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# DAFNE+: A blockchain platform for preservation and valorisation of experimental music and sound production

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## ABSTRACT

*A new international research and innovation project supported by the European Union, the DAFNE+ project for fair creative content distribution aims to empower creators and communities through new digital distribution models based on digital tokens. The purpose of DAFNE+ is to design a blockchain and NFT based platform providing digital content creators with new forms of creation, registration, distribution and monetization of their works of art. DAFNE+ addresses several creative communities and the purpose of this article is to focus on those of its features intended to the experimental sound and music community. Halfway between IRCAM's Forum and archives of interactive music/sound repertoire, and based on an autonomous organization and distributed infrastructure, the platform will enable artists, researchers and engineers to share and monetize pieces of technology for producing music and performing works - libraries, patches, documentations. This paper presents the general objectives of the project, its foundations, the specification process it followed, the target features that resulted from it and its current state of development.*

## 1. INTRODUCTION

A new international research and innovation project supported by the European Union, the DAFNE+ project<sup>1</sup> for fair creative content distribution aims to empower creators and communities through new digital distribution models based on digital tokens. The purpose of DAFNE+ is to design a blockchain and NFT (non fungible token) based platform providing digital content creators with new forms of creation, registration, distribution and monetization of their works of art. In an intuitive and simple way, without the need for technical knowledge in blockchains/NFTs, creative communities are invited to join a decentralized autonomous organization (DAO) offering new services and tools that allow the creation and co-

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creation of content in a blockchain. DAFNE+' research focuses also on the definition of new business models through the distribution of content, allowing creators and users to monetize multimedia creations. The project was started in July 2022 for 36 months and gathers an international consortium of 10 European partners including universities and public research centres, companies specialized in digital infrastructures and organizations federating creative communities. It is structured in 3 use-cases addressing the following communities:

1. User generated content at large for heritage (prosumers and multimedia students)
2. Experimental sound and music production (composers, computer music designers, sound designers and sound engineers)
3. Novel forms of artistic content exploitation (makers, designers)

This paper focuses on the second use-case led by IRCAM.

## 2. BACKGROUND

### 2.1 IRCAM

The Institute for Acoustic/Music Research and Coordination IRCAM is one of the largest public research centres in the world articulating musical creation and scientific research. IRCAM's original framework as an organization has been since its inception in 1977, as a component of the Centre Pompidou's project in Paris, to gather researchers, engineers and artists in the same place and organize productive interactions between them. Its research lab entitled STMS (Science and Technology of Music and Sound) gathers 120 researchers, faculty and engineers specialized in all scientific fields related to music and sound. The artistic and production departments commission and host some of the greatest composers and performers for producing 30 new artworks every year, mostly live performance pieces based on IRCAM's latest technology. Beyond the presence of artists, a specificity of the lab in the academic world is that most research teams include engineers who develop and maintain over years dozens of technical environments and modules (mostly software but also hardware) that integrate new research results and make them available to artists for their own production.

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<sup>1</sup> <https://dafneplus.eu>

## 2.2 The IRCAM Forum

The IRCAM Forum was founded in 1994 to make the IRCAM non-commercial technologies available to external users, mostly artists - composers, performers, sound designers, sound engineers, but also researchers and teachers, engineers, etc. 30 years after, the IRCAM Forum gathers a community of 50,000 users following a yearly growth of 25% in the last years. The main vectors for this interaction between IRCAM research teams as technology producers and these users are the forum.ircam.fr web platform and the organisation of the IRCAM Forum Workshops gathering part of the community every year at IRCAM and in various countries in collaboration with partner institutions. From a platform of distribution of IRCAM technology, the IRCAM Forum website<sup>2</sup> turned from 2019 to a community platform, enabling members to publish their own content (software distributions, articles, events), exchange in specialised discussion groups and collaborate on code through an internal git-based repository system. An important component of the IRCAM Forum is also to manage the documentation and promotion of the technology through the editorial production of related tutorials, teasers, user documentations in various forms (text documents, sound examples, videos, etc.). Technology distribution in the Forum platform is done through the Project model that can include any set of digital elements including code and data, examples, tutorials, etc. in dedicated archives. Projects can be created directly in the platform CMS, as well as mirrors from external open-source repositories such as GitHub.

## 2.3 The IRCAM Sidney patches archive

In addition to the IRCAM Forum, which hosts sound and music production tools, the Sidney private platform [1] includes versions of the technical repositories for pieces produced at IRCAM. This database contains archives of all the digital elements required to produce interactive works (patches, sounds, documentation, etc.).

## 2.4 Collaborative archiving and creative preservation: the Antony project

Storing, documenting and sharing contemporary music materials is a problem faced by many organizations. Beyond the usual difficulty to find financial resources to work on databases before they can even exist and the challenge to specify and implement a data model that ideally fits for everyone, the specificity of such data is both related to the extreme heterogeneity of the file repositories and their evolution in time.

Starting from the base of the Sidney application and methodologies, a workgroup has been created inside the French computer music association with several actors of the ecosystem in order to study and propose some common methodologies that would provide better approaches to manage musical data in the long term, especially for generative and interactive pieces [2]. Several guidelines

that resulted from this 2-year study including the following ones:

1. The workflow rules should engage external contributions to maintain the playability of a piece although the technical execution environment varies [3].
2. The granularity of the repositories needs to be exposed for pedagogical and dissemination reasons.
3. The versions of an artistic work should reference the original one [4].

To meet these objectives, a git-based code management was proposed. Not only it provides a continuity and historicity of the contributions, but it also ensures that the versions of the code can be differentiated and identified uniquely as commits or tags. Practically, it also gives the possibility to create branches to develop, test and prototype new future versions. Of course, this is a very common workflow in engineering and code development but not as usual in the musical use cases.

## 3. FEATURES FOR EXPERIMENTAL SOUND AND MUSIC IN DAFNE+

### 3.1 Initial assumptions

Given the initial purpose of DAFNE+ as a blockchain/NFT platform aimed at empowering artists for publishing and monetizing their works, and building on the experience of IRCAM Forum, Sidney and Antony, the initial assumptions of targeted features for experimental music production were the following:

- Experiment new possibilities of registration and distribution of creative technologies (applications, libraries) using the blockchain. Provide access to existing tools, support their extensions and the development of new ones;
- Extend managed assets to artistic productions. More precisely, the objective was not to pretend replacing existing circuits of music right collection and management, for music composition, audio recordings or performance; in the continuity of Sidney and Antony, the focus was put on a category of productions mostly unaddressed by right collecting societies but central for experimental music: the technical elements needed to produce the work.
- Manage explicitly successive versions of a work and the rights granting process for enabling the production of new versions.
- Manage, through NFTs and associated smart contracts, access rights to these assets including through cryptocurrency-based monetization processes.
- Implement a decentralized content management architecture ensuring the best conditions for long-term sustainability.
- Unlike IRCAM-centered Forum and Sidney, organize the community in the form of a DAO (Distributed Autonomous Organization) in which members would be part of the organization and decide on the asset management and monetization rules.

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<sup>2</sup> <https://forum.ircam.fr>

### 3.2 Specification process

These assumptions were integrated in a process of specification that gathered the project DAFNE+ partners and involved representatives of the targeted communities. It started with several internal project workshops to exchange on the different use-cases through a common analysis grid based on *storylines* identifying managed assets, user types and roles and their potential interests for each storyline. This process enabled to identify aspects specific or common to several use-cases. Although very different on the addressed communities and types of digital contents managed, a lot of similarity emerged on the main categories of assets to be managed and user roles in relation to these categories. A common vocabulary was adopted and converged on the concepts of *Components* and *Repositories*. *Components* are technical modules (code scripts, libraries, executables, databases...) that intervene in digital creative tools, whereas *Repositories* gather technical elements needed for a creative process, mostly creative application documents and data. The distinction between them lies less on their technical form than on their purpose: *Components* are produced by technical experts and perform a generic technical process independently of a specific artistic project, whereas *Repositories* are the support of a creative process, in particular for the production or reproduction of the artifact. Another important dimension resulting from these exchanges was the collective dimension of the involved creative processes with possibly different roles assigned to various categories of users.

In parallel, DAFNE+ technical, business and legal partners elaborated a set of general questions that cut across the various use cases.

This stage of elaboration by the DAFNE+ consortium was then confronted to a user feedback process. An online survey was publicly announced through various communication channels. Following its launch of the survey, use case managers organised live exchanges with representatives of their communities through a set of workshops and interviews. The qualitative feedback they obtained helped interpret the survey responses to feed into the platform specification. Another outcome of this feedback was to feed an update of the use case specifications from the initial assumptions. What emerged then was the necessity of structuring each use-case in several scenarios, involving different assets and/or user communities and roles. The answers to the survey enabled to prioritize the features to be developed and were then translated to functional and technical specifications, that fed the platform development during the second semester of 2023.

### 3.3 Features for experimental sound and music production

Some platform features are common to all DAFNE+ use-cases and communities, such as:

- the use of a distributed content management system,
- the possibility of declaring ownership on uploaded contents, possibly between several users with defined

shares, and/or on the organizations to which they are affiliated,

- then to mint them as NFTs, and publish them in the platform's marketplace and possibly to external marketplaces,
- the availability of a set of creative tools resulting from research carried out as part of the project, including on AI-based image processing and 3D modeling,
- the setup of a DAO for managing the exchanges within the community.

The platform features more specifically intended for experimental sound and music production are summarized in the following scenarios and tool sets.

#### 3.3.1 Scenario 1: Software components

This scenario concerns the distribution and use of software components for audio/music creative processes (libraries, applications, datasets, etc.). Novel possibilities enabled by the blockchain include its use for declaring software anteriority, NFTs supporting crowdfunded code development in the spirit of Patreon, and its complementarity to open-source software distribution for protecting non-public domain components, such as datasets resulting from artistic processes (performance recordings) that can be stored in the platform and made available conditionally to the acquisition of an NFT associated to a license in the form of a smart contract.

#### 3.3.2 Scenario 2: Work repositories

This scenario is central to the project and aims to support the technical and legal foundations of an open database of sound/music work repositories: in the international computer music community, and despite various expressed marks of interest and local approaches there has been up to now no large-scale infrastructure developed for that purpose. The setting of such an open work repertoire gathers converging interests of composers, computer music designers, performers, performance venues and musicologists, and even possibly collectors who would like to acquire rights on the technical form of major works that are expected to be milestones in the history of sound and music aesthetics. The initial focus was on computer music, but positive feedback from artists and sound designers has led us to extend the scope to the latter: in commercial sound design or urban installations, declaring the work in the blockchain before submitting it for tender can provide a kind of security against copying. The possible formats are very open and can include the algorithms used to compose the piece, the patches to perform it, but also multichannel recordings, that are currently not supported by most NFT marketplaces. A major problem identified in many cases is that work repositories can include copyrighted content, such as scores or recordings. The approach being pursued, which is the subject of legal studies currently underway at international level, is to store such content privately and only allow access to it subject to the acquisition of an NFT associated with a smart contract license that will specify the conditions of use acceptable to the holders of these neighbouring rights. In addition, the platform specification foresees the management of work versions, i.e. several blockchain assets

pointing to the same piece, with the choice given to the initial owner either to allow anyone to produce a new version, or to prevent it by default and be able to select users of his/her choice who will be trusted for respecting the original artistic intention and make relevant choices therefore.

### 3.3.3 Scenario 3: Private spaces

This last use-case was not initially foreseen and emerged from exchanges with composers in workshops and interviews. The idea is to transpose crowdfunding processes to contemporary music creation using NFTs: fans and collectors will be invited to contribute to the funding of an ongoing creation process against counterparts (“private spaces”) to be defined by the artists and their commissioners in smart contracts, including VIP access to the work premiere, invitation to follow the production process, exchange sessions with the artists, mention of their names as part work sponsors, etc.

### 3.3.4 Creative tools

The IRCAM Forum already proposes many creative tools and an API has been developed to enable the access to its projects metadata from the DAFNE+ platform’s tools catalogue. DAFNE+ also supports the development of existing or new creative tools. This support has been dedicated up to now to the following advances:

- The development of version 2 of RAVE<sup>3</sup>[5], a real-time audio processing technology based on a variational autoencoder featuring timbre transfer and generativity.
- A contribution to the development of WebPd<sup>4</sup>, a web interface that enables to play Pure Data patches in a browser, with all patch parameters specified in the URL. WebPd may be used for instance as a preview interface for some Pure Data work repositories.
- The development by Miller Puckette and test in a large scale production project by Philippe Manoury of Reality Check [6], a system dedicated to assessing the conformance of a new version of a Pure Data patch by comparing its audio outputs with those of a reference patch, using the same set of recorded inputs. In DAFNE+, it is intended to support the development of new versions of a patch.

## 4. CURRENT STATUS AND NEXT STEPS

As of January 2024, a first version of the platform<sup>5</sup> is publicly open and manages user registration, upload of content, declaration of ownership rights, publication of uploaded assets on the platform’s marketplace etc. The used blockchain is Polygon and the platform release runs on testnet, i.e. with bitcoins with no exchange value –here MATICs of Polygon’s Mumbai testnet. Moreover, the starting licensing conditions are restricted to the Creative Commons license, so to public-domain work repositories contents. Planned updates foresee the possibility of more

restrictive access and licensing conditions, the management of work versions, and the setup of the DAO. Beyond the technical and legal validation of its concepts during the project’s timeframe, the sustainability of the developed platform will be only possible if a sufficiently large community is involved so that recurrent means can be found for its operation.

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<sup>3</sup> <https://forum.ircam.fr/projects/detail/rave/>

<sup>4</sup> <https://forum.ircam.fr/projects/detail/webpd/>

<sup>5</sup> <https://dafneplus.eng.it/>