**Source: 3GPP SA4 Audio SWG**

**Title: Organization of IVAS Characterization Phase**

**Document for: Agreement**

**Agenda Item: 15.2**

# **1. Introduction**

This document provides the outline on organization of IVAS Characterization Phase. The document was discussed and **agreed in the Audio SWG**.

Basis are the working assumptions discussed at SA4#124, contributions received, and discussions in Audio SWG and between Audio SWG and Ittiam.

# **2. Goals of IVAS Characterization Phase**

While IVAS Selection Phase run on the basis of floating-point code, the IVAS-2 Project Plan schedules the availability of fixed-point code for March 2024. Characterization testing aims at testing the FX code. Hence the Characterization Phase consists of two sub-tasks, namely making the FX code available in time, and running subjective listening evaluation of IVAS using the FX code.

Considerations were made how to achieve these goals. First the availability of the FX code in time had to be solved and for this, outsourcing the conversion of FL code to FX to a specialized expert company was identified as the only feasible way. The Audio SWG chairman made a call over the 3GPP SA4 reflector on 9 May 2023. Ittiam replied on 15 May 2023 and expressed interest, then contacts were established to Ittiam, and officials provided a presentation and quote to Audio SWG, and discussion was organized to identify key factors / requirements of FL-to-FX conversion. For this sub-task, part of the collected funds of 1.2Mio euro is planned to be spent.

The quote by Ittiam to perform the FL-to-FX conversion is attached to this document.

The second sub-task will be to run the characterization phase subjective experiments. For this sub-task, part of the collected funds of 1.2Mio euro is planned to be spent to external listening labs, according to the characterization test plan (see IVAS-2 for the development schedule).

**3. Key factors / requirements for IVAS FL-to-FX conversion**

BASOPS

* Usage of BASOPs in IVAS FX code
* STL2023 is the basis, including the 64-bit BASOPs.
* Overflow and Carry flag used inside the BASOPs and written to global variables shall be avoided. In case Overflow or Carry would be required, new dedicated operators that expose those flags without the use of global variables shall be used.

To reflect this and potential other necessary improvements, some operators may need an update; this update will be provided by Audio SWG to Ittiam in time.

* Contribution to ITU-T on modified BASOPs will be desirable.
* For the EVS part, the “alternative” 64-bit FX EVS implementation will be used, together with the 64-bit BASOPs (TS 26.452).

Complexity

* Complexity (WMOPS) ratio between IVAS FX and IVAS FL should be no worse than the complexity ratio between EVS FX and EVS FL; the goal is that the design constraints are met with the FX code.
* Memory savings: always use the smallest data type (and respective BASOPs) as far as possible, in a reasonable balance with complexity.

FX coding practices

* 3GPP Forge will be used as the platform of FX development, similarly to the development of FL code in Public Collaboration.
* Inclusion of 3rd party code or open-source code is not allowed; no code generated by AI tools.
* Structure of FL code shall be preserved to the maximum extent to allow comparison between FL and FX code and easier maintainability of the two code bases. This includes the best preservation of function prototypes and comments in the code; file names shall remain unchanged. In addition, all variables converted to FX shall be marked with precision information (integer, fractional) in Q-notation; precision changes should be documented; the goal is that the original functions could be used interchangeably during development; function names of converted functions shall be appended by “\_basop” during the development; the objective is to ultimately have maximum similarity to the FL code and eventually all variables and function names also in FX shall be unified to their FL counterpart.
* Interoperability between FX and FL codes shall be guaranteed; for example, valid FL bitstreams shall be decodable by the FX-decoder, related to certain quality requirements (no drop).
* Making test vectors available for conversion is responsibility of Audio SWG experts.
* Further practical matters should be discussed between Audio SWG experts and Ittiam

Project organization

* Collaborative development includes regular email exchange and a weekly call, time: Tuesday (preferred) or Wednesday (still to be considered) 12:00-13:00 CEST/CET, Teams invite will be sent by S. Bruhn/Dolby.
* Project schedule:
* IVAS codec selection approval at TSG-SA in September (11-15), in Bangalore
* Contract preparation between Ittiam and ETSI may take few weeks and starts early September.
* Scheduling T0 of the project for end of September / early October seems feasible.
* Plan is T0 = 2nd October 2023 (Monday) or earlier if administration allows.

**4. Characterization Phase Testing**

Listening lab experiments are planned to be run in external listening labs (against payment) and in the labs of volunteering 3GPP member companies. The external listening labs will be determined in time to run the experiments as scheduled in IVAS-2.

The following companies offered to run listening experiments on voluntary basis: Dolby, Fraunhofer IIS, Ericsson, Nokia, Orange, VoiceAge.

**5. Budget**

The following table contains the allocation of budget to sub-tasks.

|  |  |  |  |
| --- | --- | --- | --- |
| **Task** | **Sub-task** | **Amount** | **Amount**  **in EUR \*** |
| Selection Phase | Listening lab – Force Technology | 239.000 EUR | 239000 |
|  | Listening lab – HEAD acoustics | 179.000 EUR | 179000 |
|  | Listening lab – Mesaqin.com | 180.000 EUR | 180000 |
|  | Listening lab – MC University | 36.000 EUR | 36000 |
|  | Global Analysis Lab – HEAD acoustics | 12.000 EUR | 12000 |
| Characterization Phase | FL-to-FX conversion – Ittiam | 373.333 USD | 343702 |
|  | Listening labs and GAL – external labs (tbd) |  | 210298 |
| Total |  |  | 1200000 |

\* Exchange rate as during SA4#125.

**6. Action Items**

SA4 is requested to agree on this document, following the agreement in Audio SWG.

On this basis, ETSI MCC is kindly requested to

* contract Ittiam for performing the IVAS FL-to-FX conversion work;
* the basis is the attached quote by Ittiam;
* annex the present document to the contract as for technical requirements in section 3;
* set the start of the project with T0 = 2nd October 2023 or earlier if manageable.