – a contract for this additional “C-ROADS Pilot Austria” for testing was awarded to SIEMENS in late 2019, with 25 ITS-G5 Roadside Stations around Vienna, Graz and Linz ready for testing.

Location

The first part of the operational C-ITS rollout in Austria will cover several different areas of the motorway network with an overall number of 175 C-ITS roadside stations:

- The motorways around Vienna (A23, A4, S1, A2), already in operation for the “Living Lab”, will be updated in number and equipment to full deployment status.
- The motorways from Vienna to Linz and Salzburg (A1, A7), a stretch of nearly 300km and the Austrian part of the “C-ITS Corridor” between Netherlands, Germany and Austria, will also be fully equipped with numerous C-ITS roadside stations.
- The motorways around the city of Graz (A2) are part of the proving region for automated driving established in cooperation with the ALP.Lab consortium. Consequently, ITS-G5 roadside equipment has been installed there and will be further extended in the rollout.

- Further important locations included in the rollout are traffic hot spots on the rest of the Austrian motorway network (e.g. A12 / A13 in Tyrol) and several border areas, which are relevant for cross-border deployment.
- The rollout starts from these deployment locations and extends them to the overall Austrian motorway network, which spans around 2200 km in total. The overall rollout allows for up to 525 roadside locations on the whole Austrian motorway network until 2024 – 2027.

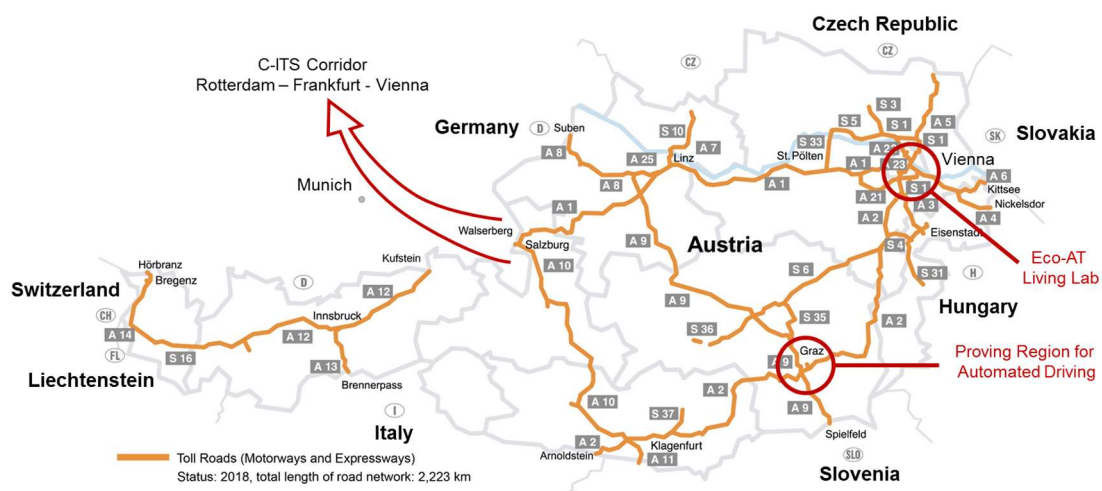


Figure 2: Location of Pilot Site 1: C-ITS Deployment on the Austrian core network corridors

Use Cases covered by the pilot

The C-ITS use cases in this deployment are the harmonized infrastructure uses cases published by C-ROADS platform releases: “Roadworks Warning” and “Hazardous Location Notification” (based on the ETSI DENM message), “In-Vehicle Signage” (based on the ISO IVI message), including the “Protected Zones” service (based on the ETSI CAM message [14]), which ensures that the existing CEN-DRSC based tolling system is not suffering from interference from the C-ITS system. However, this is only the first generation of C-ITS use cases, so called “Day 1” services. ASFINAG also plans to support services from the second-generation “Day 2” services to more specifically assist automated driving. These services deal with topics like route clearance, distance gaps, platoon support, vehicle type and/or lane specific speed recommendation but also broader issues like collective perception of objects or persons on the road or GNSS enhancement. These new services are based both on updated or revised standards (e.g. a new “automated vehicle” (avc) container in the ISO based IVI standard in its 2020 revision) as well as new message services and message formats, like the ETSI defined “Collective Perception” (CPS) and “GNSS Positioning Correction” (GPC) services. All necessary standards and the harmonized profiles from the C-ROADS platform are expected to be available in 2020 / 2021.

Schedule and Demonstration plan

A contract for the depicted C-ITS deployment is expected to be awarded in Q3/2020. The first part of that deployment with all central elements (C-ITS central stations, C-ITS Security PKI, 175 Roadside stations) will then start in Q4/2020 and last until the end of 2021. Later on, the number of roadside stations can be increased to a maximum of 525 until 2024 (regular contract) or 2027 (extended contract).

This will be an operational system for operational C-ITS equipped vehicles in live traffic. Testing and demonstrations will be possible within the operation system at any time and any place.

Further tests and demonstrations planned for 2020 are:

- “C-ROADS Pilot Austria” tests with all C-ROADS participants during all of 2020, using 25 C-ITS Roadside Stations around Vienna, Graz and Linz
- “INFRAMIX” C-ITS tests in May 2020 in Graz (AustriaTech), using 12 C-ITS installations around Graz. These tests are concentrating on Day 1 and Day 2 use cases to support Automated Driving in a mixed traffic environment
- “ICT4CART” Tests in Summer and Autumn of 2020 in Graz and the Austrian / Italian border at Brennero, using the 12 C-ITS installations in Graz and 2 additional C-ITS Roadside Stations at Brennero. These tests are concentrating on cross-border C-ITS communication over different communication media.
- “Connecting Austria” C-ITS Tests in mid 2020 using 5 new C-ITS test stations put in operation in the area around Linz. These tests are concentrating on Automated Driving and Platooning of trucks aided by C-ITS communication.

3. Pilot site 2 – Development of Hybrid C-ITS specifications together with Austrian telecom providers (including test track CCAD in Graz)

Pilot overview

As mentioned in the description of Pilot Site 1, a hybrid C-ITS deployment (short range: ITS-G5, long range: cellular) on the whole Austrian motorway network, including Day-1 and Day-2 use cases has been issued end of 2018.

With the Delegated Regulation on C-ITS not materializing in 2019, the tender was delayed for almost a year between the first stage (=applicant qualification) and the second stage (=description of services to be rendered) to reassess the overall situation. After the formation of the “C-ITS Deployment Group” (<http://c-its-deployment-group.eu/>) and its successful statement on continued deployment in late 2019, the Austrian ministry and ASFINAG decided to continue with the national tender with a new time frame, starting C-ITS Deployment in late 2020 with a fully operational system until 2021.

The system to be deploying within that tender is supposed to be a fully “hybrid” C-ITS system, meaning that long-range communication will be covered by a cellular based approach, based on the specifications on that topic emerging from the C-ROADS platform (WG2 / TF4). The harmonised specifications written within C-ROADS define an IP-based interface for C-ITS communication called “Basic Interface” (BI), which is based on an AMQP Message Broker and relevant filtering mechanism

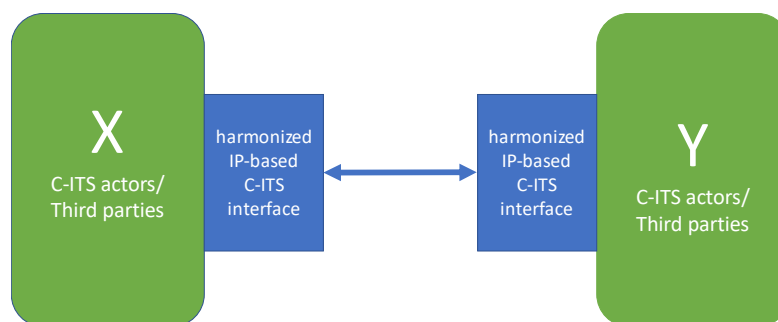


Figure 3: C-ITS Hybrid interface

This interface will be able to carry C-ITS messages over any IP connection, while maintaining the exact same content and level of trust within the “Trust Domain” created by the EU certificate and security policy compared to the short range, ITS-G5 communication.

As the specifications for this “hybrid” interface are still ongoing work within the C-ROADS platform and TF4, the work and deployment plan for Pilot Site 2 is as follows:

- Continue the ongoing work on the full specification of the IP-based C-ITS “Basic Interface” (BI) within C-ROADS WG2 / TF4
- In parallel to that, use the already existing specifications of the “Basic Interface” (BI) to implement an internal demonstration broker based on the already specified elements of

that interface. This can be used to learn about the approach, identify what works and what not and any gaps and bring the gap information back to TF4

- Plan for a demonstration of cross-border, hybrid C-ITS communication (ITS-G5 and cellular) between Italy and Austria via a C-ROADS / ICT4CART joint demonstration
- Once the “Basic Interface” (BI) has matured and is ready for deployment as well as implemented in the operational C-ITS deployment, start talks with cellular service providers or OEM cloud operators about cellular C-ITS deployment in Austria

Location

As the topic of this pilot site is fully “hybrid” long-range communication of C-ITS, no specific location for IP-based communication of C-ITS over cellular networks is necessary. Testing will however be localized at the CCAD test site in Graz and the C-ITS roadside installations at the Austrian / Italian Border at Brennero.

Use Cases covered by the pilot

As this Pilot Site aims for “hybrid” C-ITS, meaning exact same message content and trust level over different communication media: exactly the same use cases as described in Pilot Site 1 above.

Schedule and Demonstration plan

- “ICT4CART” Tests in Summer and Autumn of 2020 in Graz and the Austrian / Italian border at Brennero, using the 12 C-ITS installations in Graz and 2 additional C-ITS Roadside Stations at Brennero. These tests are concentrating on cross-border C-ITS communication over different communication media.

4. Pilot site 3 – City of Graz

Pilot overview

The city of Graz is the second largest city in Austria. The A2 motorway in the South and the A9 motorway in the West run right around the city boundaries (both coloured in red in the Figure 4 below). Both motorways are important connections for the city and at the same time, the city area of Graz is a common bypass in the event of incidents on one of the motorways.

In the West, the “Plabutschunnel” is closed at times due to maintenance and renovation works. Especially during peak hours, this creates congestions throughout the whole city. The most common bypass routes are the B67 and the B70 (coloured in blue in the Figure 4 below).

Another important topic, which will be addressed within the project, is the traffic management during events. Visitor of the fair grounds and the stadium often cause heavy congestion in the South of the city.

Location

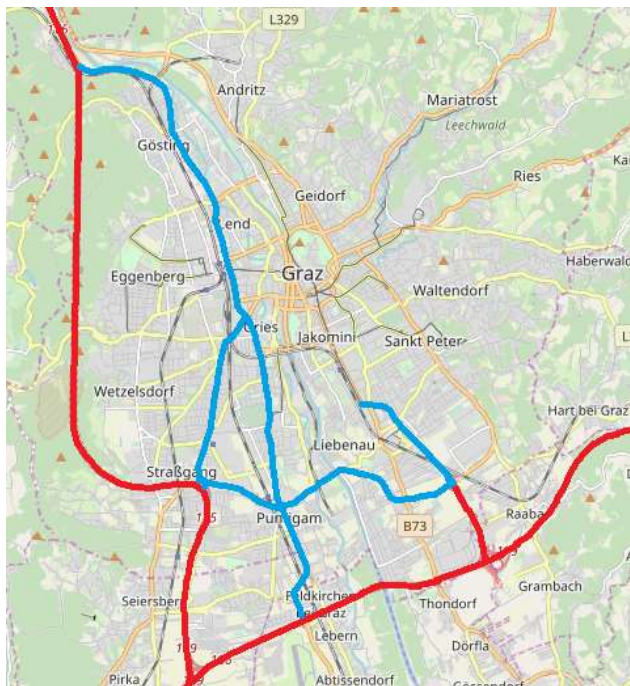


Figure 4: Map of Graz C-ITS pilot

The two red roads show the motorways (A9 in the West and A2 in the South). The road network in blue indicates those segments planned for the pilot in Graz. The routes in the West, which go from North to South, are the common bypass routes for the “Plabutschunnel” at the motorway A9. The horizontal connection includes the “Südgürtel”, which is an important subsurface connection between the West and the East. The motorway feeder road, which connects the city center to the motorway A2, is also the direct connection to the fair grounds and the stadium.

Use Cases covered by the pilot

The following Table 1 shows the planned Day 1 use cases, which are going to be covered by the pilot in Graz.

Table 1: Prioritized Day 1 use cases – Pilot Graz

Graz Pilot Site			
Service		Use case	
Name	Abbr.	Name	Code
In-Vehicle Signage	IVS	Dynamic Speed Limit Information	IVS-DSLI
		Embedded VMS “Free Text”	IVS-EVFT
Road Works Warning	RWW	Road Operator Vehicle in Intervention	RWW-ROVI
Hazardous Locations Notification	HLN	Animal or person on the road	HLN-APR
		Emergency Vehicle Approaching	HLN-EVA
Signalized Intersections	SI	Green Light Optimal Speed Advisory	SI-GLOSA
		Traffic Light Prioritisation	SI-TLP
		Signal Phase and Timing Information	SI-SPTI
Probe Vehicle Data	PVD	Vehicle Data Collection	PVD-VDC
		Event Data Collection	PVD-EDC

Further, the following Day 1.5 use cases are envisaged under the prerequisite that definition and specifications are elaborated and available:

- Connected & cooperative navigation into and out of the city
- Smart Routing
- Park & Ride Information
- Off Street Parking Information

Schedule and Demonstration plan

For 2020, the technological set-up of the Graz testbed is planned primarily. In Q2/ 2020, both final systems designed and tender preparation are planned, followed by contracting and purchase of Roadside Units, On-board Units and other necessary tools and devices. After the purchase, the installation of the devices is planned for the third and fourth quarter. In the third quarter, the existing traffic control system is upgraded and the Traffic Management Centre is implemented. At the end of 2020, the first testing will take place in the equipped testbed. Installations of further Roadside Units and other devices are not impossible due to further development of the project and upcoming synergies.

Table 2: Schedule – Pilot Graz

Planned Activity	Q2 2020			Q3 2020			Q4 2020			Q1 2021			Q2 2021			Q3 2021			Q4 2021		
Detailed Planning, Contracting and Purchase																					
Upgrade VSR and Implementation TMC																					
Installation Roadside Units																					
Testing																					

5. Pilot site 4 – City of Vienna

Pilot overview

The Austrian capital city Vienna is characterised by intense traffic flows on a daily commuter basis, especially across the city motorway A23 as well as A22, A4 and S1. These four high-level roads are connected to the city of Vienna at several neuralgic nodes and intersections and were in the focus of the first pilot phase of C-Roads.

In order to move forward on this basis, the pilot site Vienna will consist of the one way road system on the left and the right bank of the Donaukanal from the motorway intersection A23 / A4 (Knoten Prater) to the city center, the connection from motorway exit Knoten Landstraße to the city center via Landstraßer Gürtel and Prinz-Eugen-Straße as well as the Ringstraße around the historic city center.

The pilot area will be gradually equipped with C-ITS infrastructure from 2020 onwards. This includes the installation of Road Side Units (RSUs) along these corridors.

To ensure independence from any manufacturer or vendor, the open interface protocols OCIT-O and OCIT-C will be used for the communication with the Viennese traffic management center (managed by the city of Vienna). The traffic management center is equipped with a Sitraffic Scala traffic computer, version 8.0/8.1 which has to be upgraded by a C-ITS module.

Location

The suggested pilot site includes the following urban road sections with a total road length of approximately 17 km:

- Schüttelstraße – Untere Donaustraße – Obere Donaustraße – Brigittenauer Lände
- Rossauer Lände – Franz-Josefs-Kai – Dampfschiffstraße – Weißgerber Lände – Erdberger Lände
- Landstraßer Gürtel – Prinz-Eugen-Straße
- Ringstraße



Figure 5: Map of C-Roads pilot in Vienna

This area is well connected to the already established C-ITS test infrastructure in Vienna, implemented within the “C-Roads Pilot Austria”. This fully operational motorway stretch in Vienna is equipped with 11 Road Side Units.

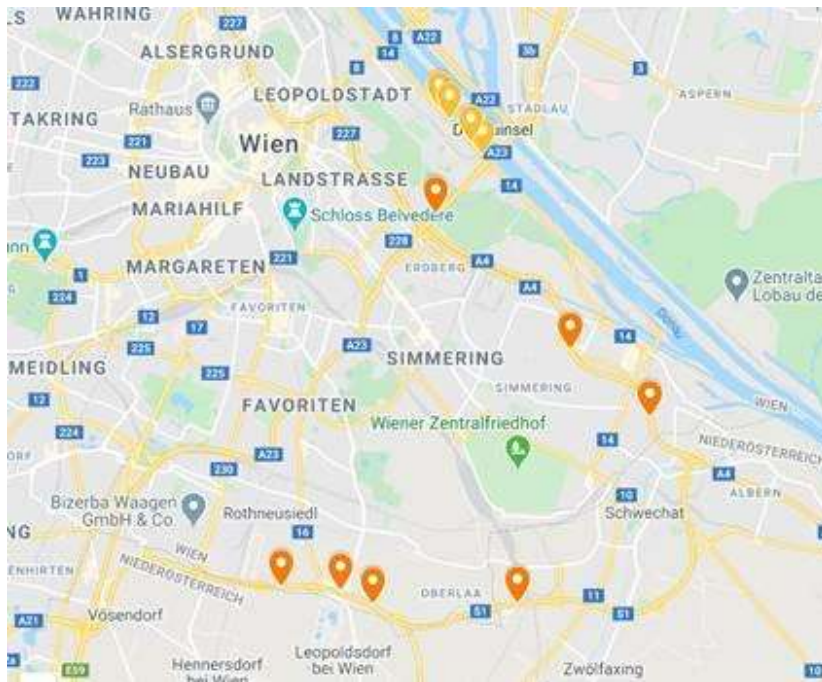


Figure 6: Viennese area of C-Roads Pilot Austria (Source: ASFINAG)

Use Cases covered by the pilot

The following Table 3 shows the planned Day 1 use cases, which are going to be covered by the pilot in Vienna.

Table 3: prioritized Day 1 use cases for the Vienna pilot site

Vienna Pilot Site			
Service		Use case	
Name	Abbr.	Name	Code
Hazardous Locations Notification	HLN	Accident Zone	HLN-AZ
		Traffic Jam Ahead	HLN-TJA
		Stationary vehicle	HLN-SV
		Weather Condition Warning	HLN-WCW
		Emergency Vehicle Approaching	HLN-EVA
Signalized Intersections	SI	Green Light Optimal Speed Advisory	SI-GLOSA
		Traffic Light Prioritisation	SI-TLP
		Signal Phase and Timing Information	SI-SPTI
Probe Vehicle Data	PVD	Vehicle Data Collection	PVD-VDC
		Event Data Collection	PVD-EDC

Deployment of **Day 1.5** use cases “**Traffic information & Smart Routing**”, “**Information on AFV fuelling/charging stations**” and “**Off Street Parking**” is envisaged, under the prerequisite that definitions/specifications are available.

Schedule and Demonstration plan

- 03/2020: Sitraffic Scala traffic computer updated to version 8.1 and equipped with the CMS module
- From 2020 onwards: Pilot area will be gradually equipped with C-ITS infrastructure

6. Pilot site 5 – City of Salzburg

Pilot overview

The Greater Salzburg Area including the City of Salzburg is catered by two national motorways, the A1 motorway (Vienna-Salzburg) running North-West along the city to the national German border and the A10 motorway (Villach - Salzburg) passing the city to the South for joining with the A1 motorway. For the City of Salzburg, both motorways are of outstanding importance due to their traffic relevance. In case of disruptions on either of these motorways, the only way to re-route traffic is through the city centre. Beside the traffic relevance for the City of Salzburg, both motorways are parts of European North-South as well as West-East motorway corridors with high loads of tourist traffic.

In addition, the City of Salzburg faces two distinct challenges stemming from its geographic location, topographic peculiarities, urban development as well as its history and a world-renowned reputation amongst tourists. The first challenge is a high traffic load stemming from commuters, which can be observed on weekdays especially in the mornings and evenings. This regularly leads to traffic congestion and delays on major roads into and out of the city. In some road sections, not only the motorized private transport is affected but also public transport i.e. busses. The second challenge arises from Salzburg's major importance as an international tourist hot spot. More than 50.000 coaches enter the city each year. Tourists travelling individually and residing in the peri-urban area around the city flock into Salzburg especially during rainy days in the summer months. These two facts put an additional strain on the road network and aggravate the aforementioned challenges.

Location

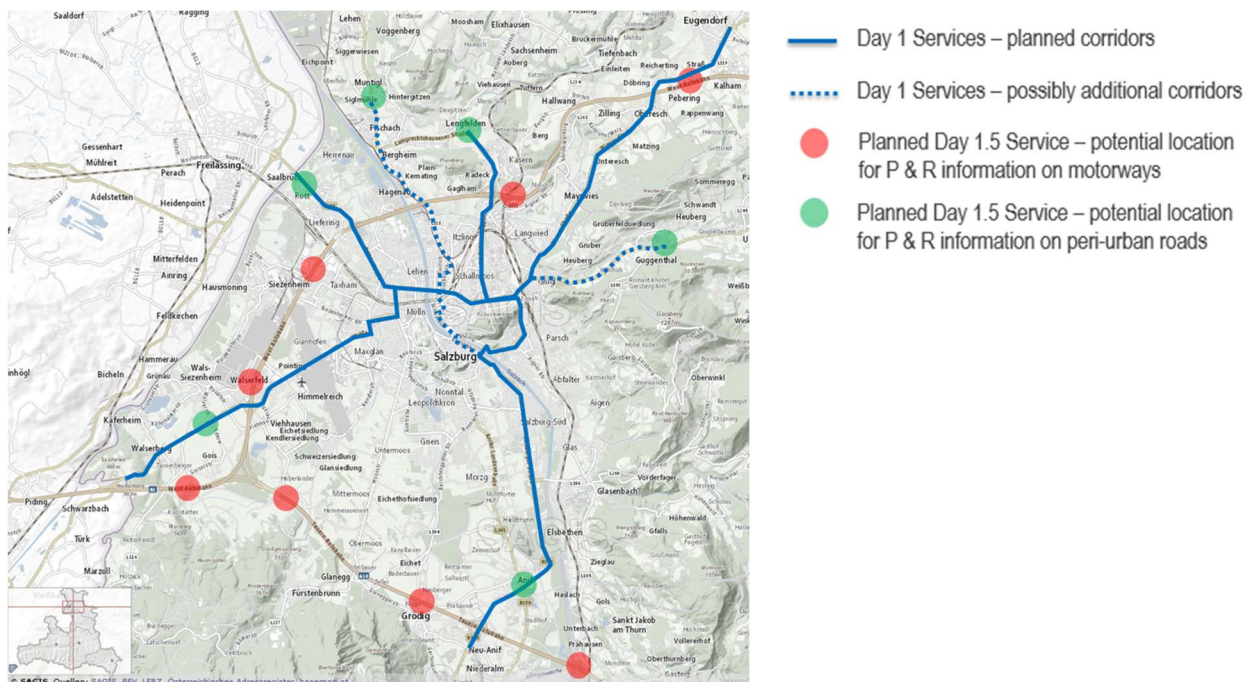


Figure 7: Potential corridors for the deployment of C-ITS infrastructure supporting Day 1 services and planned locations for Day 1.5 services around the City of Salzburg (Source: map adapted from SAGIS online 2019)

The Salzburg pilot aims at deploying C-ITS infrastructure on the main roads intersecting the city centre (i.e. peri-urban roads B1, B150, B155 and B156 will be equipped with road side units in order to test the prioritized Day 1 use cases (see Table 4). In addition, those roads also serve as detours for the motorways (which will also be equipped with ITS-G5 road side units). Hence, it is possible to create a continuous ETSI ITS G5 infrastructure between the motorways and the peri-urban and urban road networks. In order to enable seamless traffic management, the two Traffic Management Centres (ASFINAG's and Salzburg's) will be enabled to exchange data about incidents, traffic conditions and possible routing strategies. Furthermore, for the Salzburg pilot it is also planned to integrate public transport use cases such as C-ITS-enabled public busses or P+R information. Moreover, the Approaching Emergency Vehicle use case should be piloted as well.

In addition to the piloting of the aforementioned use cases, the C-Roads activities will be closely linked to automated driving research activities in Salzburg, more specifically the Digibus® Austria project for automated driving in public transport as well as the H2020 SHOW project for large-scale demonstrations of connected and automated driving. Therefore, the C-ITS pilot installation along the B158 peri-urban road will connect the city centre to the test track for autonomous driving in the village of Koppl, which is already equipped with C-ITS road side units. .

Use Cases covered by the pilot

The following Table 4 shows the planned Day 1 use cases, which are going to be covered by the pilot in Salzburg.

Table 4: prioritized Day 1 use cases for the Salzburg pilot site (own table)

Salzburg Pilot Site			
Service		Use case	
Name	Abbr.	Name	Code
Signalized Intersection	SI	Green Light Optimal Speed Advisory	SI-GLOSA
		Traffic Light Prioritization	SI-TLP
		Emergency Vehicle Priority	SI-EVP
In-vehicle Signage	IVS	Other Signage Information	IVS-OSI
Hazardous Location Notification	HLN	Emergency Vehicle Approaching	HLN-EVA
Probe Vehicle Data	PVD	Vehicle Data Collection	PVD-VDC
		Event Data Collection	PVD-EDC

Deployment of **Day 1.5** use cases “**Park & Ride information**”, “**Off Street Parking Information**” and “**Connected and cooperative navigation into and out of the city**” is envisaged, under the prerequisite that definitions/specifications are available.

Schedule and Demonstration plan

The following table shows the deployment plan:

Table 5: Schedule and Demonstration plan

Time	Description
Feb. – Jun. 2020	Development and specification of the prioritized Day 1 C-ITS services and use cases
Feb. 2020	Communication of the planned Day 1.5 services in WG4 Urban C-ITS
Feb. 2020 - ongoing	Active participation in the creation of the specification for the prioritized Day 1.5 services
Mar. – Jun. 2020	Definition C-Roads 2 pilot routes in the city of Salzburg and peri-urban area
Mar. – Jun. 2020	Development of technical concept including the system architecture
Jun. 2020	Final Deployment Plan
Jul. – Oct. 2020	Preparation of Tender
Oct. 2020	Tender launched
End of Mar. 2021	Start of installation of C-ITS equipment on the urban and peri-urban infrastructure of Salzburg

7. Summary

Each of the pilot sites defined the location of their pilots and described the locations in terms of related road sections as well as concerning relevant Use Cases. Based on the current list of Day 1 Use Cases the pilot sites categorised the Use Cases in three different levels (see Table 6). Those, planned to be implemented are marked in green, those that might be implemented are marked in yellow and those that will not be implemented are marked in red. Additionally, the pilot sites defined future use cases (Day 1.5 respectively Day 2) being of interest and benefit to them, that still need to be specified by C-ROADS.

For the current status of the project, it can be stated, that the possible Use Cases can be altered and extended during the project implementation according to location circumstances and specification progress by the C-ROADS Working Groups.

Table 6: Overview and categorisation of Use Cases for each pilot site

Use Cases	Pilot 1 - C-ITS deployment on the Austrian core network corridors	Pilot 2 - Development of Hybrid C-ITS specifications together with telecom	Pilot 3 - City of Graz	Pilot 4 - City of Vienna	Pilot 5 - City of Salzburg
In-Vehicle Signage (IVS)					
IVS – Dynamic Speed Limit Information (IVS-DSLI)					
IVS – Embedded VMS „Free Text“ (IVS-EVFT)					
IVS – Dynamic Lane Management (IVS-DLM)					
IVS – Other Signage Information (IVS-OSI)					
Road Works Warning (RWW)					
RWW - Lane closure (and other restrictions) (RWW-LC)					
RWW - Road closure (RWW-RC)					
RWW – Road Works – Mobile (RWW-RM)					
RWW – Winter Maintenance (RWW-WM)					
RWW – Road Operator Vehicle in Intervention (RWW-ROVI)					
RWW – Road Operator Vehicle Approaching (RWW-ROVA)					
Hazardous Locations Notification (HLN)					
HLN – Accident Zone (HLN-AZ)					
HLN – Traffic Jam Ahead (HLN-TJA)					
HLN – Stationary vehicle (HLN-SV)					
HLN – Weather Condition Warning (HLN-WCW)					
HLN – Temporarily slippery road (HLN-TSR)					
HLN – Animal or person on the road (HLN-APR)					
HLN – Obstacle on the road (HLN-OR)					
HLN – Emergency Vehicle Approaching (HLN-EVA)					
HLN – Railway Level Crossing (HLN-RLX)					
Signalized Intersections (SI)					
SI – Green Light Optimal Speed Advisory (SI-GLOSA)					
SI – Traffic Light Prioritisation (SI-TLP)					
SI – Signal Phase and Timing Information (SI-SPTI)					
SI – Imminent Signal Violation Warning (SI-ISVW)					
SI – Emergency Vehicle Priority (SI-EVP)					
Probe Vehicle Data (PVD)					
PVD – Vehicle Data Collection (PVD-VDC)					
PVD – Event Data Collection (PVD-EDC)					
Others/New Use Cases					
"Day 2" Services to support Automated Driving					
"Day 2" Services for Collective Perception					
Traffic information					
Information on AFV fuelling/charging stations					
Smart Routing					
Park & Ride Information					
Off Street Parking					
Connected and cooperative navigation into and out of the city					

