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**Question(s):** 10/16

Geneva, 25 August 2011

**LIAISON STATEMENT****Source:** Q10/16**Title:** Reply LS to IETF CODEC WG on their OPUS codec

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**LIAISON STATEMENT****For action to:** IETF CODEC WG**For comment to:** ITU-T SG12**For information to:** -**Approval:** ITU-T SG 16 management by correspondence (25 August 2011)**Deadline:** 1 November 2011

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ITU-T SG16 thanks IETF CODEC WG for their LS providing information on the progress of their work on the Internet Wideband Codec (OPUS). Following the invitation from IETF Codec WG to provide comments on the document (<http://datatracker.ietf.org/doc/draft-ietf-codec-opus/>), ITU-T Q10/16 Rapporteur requested WP3/16 audio coding experts to send him any comments. The following responses have been received on the OPUS codec itself and associated documents mentioned in IETF LS.

**1. Comments on OPUS specification (text and C-code)**

SG16 experts are unsure about the maturity level of the specification and wonder when a final standard will be delivered. It is stated that "the design team believed the codec was complete by June 2011, consequently, the codec group issued a WGLC for the codec on July 8, 2011". However, since that date, several patches and bug fixes have been sent on the IETF reflector, which suggests that the last-call agreement on the codec was based upon an unstable version.

Misalignments between the specification text and the C-code implementation have also been noted: some algorithmic features performed in the C-code implementation, e.g., warped LPC, are not described in the text, whilst some algorithmic features described in the specification text are not implemented in the source code, e.g., the switching between SILK and CELT at speech/music and music/speech frame transitions.

Besides the patches already provided, other issues have also been noted in the C-code such as:

- The "readme" file is not in agreement with the "help" output of the executable command line (probably the readme has been written for an older software version?);

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- The C-code still contains some "TODO" comments;
- Parts of the C-code seems to be either unreachable or remain unoptimized: We believe that a significant amount of work still needs to be done to derive an efficient implementation without useless additional complexity;
- The portability of the current version is rather limited. Speech and audio coding standards are expected to have a wide portability so that they can be used in a wide range of environments. The OPUS codec software seems to have been natively developed for Linux (or Cygwin) and does not seem to be easily portable to other platforms. For instance, it cannot be compiled directly on another platform with a different compiler such as DOS/Microsoft Visual Studio and building a Microsoft Visual Studio project will require various modifications to the C-code;
- Test vectors to check the compliance with the OPUS standard are missing: Speech & audio coding standards should have a minimum set of Test Vectors to check whether the generated executable works properly and any implementation complies with the expected standardized format;
- The auxiliary functionalities required for VoIP, e.g. time shortening/stretching, are not provided together with the codec. An important justification for the formalization of the IETF Codec WG was that these functionalities were stated to be very crucial for VoIP quality and are not provided in the codecs from other SDOs.

## **2. Comments on quality requirement references of OPUS**

The understanding of SG16 experts was that the primary objective of the IETF Codec WG was to develop a codec which is royalty-free and easily distributable, as given in guidelines (<http://datatracker.ietf.org/doc/draft-ietf-codec-guidelines/>), and this was the main motivation behind using royalty-free codecs to define the quality requirement references, as given in Section 5.1 of codec requirements (<http://datatracker.ietf.org/doc/draft-ietf-codec-requirements/>). It is unfortunate that this objective seems to not have been achieved. We believe that the choice of the codecs for quality requirement references were not appropriate and have subsequently been shown to be somewhat misleading. These requirements should have been set with regard to standardized codecs based on their technical merits rather than their royalty status.

## **3. Comments on OPUS performance assessment**

According to test results provided in another IETF deliverable referred in your LS (<http://datatracker.ietf.org/doc/draft-valin-codec-results/>), OPUS appears to have some promising quality. Yet, this deliverable does not include any formal test results based on a test plan designed with appropriate standardized testing methodologies. Moreover, it is a compilation of various tests conducted for different purposes using older versions of the codec. Therefore, it is difficult to assess the quality of the final version of OPUS codec which enters WGLC.

As communicated in our March 2011 LS, quality performance assessment requires the selection of suitable testing methodologies, careful and extensive design of test plans and analysis of the results. For example, we have received instructions from the experts in SG12 that subjective quality assessment should be based upon formal listening tests in at least two languages, to evaluate codec performance and to guarantee suitability of codecs for international use. Once again, we invite you to consult ITU-T SG12 for advice on the quality assessment of codecs and a more thorough review of your deliverable on test results.

Additional information on other codec performance criteria is also missing such as complexity and memory consumption for the various OPUS operating options (bit rates, modes, complexity).