SignON

Sign Language Translation Mobile Application and Open Communications Framework

Deliverable D2.6 -

First Release of the SignON Communication Mobile Application

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0.1	MAC	16/02/2022	Initial draft based on initial and development test Apps, and D2.3 & further research.

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Acronyms

The following table provides definitions for acronyms and terms relevant to this document.

Acronym	Definition
API	Application Programme Interface
App	SignON Communication and Translation Mobile Application
ASL	American Sign Language
ASR	Automated Speech Recognition
BSL	British Sign Language
DevOps	A set of practices that combines software development and IT operations[1]
DHH	Deaf and Hard of hearing
DoA	Description of the Action
GA	Grant Agreement
HTML	Hypertext Markup Language
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
ICT	Information and Communication Technologies
InterL	Interlingua
IS	International Sign
ISL	Irish Sign Language
LSE	Spanish Sign Language (Lengua de Signos Española)
MT	Machine Translation

[1] What is DevOps? - Amazon Web Services (AWS)

NGT	Sign Language of the Netherlands (Nederlandse Gebarentaal)
NLP	Natural Language Processing
SignON	Both the service and this project (GA 101017255)
SL	Sign Language
SLR	Sign Language Recognition
SLTT	Sign-Language-To-Text
STT	Speech-To-Text
TTS	Text-to-Speech
TTSL	Text-to-Sign-Language
UI	User Interface
URL	Uniform Resource Locator
UX	User Experience
VGT	Flemish Sign Language (Vlaamse Gebarentaal)
WP	Work Package
WWW	World Wide Web

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Executive Summary

This deliverable is the first Release of the SignON Transmodal Machine Translation Mobile Application and first formal output of task T2.3 “Design and Development of the SignON Communication Mobile Application”, which is developing the app using an iterative user-driven agile DevOps approach and industry-standard components in the SignON open Framework as described in D2.3. The SignON Communication App aims to be an intuitive, easy-to-use user input and output interfacing with the cloud-based SignON Service platform (T2.1 and T2.2) where the computationally intensive tasks (of WP3, 4 & 5) will be executed. This first release of the App has enabled WP1 formative evaluation pilot trials to take place, as reported in D1.9 ““First Technical requirements and user research (UX design) report”, and evolving it to its Final Release, as D2.7, at the end of the project. This co-creation approach aims to ensure wide uptake, improved sign language detection and multilingual speech processing on mobile devices for everyone. The SignON App V1.0 is available for both Android and Apple mobile devices on the Google Play Store and Apple App Store as “SignONMobile”.

1. Introduction

SignON is researching and developing the SignON Transmodal Machine Translation Mobile Application communication service that uses machine translation to translate between sign and spoken languages. This service will facilitate the exchange of information among deaf and hard of hearing (DHH), and hearing individuals. In this user-centric and community-driven project we are tightly collaborating with European DHH communities to (re)define use-cases, co-design and co-develop the SignON service and application, assess the quality and validate their acceptance. Our ultimate objective is the fair, unbiased and inclusive spread of information and digital content in European society.

SignON will be a free, open source application and framework for conversion between video (capturing and understanding sign languages), audio and text and translation between signed and spoken languages. To facilitate these tasks, SignON will use a common representation for mapping of video, audio and text into a unified space that will be used for translating into the target modality and language. To ensure wide uptake, improved sign language (SL) detection and synthesis, as well as multilingual speech processing on mobile devices for everyone, we will deploy the SignON service as a smart phone application running on standard modern devices.

The SignON App has a lightweight interface. The SignON Framework of services, however, is distributed on a cloud platform where the computationally intensive services are executed. The project is driven by a focused set of use-cases tailored towards the sign language communities. We target signed and spoken languages from Ireland (Irish Sign Language, Irish and English), Britain (British Sign Language and English), the Netherlands (Sign Language of the Netherlands/Nederlandse Gebarentaal and Dutch), the Flanders region of Belgium (Flemish Sign Language, Flemish and Dutch) and Spain (Spanish Sign Language and Spanish). Nevertheless, SignON will eventually incorporate machine learning capabilities that will allow (i) learning new sign, written, and spoken languages; (ii) style-, domain- and user-adaptation and (iii) automatic error correction, based on user feedback.

The technical requirements of the App are derived by iteratively mapping the end and professional user requirements (Task 1.3) on the technical implementation of the App. Each user group typically has the need for different essential specifications that fit the daily user's habits or the system integration in the professional workspace.

- An end user will have the need, e.g. of an easy-to-use user interface (UI) on a mobile device and good user experience (UX) design.
- A professional user (e.g. media provider) will require an easy-to-use application programming interfaces (APIs) for a video player integration.

Task T2.3 “Design & Development of the SignOn Communication Mobile Application” interlinks with task T1.4 “Technical user Requirements, Iterative design process (UX)”. During the different development cycles, the execution of T1.4 is the principal intermediary to moderate each cycle from design process to user testing, to generate and constantly improve the SignON Mobile App to better meet users’ wishes and requirements.

2. SignON User-Centred Co-Creation Phased Development Process

This deliverable is the first release of the SignON Mobile Application and first formal output of task T2.3 “Design and Development of the SignON Communication Mobile Application”, which is developing the app using an iterative user-driven agile DevOps approach and industry-standard components in the SignON open Framework as described in D2.3. The SignON Communication App aims to provide an intuitive, easy-to-use user input and output, that interfaces with the cloud-based SignON Service platform (T2.1 and T2.2) where the computationally intensive tasks (of WP3, 4 & 5) will be executed. This First Release of the App has enabled WP1 formative evaluation pilot trials to take place, as reported in D1.9 “First Technical requirements and user research (UX design) report” and evolving it to its Final Release, as D2.7, at the end of the project. This co-creation approach aims to ensure wide uptake, improved SL detection and multilingual speech processing on mobile devices for everyone.

The phased development of the SignON platform (including the SignON mobile application, service, framework and components) is according to iterative R&D cycles and released in phases at the completion of each cycle. This is being coordinated through a phase-release schedule that includes major, minor and patch releases. This enables co-creation workflow cycles to take place, evolving it to its final release at the end of the project.

The prototype components are as follows:

- **SignON open framework** is being developed as a collection of scripts, tools, services, specifications and APIs that provide the communication between the different components and the user (via the SignON Mobile App) in a distributed microservice architecture. This follows a bottom-up design methodology, assuming the existence of the separate components.
- **SignON communication and translation mobile application,** each user’s interface to the overall cloud platform and SignON framework, is being developed using industry-standard components and open frameworks to run on standard modern smartphone and tablet devices without the need for special equipment. Following the initial co-creation events and a preliminary analysis, a fast prototype was developed to enable users to become familiar with the intended features and UI of the SignON Mobile App service. It facilitates active involvement of users in the co-creation cycles from early in the project leading to defining functional specification and its co-development (through formative evaluation in WP1), resulting in the App’s second formal operational release at mid project.

An iterative user-driven Agile DevOps development approach is adopted. This involved an initial fast prototype to enable users to become actively involved in the co-creation process of its functional specification and its co-development (through formative evaluation in WP1) from early in the project, resulting in its first formal operational release in two stages (this deliverable and D2.7 at the end of the project). This co-creation approach aims to ensure wide uptake, improved SL recognition and multilingual speech processing on mobile devices for everyone.

2.1 Initial fast prototype SignON App

While the final SignON App will be functionally very rich, the initial fast prototype SignON App was demonstrated on Android with the following 2 major elements of the SignON Framework:

1. **SignON Mobile App Input Functions:**
    a) Records SL video or spoken language audio messages on the phone.
    b) Choose an input spoken language – English, Spanish or Dutch.
        i. Uses a standard Speech-to-Text [2] app or phone feature to produce text of the recorded audio message in that spoken language.
        ii. Key in a text message in that spoken language.
2. **SignON Mobile App Output Functions:**
    a) Display this device's most recent video (without SL recognition).
    b) Choose an output spoken language – English, Spanish or Dutch.
        i. If need be, translate the most recent stored input text message to the chosen output spoken language.
        ii. Display that text message in the chosen output spoken language.
        iii. Speak that text message in the chosen output spoken language using a standard Text-to-Speech (TTS) app or phone feature.

This fast mobile app prototype demonstrated these early SignON features, so that users could start to see, hold, and feel something tangible and provide realistic inputs on what they need, and for the developers to get an appreciation of the realities of the mobile app platform and cloud requirements. This initial prototype is being iteratively improved based on the user-driven feedback of WP1 (using an iterative DevOps approach). Its open framework enables it to be readily implemented in other mobile Operating Systems (OS) such as iOS.

[2] Or Automated Speech Recognition (ASR), as used in standard scientific terminology, See Speech-to-Text: Automatic Speech Recognition | Google Cloud

The initial fast prototype of the SignON Mobile App was published[3] and privately distributed to all project Partners for use on their users' Android phones through the Google "Play Store", to undertake the Cognitive Walkthrough described in D1.4 "First Technical Requirements & User Research (UX design) Report" This allowed real user feedback early in the project to enable users direct the project's R&D in a meaningful and user-centred way.

2.2 SignonDev Engineering Test Development App

As reported in D2.3 "First release of the Open SignON Framework" (January 2022) an engineering development test App (signondev) was also developed to test and prove the SignON Framework Architecture.

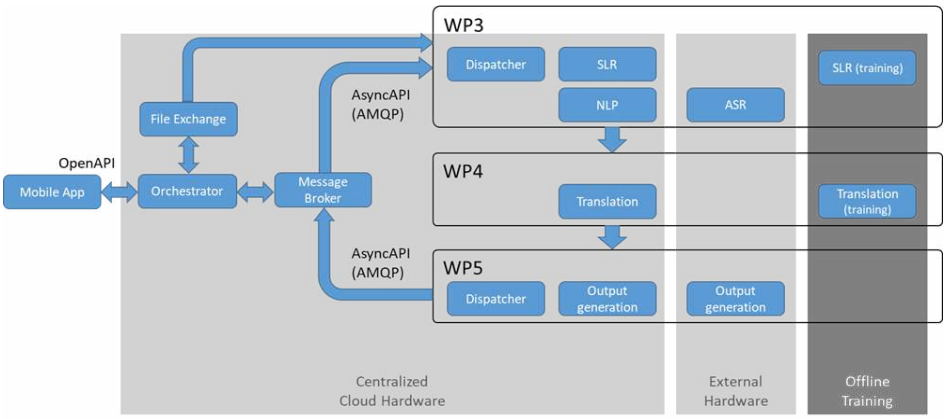

Figure 1 SignON Framework Architecture

This engineering development test App (signondev) was used to interact with the Orchestrator to test and verify the SignON Framework operation by accessing the evolving SignON backend services. This App was in addition to the initial fast prototype of the users' SignON Mobile App, which is described in D6.6 (SignON Market Analysis). The SignON DevApp was made available as a closed Android App (downloadable only on invitation) on the Play Store and automatically updates when SignON backend services become available.

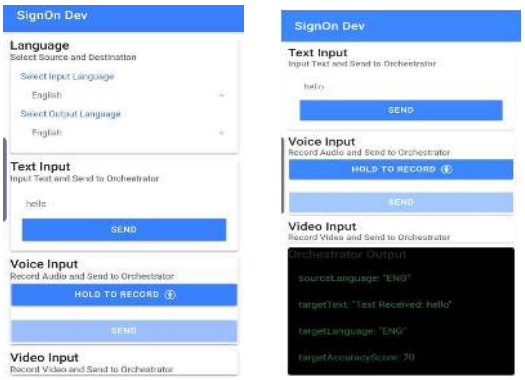

Figure 2 Initial SignON Development test App

3 See Release | Google Play Console

3. First Release of the SignON Mobile App

As described in the Description of Action (DoA), the SignON Communication App aims to be intuitive, easy-to-use user input and output interfacing with the cloud-based SignON platform where the computationally intensive tasks of the SignON Framework (from WP3, 4 & 5) will be executed. The SignON Transmodal Machine Translation (MT) Mobile App must run on standard modern smartphone and tablet devices and OS, using their existing cameras, other input sensors and UIss.

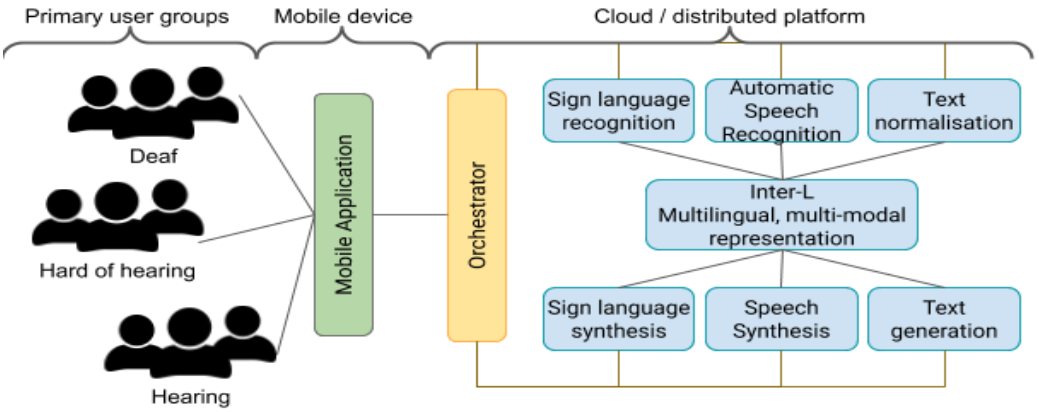

Figure 3 SignON Communication App and Service

The SignON Application's users' requirements are derived by mapping the end and professional user requirements (Task T1.3) and interlinking to this task (T2.3 "Design & Development of the SignOn Communication Mobile Application") on the technical implementation of the SignON application. During the different development cycles, the execution of task T1.4 "Technical user Requirements, Iterative design process (UX)" consists of being the principal intermediary to moderate each cycle from design process to user testing and to provide definitions on the UX design of the Mobile App.

Based on the users' formative evaluation feedback, discussion of the user requirements and the project objectives from the DoA, the current definition of the user technical requirements of the SignON Mobile App are described in D1.9 "Second Technical Requirements & User Research (UX design) Report".

As a technology product, SignON is conceptualised around multiple MT components orchestrated within the SignON Framework and distributed on the cloud using a distributed microservice architecture. The envisaged components operate in a network of remote machines and are accessible through APIs.

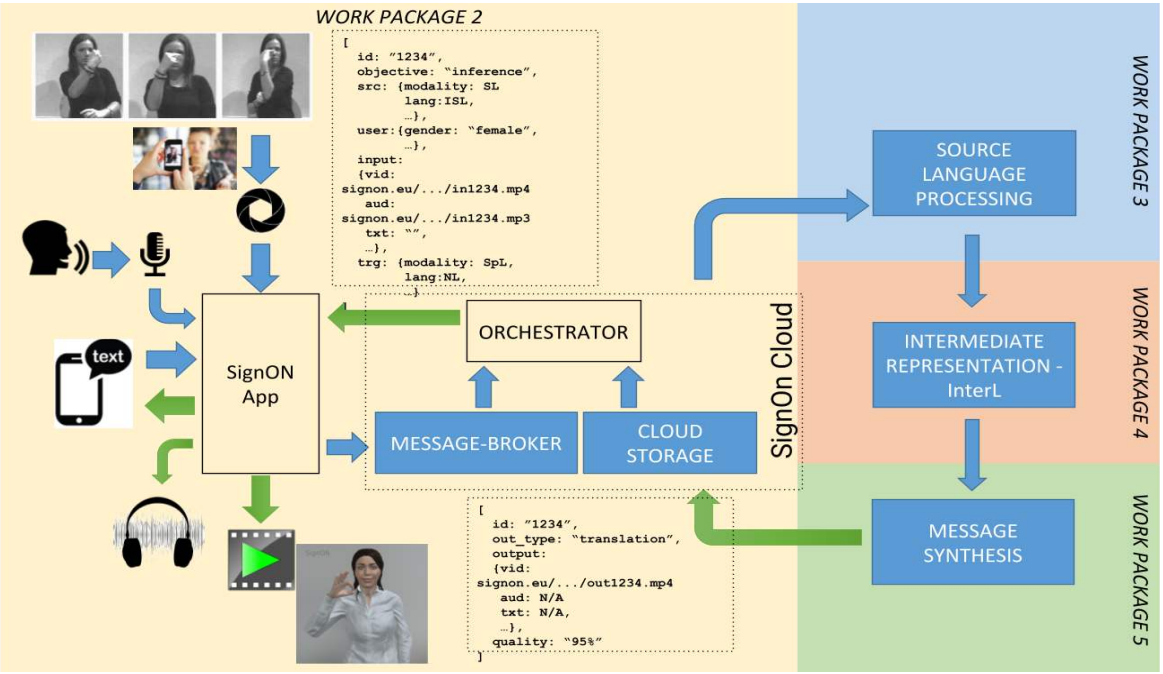

Figure 4 SignON Service Architecture

The SignON framework in practice encompasses pipelines for translation between different languages and modalities, e.g. one such pipeline is for translating from Irish Sign Language (ISL) to spoken Dutch (sign-to-speech translation). This type of distributed architecture has proven effective for large and scalable, cloud-based software ecosystems. The distributed and modular architecture of the software facilitates the uptake and growth of the SignON service beyond the life of the project. Its modularity allows for improved and additional components to be seamlessly integrated into the SignON framework.

The SignON services will be made available to third parties such as broadcasters, so they can integrate their services and components into the complete SignON Framework. This ensures wide and coherent development of new services for all users, enabling the SignON Framework to become the industry standard and platform for fair, unbiased, and inclusive sharing of information and digital content in European society. The SignON Framework will encapsulate all internal components, e.g. ASR, SLR, 3D virtual signer synthesis, interlingua, NLU, and so on. Each component will reside on a remote machine and operate independently from the rest in a distributed microservice architecture, providing Function as a Service (FaaS)[4] enabling SignON applications with the potential to scale in real time in response to demand.

[4] https://en.wikipedia.org/wiki/Function_as_a_service

The SignON Transmodal Machine Translation App aims to enable users to communicate in the way they want to**.** They can select a default option, e.g. always receiving and sending messages in Flemish Sign Language (VGT). But they also can use different modes. Users who by default use one SL (e.g. VGT), may also produce a message in a spoken language (e.g. Dutch), or in another sign language (e.g. the Sign Language of the Netherlands, NGT).

3.1 Functionality of Signon App V1.0

The first release of the SignON Mobile App V1.0 is available for both Android and iOS mobile devices on the Google Play Store and Apple App Store, as “SignONMobile”.

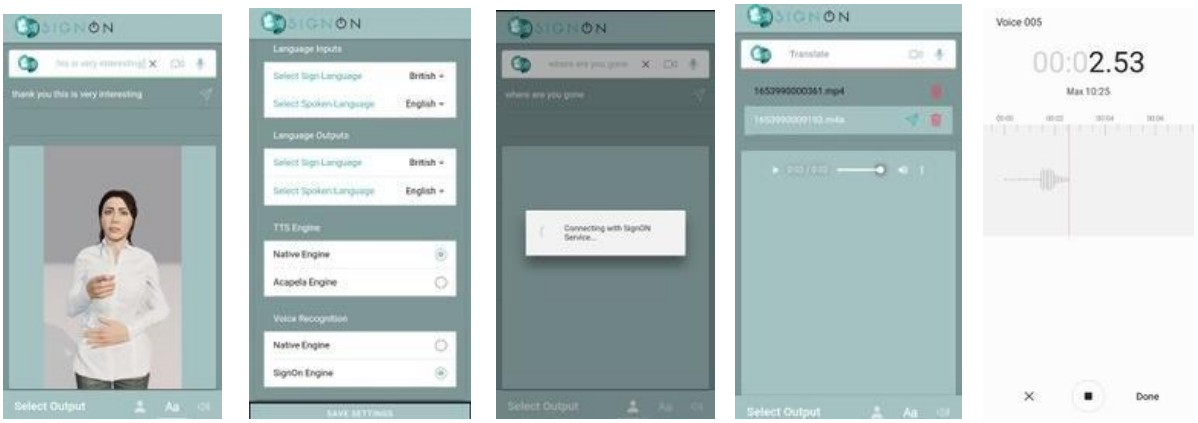

Figure 5 SignON Mobile App V1.0 screens

Use of the App is very simple and intuitive, as explained in the “User Guide” in Figure 6.

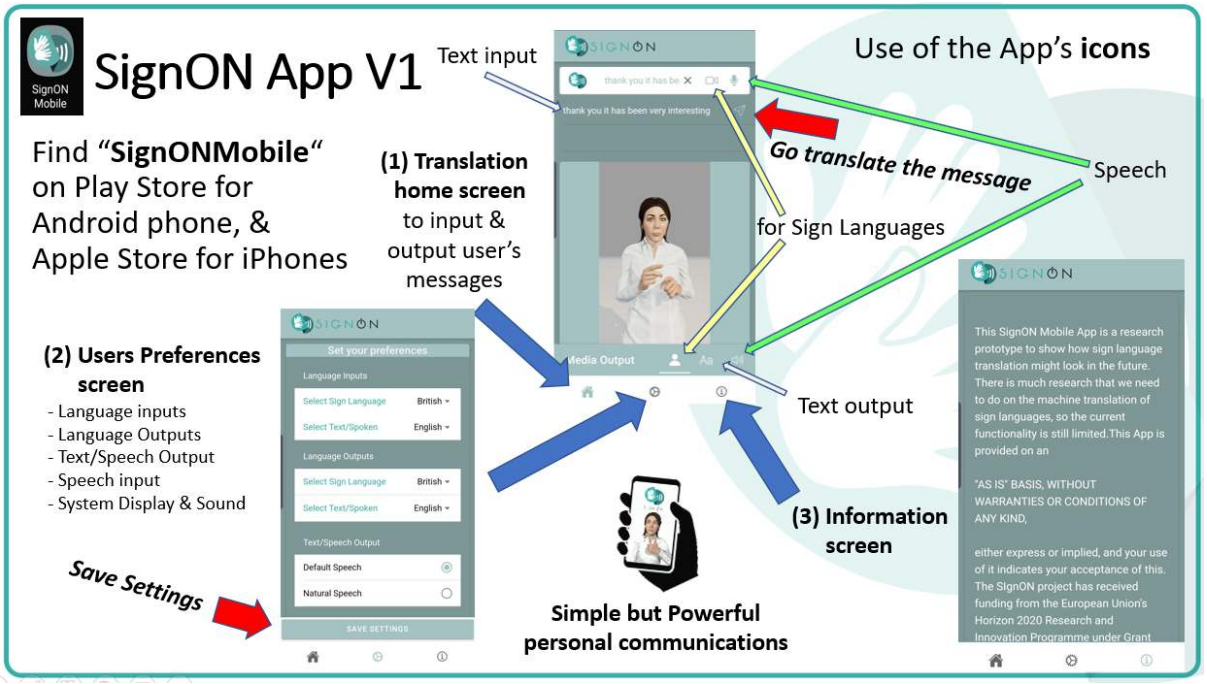

Figure 6 How to use the SignON App V1.0

The SignON App V1.0 is an evolution of the initial fast prototype used for D1.4, as explained in Section 3. However, there was no interaction or delivery of the SignON Framework backend services, until the SignON Framework infrastructure became available, as described in D2.3 "First release of the Open SignON Framework". So, the First Release of the SignON Mobile provides the SignON SL, ASR and MT Framework Services, that are now available from the ongoing WP2, WP3, WP4 and WP5 R&D work,[5] as summarised in Figure 7.

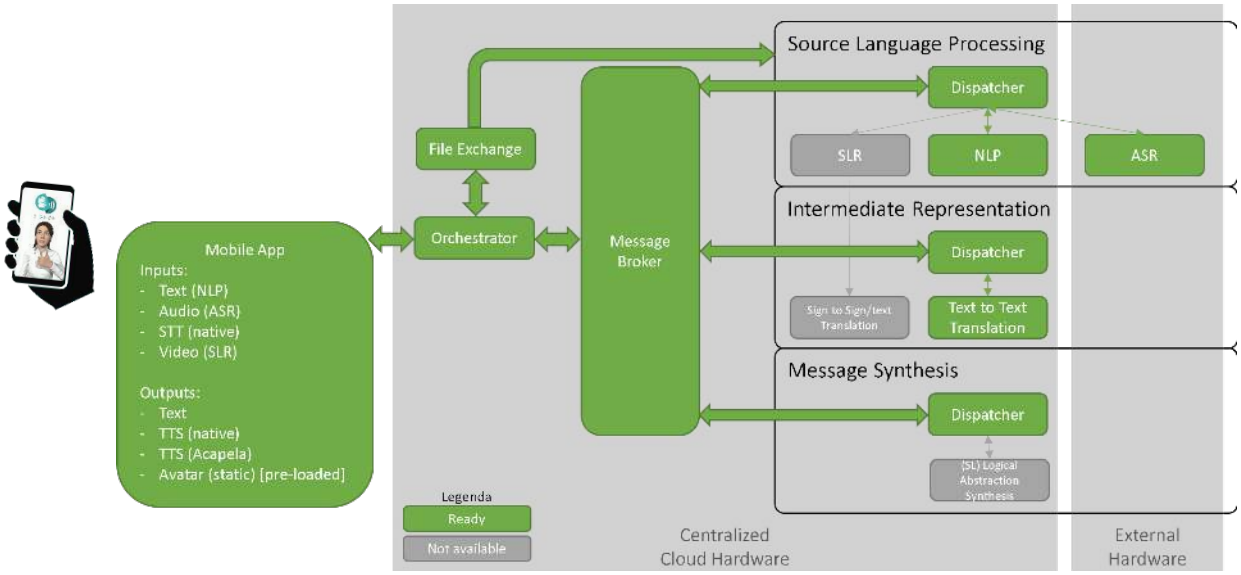

Figure 7: SignON App V1.0 Functionality

Given the available SignON Framework services, the partners agreed that the App V1.0 would demonstrate initial pre-recorded Avatar messages in all 5 SLs, and include the Acapela TTS[6] and the initial version of the SignON ASR[7] for "atypical speech" as described in the DoA of the GA. The SLR functionality will be included in the App V2.0 when available later in the project.[8]

The functionality of the SignON App V1.0 compared to the initial fast prototype (described in section 2.1) is summarised in the following diagram:

5 As described in the most recent deliverables of each of the WPs.

6 Acapela Group: Text To Speech (TTS) solutions, personalized voices based on neural technology. (acapela-group.com)

7 As described in D3.4 "Automatic speech recognition component and models".

8 As described in D3.2 "Sign language recognition component and models"

App V1.0	Fast Prototype App	App V1.0	Comment
SL input	None	No active SLTT yet	Will be in V2.
SL output		TTSL Demo SignON Avatar with 2 messages x 5 SLs	Predeveloped & statically loaded to App
Speech input & output	Dutch, English, Irish, Spanish as specified in the GA.	1. Phone's TTS 2. Acapela TTS service	SignON ASR "atypical speech" as per GA.
Text input/Output		Done	Uses Phone's own Text features.
Mode Translation	Text to/from Speech	Text to limited set of SL messages.	2 x 5 initial SL messages
Language Translation	Text/Speech: Done SL: None	Demo TTSL with Avatar	1. Initial 2 messages in all 5 SLs (BSL, LSE, ISL, VGT, NGT) as per the GA. 2. Presented as static Avatar sentences

Figure 8 SignON App V1.0 vs Initial Prototype

From various sources[9] and especially user feedback from the project partners in WP1, the following 10 initial Avatar phrases were chosen:

1. *Hello, nice to meet you*
2. *How are you?*
3. *Sorry, I do not know sign language*
4. *I am trying to communicate with you via this app*
5. *How can I help you?*
6. *Where is the meeting?*
7. *When is the meeting?*
8. *Excuse me, could you clarify that?*
9. *Thank you, this has been very interesting*
10. *Have a good day*

It was agreed that the App V1.0 should present these In all 5 SLs as per the DoA:

a) British Sign Language (BSL)
b) Flemish Sign Language (VGT)
c) Irish Sign Language (ISL)
d) Sign Language of the Netherlands (NGT)
e) Spanish Sign Language (LSE)

Following consortium discussions, it was agreed that there would be little value in pre-recording all 50 of these Avatar message sequences and that 2 phrases in all 5 SLs would be adequate to give users a feel for the quality of the SignON avatar. So, the partners choose the following 2 phrases as being most representative for them:

1. *I am trying to communicate with you via this app*
2. *Thank you, this has been very interesting*

These SL messages were video recorded by partners, and transferred to Avatar sequences[10] for use in the App V1.0.

[9] Such as https://www.handspeak.com/word/most-used, Basic signs everyone should know | Easterseals Blog
[10] As described in D5.1 "First version of virtual character" and D5.8 "A Realiser of BML-based Script to 3D Animated Character"

3.2 App V1.0 implementation of the SignON User Requirements

Within the constraints described above, the First Release of the SignON Mobile App implements much of the user technical requirements documented in D1.9 "Second technical requirements and user research (UX design) report", as follows:

SignON App V1 Features	User Technical Requirements from D1.9	Current status
A. User's Mobile Device	1. The SignON App must be easy and intuitive to use, simple but powerful, and running on standard modern phones and tablets. 2. The SignON Mobile App will be free and easily downloadable by users from the Google Play Store for Android phones and tablets, and from the Apple App Store for iPhones and iPads. 3. All the SignON Mobile App's user's inputs and outputs will be on a single mobile user device to communicate in-person with people nearby. 4. Future versions may interwork with a messaging app (such as WhatsApp) on the same user device, to remote people. 5. The User's Mobile Device must have broadband data Internet access for the App to operate using the SignON Framework cloud-based services. a. Future versions may provide limited off-line operation, such as an user selectable vocabulary of Signing GIFs, if requested by users.	1. Done. 2. Done. 3. Done. 4. In progress 5. Done a. To be done.
B. System Performance	1 Translation/conversion will be unidirectional operation with users taking turns to input their messages of up to 30 seconds duration. a. Users may choose to store messages on their own device, but messages will not be retained by the Framework cloud system. Data privacy and protection will be explicitly stated to the user. b. Video, audio, or text streaming will not be provided. 2 Translation/conversions should: a. Respond within 2 seconds – with a maximum of 5 seconds for SL-to-SL translations, to enable effective user communications. b. Provide user-acceptable accuracy for 75% of users. 3 Users should have at least 75% average satisfaction rating with the overall operation of the SignON service.	1. Done. 2. Done for speech & text. Not yet for SL. 3. Not yet achieved
C. User Preferences	1. The SignON App supports video, audio and text UI modalities of communication[11], and provides one-tap user-selectable translation and conversion between any combination of: a. Flemish Sign Language (VGT), Sign Language of the Netherlands (NGT), Irish Sign Language (ISL), British Sign Language (BSL) and Spanish Sign Language (LSE). b. English, Irish, Dutch and Spanish speech and text. 2. The App will provide, and retain, user selectable a. default personalised options for the UI, App text languages and favourite settings. b. UI display, audio, and text options, including contrast and SL avatar customisation.	1. Done. 2a. Part done. 2b. Part done – no avatar options yet.

[11] SignON does not support other UI modalities or tactile SLs, see for instance "DeafBlind Communities May Be Creating a New Language of Touch", May 2022, DeafBlind Communities May Be Creating a New Language of Touch | The New Yorker, and Protactile - Wikipedia

D. SL Translation	1. User SL Input a. No additional special attachments or special lighting will be required for capturing SL input. The App will automatically adapt to input ambient light conditions, within the limits of the user's device. b. User-selectable use of either selfie or forward-facing device video camera live, or a pre-recorded video. c. SLR lexical accuracy[12] and operation to be acceptable to 75% of users: i. Accommodating both formal & informal styles. ii. Covering regional signs, age variation & fingerspelling. iii. Recognising emotion (through facial expression and signing style). iv. Recognising and translating classifiers and using an appropriate lexicon. v. Attending to specific features of SL grammar. d. Future versions may include a user option to add new signs, or have SignON learn them through repeated use of certain signs. e. Performance better than best available automatic SL translations for all SignON's supported SLs. 2. User SL output a. A user acceptable and customisable 3D virtual signer, which focuses on linguistic lexical accuracy. This means accurate hand forms, hand and finger movements, body movement, posture, co-speech gestures[13], the right speed, and facial features such as showing the right emotion, lip movement, eyebrows, and eye gaze. Apart from this, the avatar must be user customisable concerning gender, skin colour, and contrasting colours in clothing and background. b. Have a user option to include message text to confirm and correct the accuracy of the avatar's signing. c. Must adhere fully to the "Best Practice Protocol on Sign Language Avatars" from the University of Vienna.[14] d. Overall performance better than best available avatars.	1a. Done. 1b. Done. 1c.Not yet, In progress 1d. In progress 1e. In progress 2a. In progress 2b. In progress 2c. Almost fully - in progress 2d. Not yet – in progress.
E. Speech & Text Translation	1. For normal and atypical, formal and informal speech. 2. User preselection, and an option for automatic detection of the user's input text and speech languages. 3. Indicate visually that speech is being recorded and played back (for DHH users). 4. User option to store conversation message texts on the user's device. 5. Future work may translate/answer phone calls, interpret emotions and ambient background noise, and use symbols or simple text. 6. Overall performance is better than best available translation apps.	1. Done for normal speech. 2. Done. 3. Done. 4. In progress 5. In progress 6. In progress.

Table 1 Status of current SignON App V1.0 Functionality

[12] At the level of SL lexical items accuracy similar to text/speech translation Apps such as Google Translate, thus not addressing the wider inter-personal communications and richness of body language and SL's multimodal communications richness, the "megablend" as discussed in "Visuo-spatial construals that aid in understanding activity in visual-centred narrative", Donna Jo Napoli and Lorraine Leeson, Language, Cognition and Neuroscience, Volume 35, 2020 - Issue 4, https://doi.org/10.1080/23273798.2020.1744672, see also https://www.redhenlab.org and https://markturner.org

[13] Frontiers | Gesture's Neural Language | Psychology (frontiersin.org) and Co-Speech Gesture in Communication and Cognition (uoregon.edu). See for instance Sign Language Avatars | Kara Technologies

[14] https://avatar-bestpractice.univie.ac.at/en/english/

Overall, while the SignON App V1.0 addresses much of its spoken language and text MT requirements, it only addresses part of the users' SL MT requirements.

3.3 Adherence to the Vienna Best Practice Protocol on Use of SL Avatars

Within its constraints, the First Release of the SignON Mobile App's avatar meets most of the Vienna Best Practice Protocol[15] recommendations for the Use of SL Avatars, based on the user feedback discussed in D1.9 "Second technical requirements and user research (UX design) report", as follows:

Vienna Best Practice Recommendations		Met by SignON V1.0 Avatar
Linguistic Aspects	1. Avatars' torso, pelvis, shoulders (individually & together), all parts of the face, including eyes (direction of gaze), & entire head must be moved completely & appropriately. 2. Offer diversity in style & register, as well as linguistic variants within a text. 3. Provide precise (frame exact), harmonious interplay of manual & non-manual components of a sign. 4. Recorded avatar videos should feature pictograms & images where appropriate. 5. Signing avatars must be intelligible for all deaf SL users who depend on the conveyed information with appropriate linguistic quality of the animation. 6. Captions should be included.	1.Yes 2. Not yet 3. Partially 4. Not yet 5. Yes 6. Not yet
Aspects of Translation Competence	7. Texts presented by avatars must undergo quality control before being published/released. 8. Use deaf-led quality control to certify avatars or texts presented by avatars. 9. For computer-generated translation, quality control is by trained & qualified interpreters. 10. Use appropriate quality management criteria for movability, fine motor skills of the animation, ease of perception & translation quality, etc. that exceed the DIN EN ISO 17100:2015 Requirements for translation services[16].	7.Yes 8.Yes 9.Yes 10.Yes
Ethical Aspects	11. SLs originate from deaf communities & must be treated with respect. 12. Avatars are not a substitute for human interpreters, they may be an addition. 13. Deaf people must guide where avatars can be appropriately deployed. 14. Deaf people must lead in the creation of SL avatars, translation process, & quality control. 15. Avatar developers need to cooperate with each other & with the self-advocacy associations of deaf communities. 16. Avatars should be developed & researched in interdisciplinary teams. 17. "Nothing about us without us" must apply in the field of SL avatars. 18. Must adhere to the UN Convention on the Rights of Persons with Disabilities including "professional sign language interpreters, to facilitate	11.Yes 12.Yes 13.Yes 14.Yes 15.Yes 16.Yes 17.Yes 18.Yes 19.Yes 20.Yes

[15] "Best Practice Protocol on the Use of Sign Language Avatars", Verena Krausneker, Sandra Schügerl, University of Vienna, 2021, University of Vienna (univie.ac.at)

[16] ISO - ISO 17100:2015 - Translation services — Requirements for translation services

Vienna Best Practice Recommendations		Met by SignON V1.0 Avatar
	accessibility to buildings & other facilities open to the public", ensure right to freedom of expression & opinion, including the freedom to seek, receive & impart information by "recognizing & promoting the use of SLs". 19. Human/citizens' rights & true accessibility must be prioritized over cost savings. 20. All publicly funded signing avatars must adhere to this Best Practice Protocol.	
Situational Appropriateness	21. Deaf people should make the informed decision when & where avatars can be deployed. 22. Avatars are not yet able to relate complex topics & not every length of text can be adequately represented. 23. Best use of avatars is where the content allows it & SL recognition is demonstrably of the highest quality. 24. Deployment crucially depends on the sensitivity of the topic & potential for danger. 25. In all cases where hearing people are informed by human voices or real speakers, deaf people should also be informed by human interpreters. 26. For more confidence in the avatars, those responsible for them are identified, e.g., on the website of the avatar provider. 27. Avatar SL content must aim at gaining the trust & convince all deaf viewers, including those with multilingual & high levels of linguistic competencies. 28. There should be emotion & charisma in avatars, including e.g. irony & nuances. 29. Interdisciplinary research on avatars & their ramifications should be conducted continuously.	21.Yes 22.Yes 23.Yes 24.Yes 25.Yes, when available 26.Yes 27.Yes 28.Not yet 29.Yes
Social Aspects	30. Avatars should only be deployed when they are a useful & appropriate addition to human interpreters. 31. Avatars must not contribute to the social isolation of deaf people. 32. Deaf people should not be "obliged" to spend even more time in front of a screen instead of having real, live interactions,	30.Yes 31.Yes 32.Yes
Aesthetic Aspects	33. In all situations, it must be evaluated if an avatar (a character that is perceived to be highly artificial), is appropriate. 34. Depending on the situation & video, the avatar sizing must ensure ease of intelligibility, & if the animated avatar should be free-standing or better placed in picture-in-picture. 35. Consider when it is desirable for a SL to be represented by a human & when it makes no real difference if an animated, artificial avatar does so.	33.Not yet 34.Yes 35.Yes

Table 2 Status of current SignON App Avatar use.

The Vienna report[17] concluded that it "*would be desirable that SL avatar technology was freely available to everyone as an application (such as Google Translate or other free computer assisted translation tools). Hence, deaf people could use avatars independently and self-determinedly in those situations they find appropriate (and would even supply the app with information that is relevant for future users)*". This is exactly what SignON is doing!

[17] "Best Practice Protocol on the Use of Sign Language Avatars", Verena Krausneker, Sandra Schügerl, University of Vienna, 2021, University of Vienna (univie.ac.at)

4. Conclusions and Recommendations

SignON will provide a free and open-source MT between sign language, speech and text in different languages that will go beyond current partial applications. With SignON each user will be unrestricted by the source and target modalities and languages and can choose their preference via the mobile App's UI, a light-weight interface that features an intuitive responsive easy-to-use UI, personalised to provide each user with their typical translation languages and modalities, allowing the user to simply modify these as they require, and allowing to train to improve its performance to better meet their needs.

This deliverable is the first formal Release of the SignON Mobile Application, which is available on the Google Play Store and Apple App Store as "SignONMobile" for both Android and IOS mobile devices. It is also the project's first output of task T2.3 "Design and Development of the SignON Communication Mobile Application", which is developing the app using an iterative user-driven agile DevOps approach and industry-standard components in the SignON open Framework as described in D2.3. The SignON Communication App aims to be an intuitive, easy-to-use user input and output interfacing with the cloud-based SignON Service platform (T2.1 and T2.2) where the computationally intensive tasks (of WP3, 4 & 5) will be executed.

This First Release of the app has enabled WP1 formative evaluation pilot trials to take place, as reported in D1.9 , and it will now be evolved to its Final Release, as D2.7, at the end of the project. This user-driven iterative co-creation approach aims to ensure wide uptake, improved SL detection and multilingual speech processing on mobile devices for everyone.