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A critical review of the IEEE 1599 standard

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ABSTRACT

IEEE 1599 is an XML-based format standardized in 2008 by the Computer Society of the Institute of Electrical and Electronics Engineers (IEEE). The goal of this standard is to provide a comprehensive description of a music piece, supporting the encoding of heterogeneous aspects (symbolic, formal, graphical, audio, etc.) inside a unique XML document. The format presents advanced features such as a multi-layer information structuring and full synchronization among synchronizable entities. In this work we aim to conduct a critical review of IEEE 1599, not only providing a brief overview of its strength points but above all underlining those aspects that could be improved. The paper will also compare IEEE 1599 with other common formats for representing music information.

Contents

1. Introduction

IEEE 1599 is an international standard originally conceived to provide a comprehensive description of all music information related to a single piece. The history of this format spans about 15 years, undergoing a continuous process of revision and development. Due to the standardization by the Computer Society of the Institute of Electrical and Electronics Engineers (IEEE), in 2008 the characteristics of the standard were set: any change would require an international balloting aiming at the release of a new version.

Nevertheless, in the last years the developers and researchers who adopted IEEE 1599 encountered some problems that should be addressed. The goal of this work is to point out a number of open issues recently emerged and propose a revision of some aspects of the standard, without distorting its original philosophy and approach.

The paper is organized as follows: Section 2 describes the key development stages of IEEE 1599, Section 3 presents a short overview to let a non-expert reader understand its main concepts, Section 4 provides a comparison with other music-oriented representation formats, Section 5 contains a critical review of the IEEE 1599 standard, and Section 6 provides a final discussion about the reasons for IEEE 1599 underutilization.

2. IEEE 1599 milestones

Even if the design and standardization of IEEE 1599 involved dozens of experts in the fields of music, musicology and computer

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science worldwide, it was mainly conceived, designed and implemented inside two research centers, namely the Laboratorio of Informatica Musicale (LIM) of the Università degli Studi of Milan and the Scuola universitaria professionale della Svizzera italiana (SUPSI).

The first step was the establishment of the Technical Committee on Computer Generated Music, founded in 1992 in order to cover a vast interdisciplinary area spanning from Audio Signal Processing to Music composed or performed with the help of computers. Soon the activities of the committee focused on the problem of providing a comprehensive description of music information. In 2001 the IEEE Standard Association approved a recommended practice for the "Definition of a Commonly Acceptable Musical Application Using the XML Language". It was the first formal step towards the standardization of the forthcoming IEEE 1599 standard.

In 2002 a milestone event took place at the Università degli Studi of Milan, namely the first IEEE International Conference on Musical Application using XML. In that occasion, an early version of the format — called MX — was presented to an audience of experts in the field of XML representations for music. Most ideas of the future standard were already present in MX [1].

In late 2008, as a result of the efforts of the IEEE Technical Committee on Computer Generated Music, the MX format overcame the balloting phase and it was internationally recognized by the IEEE. The name assigned to the standard was IEEE 1599.

After the standardization, the research and development activities of the working group moved to the design and implementation of off-line and on-line applications. In the former context, relevant initiatives involved institutions such as Archivio Storico Ricordi of Milan, Bach Archive of Leipzig, the Italian Ministry of Cultural Heritage and Activities [2].

In the framework of Web-oriented technologies and applications, an important initiative was EMIPIU. Born as a publicly-funded international scientific cooperation in 2011, EMIPIU is an acronym standing for Enhanced Music Interactive Platform for Internet User. The project aimed at the application of information technology to music cultural heritage, addressing in particular theaters, opera houses, museums, music initiatives, public and private institutions, conservatories, etc. The EMIPIU project was carried out by the Laboratorio di Informatica Musicale (LIM) — Università degli Studi di Milano[1] and the Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier (LIRMM) — Université Montpellier 2.[2] The portal, which is still publicly available at http://emipiu.di.unimi.it, was implemented by Didael KTS S.r.l.[3]

In order to understand the importance that IEEE 1599 still has in the field of music and multimedia description and diffusion, latest applications based on this standard have been recently presented at the first Web Audio Conference organized by IRCAM and Mozilla in January 2015 [3].

The present work has been presented and discussed at the 11th International Symposium on Computer Music Multidisciplinary Research (CMMR) — Music, Mind, Embodiment, which took place in Plymouth, UK on 16–19 June 2015.

3. A short overview of the standard

The key characteristics of the IEEE 1599 standard have been described in detail in many scientific publications. In addition to the official IEEE documentation, [4] discusses most of its aspects, ranging from the broad description of general concepts (e.g., multi-layer layout, common data structures and implementation of synchronization mechanisms) to specific application domains (e.g., the applicability of the standard to cultural heritage re-living and the support to Music Petri nets). Some commented examples are available in [5]. Describing the IEEE 1599 standard in detail goes beyond the purposes of this work. In this subsection we will cover only the basic concepts, for further details please refer to the mentioned bibliography.

The innovative contribution of the format is providing a comprehensive description of music and music-related materials within a unique framework. IEEE 1599 adopts an XML-based encoding and consequently it is fully compliant with the World Wide Web Consortium (W3C) specifications [19]. Comprehensiveness in music description is realized through a multi-layer environment. The XML format provides a set of rules to create strongly structured documents. IEEE 1599 implements this characteristic by arranging music and music-related contents within six layers:

- General — Music-related metadata, i.e. catalogue information about the piece;
- Logic — A score description in terms of music symbols;
- Structural — Identification of music objects and their mutual relationships;
- Notational — Graphical representations of the score;
- Performance — Computer-based descriptions and music performances through languages such as MIDI or MPEG4;
- Audio — Digital or digitized recordings, including video clips and movies.

Music events are identified in the encoding through a unique id thanks to a common data structure, known as the spine. After listing, sorting and marking music events in the spine, they can be described in different layers (e.g., the graphical aspect of a chord and its audio performance), and multiple times within a single layer (e.g., the sound of that chord in different audio performances or its graphical aspect in different scores). Consequently, the multi-layer environment provided by IEEE 1599 supports two synchronization modes:

1. Inter-layer synchronization, which takes place among contents described in different layers. Different layers are used to store heterogeneous information referring to the same music piece in a synchronized way;
2. Intra-layer synchronization, which occurs among the contents of a single layer, where homogeneous information is contained.

Coupling the aforementioned kinds of synchronization, it is possible to design and implement an advanced framework for music, whose goals could range from an advanced media experience to music-based edutainment, from cultural heritage re-living to music practice and education.

4. Comparison with other formats

4.1. XML-based formats

At the moment of writing, the two main XML-based alternatives to IEEE 1599 are represented by the Music Encoding Initiative (MEI) [6] and MusicXML [7].

In recent times W3C has launched the Music Notation Community Group,[4] an initiative that aims to unify formats syntactically and semantically different in order to establish the guidelines for a standardized approach. The original goal was to develop and maintain format and language specifications for notated music used by

[1] http://www.lim.di.unimi.it
[2] http://www.lirmm.fr
[3] http://www.didaelkts.it
[4] https://www.w3.org/community/music-notation/