



## An open-source web framework for ethnomusicological audio archives management and automatic analysis

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1st International Digital Libraries for Musicology workshop



12th September 2014, London, UK

# Outline

- 1 Introduction
- 2 The Telemeta platform
- 3 TimeSide, an audio analysis framework
- 4 Sound archives of the CNRS - Musée de l'Homme
- 5 The DIADEMS project
- 6 Conclusion

# Introduction

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# Introduction

## Context

- Since 2007, the Research Center for Ethnomusicology (CREM) and Parisson have been developing an innovative, collaborative and open-source **web-based multimedia platform** for **humanities and social sciences research**.
- Official platform online since 2010 :  
*Sound archives of the CNRS - Musée de l'Homme*  
<http://archives.crem-cnrs.fr>
- This **collaborative** platform support numerous aspects of the field of **ethnomusicology**, ranging from musical analysis to comparative history and the anthropology of music. The platform also provides many useful resources for the fields of anthropology, linguistics and acoustics.

# Introduction

Towards automatic audio content analysis ...

- Recently, an open-source **audio analysis framework**, TimeSide, has been developed to bring automatic audio content analysis capabilities to the Telemeta web platform.

... and interdisciplinary collaboration

- Since 2013, as part of the DIADEMS project, academic researchers and engineers from the *Science and Technology of Information and Communication* domain and researchers from the *Musicology and Ethnomusicology* domain have been collaborating to develop new computer tools to **automatically index** the recording contents.

# The Telemeta platform

## 1 Introduction

## 2 The Telemeta platform

- Web audio content management features
- Metadata

## 3 TimeSide, an audio analysis framework

## 4 Sound archives of the CNRS - Musée de l'Homme

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# The Telemeta platform

## A web audio platform

The primary purpose of the project is to provide researchers working on audio materials with a scalable system to:

- access, preserve and share **sound items** and
- access and enrich **associated metadata** that contains key information on the context and significance of the recording.

## An open-source software

- Telemeta, is a **free and open source software (GPL-like licence)** in accordance with **open web standards**.



<http://telemeta.org/>

# Telemeta Item page

CREM  
Centre de Recherche  
en Ethnomusicologie

Search | Search

Welcome, Thomas Filion | Profile | Help | Sign out

Desk Archives Geo Navigator Advanced search Users Admin

Item : Bruits iconiques de lamentation :

Edit Copy Add to playlist Previous Next

Spectrogram Lin

00:00 00:34 01:00 01:30 02:00 02:30 03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

1 2 3 4 5 6 7 8 9 10 11

Nasalisation et octavation

Title: Bruits iconiques de lamentation :  
Original title / translation: Déploration de la bataille de Kerbala  
Collector: LAMBERT, JEAN  
Collection: CNRSMH\_I\_2013\_611  
Recording date: Jan. 1, 1998 - Dec. 31, 1998  
Last modification: April 8, 2014, 10:50 p.m. (j.lambert)

Analysis Markers

00:00:07.87 Chute dans le grave à la !  
author: j.lambert

00:00:29.63 Chute dans le grave  
author: j.lambert

00:00:34.81 Chute dans le grave  
author: j.lambert

Geographic and cultural informations  
Musical informations  
Archiving data

# Web audio content management features and architecture

## Main features of Telemeta

- Pure **HTML5** web user interface including dynamic forms.
- Database management through Strong Structured Query Language (**SQL**) or Oracle backend.
- **On-the-fly audio analyzing**, transcoding and metadata embedding in various multimedia formats, provided through an external component, *TimeSide*.
- Social editing with semantic ontologies, smart workflows, human or automatic annotations and segmentations.
- **User management** with individual desk, playlists, profiles and group access rights.
- High level **search engine** geolocation, instruments, ethnic groups, etc...).
- Multi-language support (currently english, german, french and chinese).

# Metadata

In addition to the audio data, an efficient and dynamic management of the associated metadata is also offered.

- Metadata provides valuable informations about the **source of the data** and to the related **work of peer researchers**.
- Dynamically handling metadata in a **collaborative** manner optimizes the continuous process of knowledge gathering and the **enrichment** of the materials in the database.
- One of the major challenges is the **standardization** of audio and metadata formats with the aim of long-term preservation and usage of the different materials.
- The compatibility with other systems is facilitated by the integration of the **metadata standards protocols** *Dublin Core* and *OAI-PMH* (Open Archives Initiative Protocol for Metadata Harvesting).

# Metadata

## Contextual Information

### Contextual Information

In an ethnomusicological framework, contextual information may include:

- Geographic information
- Cultural information ( population, related cultural elements, ...)
- Musical information ( title, instruments, ...)
- Archive or recording information (recording technical data, depositor, collector, year of the recording, year of publication of papers describing the work, ...)

### Additional materials

Moreover, through the platform, diverse materials related to the archives can be stored, such as:

- iconographies (digitalized pictures, scans of booklets and field notes, and so on),
- hyperlinks and
- biographical information about the collector.

### Examples

# Descriptive and analytical information

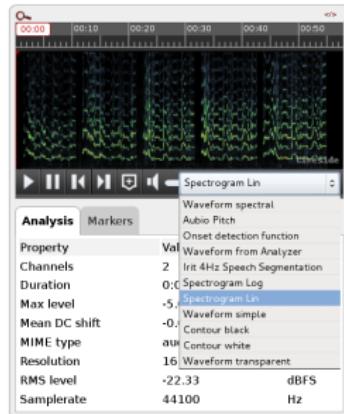
## Visual representation and segmentation

### Visual representation of the sound

The embedded TimeSide audio player allows for a selection of various visual representations of the sound (e.g. **waveforms and spectrograms**) and some representations of computational **analysis**.

### Segmentation

Automatic analysis can produce a list of **time-segments** associated with **labels** (e.g. detection of spoken versus singing voices, chorus, musical instrument categories, and so on).



# Descriptive and analytical information

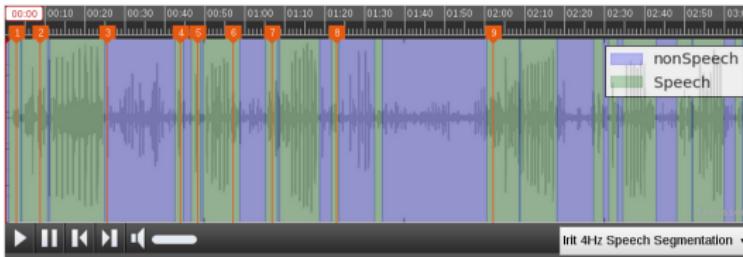
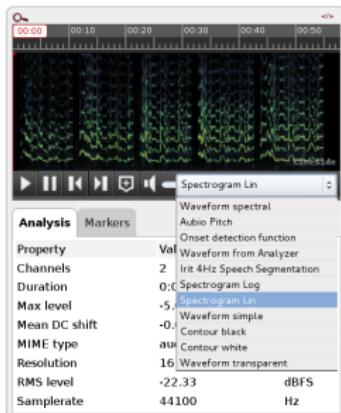
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# Descriptive and analytical information on the audio content

## Annotations

### Markers

- The embedded audio player also enables annotation of the audio content through **time-coded markers**.
- These annotations are **indexed** through the database.
- Users can create their own annotations and **share** them with colleagues.



# TimeSide, an audio analysis framework

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  - Audio management
  - Audio features extraction
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# TimeSide

## An open web audio processing framework

- TimeSide is the **signal processing engine** of Telemeta developed and published as a separate project.
- TimeSide is an *open-source audio analysis and visualization framework* based on both **Python** and **JavaScript** languages that provides state-of-the-art signal processing and machine learning algorithms together with **web audio** capabilities for displaying and streaming files.

<https://github.com/yomguy/TimeSide/>

## Audio management

TimeSide provides the following main features:

- Smart dynamic audio player with enhanced visualization (e.g. waveform, spectrogram) that can be embedded into any html page through *iframe* (live example: [Yomguy blog](#))
- Multi-format support: decodes the vast majority of audio and video formats
- On-the-fly audio analysis, transcoding, streaming and metadata embedding based on an easy plugin architecture.

# Audio features extraction

## Audio features extraction

TimeSide incorporates some state-of-the-art **audio feature extraction libraries** such as:

- Aubio: <http://aubio.org>
- Yaafe: <http://yaafe.sourceforge.net>
- Vamp plugins: <http://www.vamp-plugins.org>

Given the extracted features, every sound item in a given collection can be automatically analyzed.

The results of this analysis can be:

- Serialized to the web browser through common markup languages: XML, JSON and YAML
- Stored in a scientific file format (e.g. NumPy format or HDF5)
- Exported to sound visualization and annotation software (e.g. Sonic Visualizer)

# TimeSide engine architecture

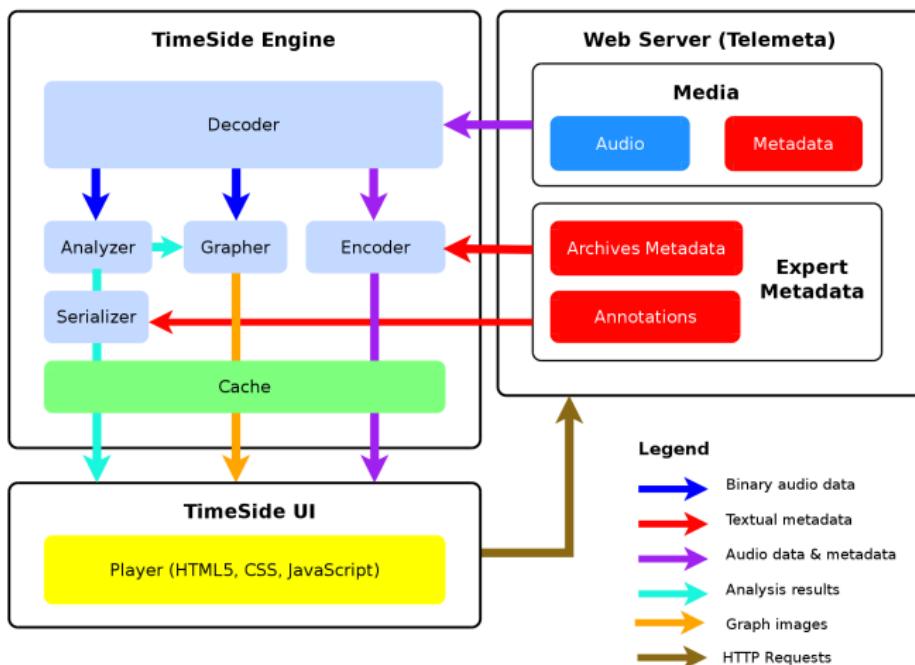


Figure: TimeSide engine architecture and data flow with Telemeta web-server

# Sound archives of the CNRS - Musée de l'Homme

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- Archiving research materials
- Uses and users of digital sound archives

5 The DIADEMS project

# Sound archives of the CNRS - Musée de l'Homme

- Since June 2011, the Telemeta platform has been used by the **Sound archives of the CNRS - Musée de l'Homme<sup>a</sup>** and managed by the CREM.
- These archives available for researchers, students and (when copyright allows) to a broader audience.
- It is one of the most important Sound archives library in Europe
- Through this platform, these archives can be shared, discussed and analyzed.

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<sup>a</sup><http://archives.crem-cnrs.fr>

# Archiving research materials

- The Sound archives of the *CNRS - Musée de l'Homme* have been collected by researchers attached to numerous research institutions across the world.
- Most of the recordings come from the fieldwork of researchers in **all continents** during the last **110 years**.
- Nearly **3700 hours of record collections** e.g. more than 5000 discs, many of which are very rare)
- **4000 hours of unpublished recordings**, from early research expeditions (e.g. Dakar-Djibouti (1932), Ogooué-Congo (1946)).
- **47,200 items** containing more than **26,000 sound files** (including 12,000 sounds on free access since May 2014).

# Uses and users of digital sound archives

- Three main activities: **archiving, research and education**
- Three main disciplines: **Ethnomusicology, Anthropology and Linguistic**
- Primary users of the platform are archivists, researchers, students and professors of these disciplines.
- Nonetheless, a qualitative survey showed that other disciplines (such as Art History) have used the platform.
- When used for education, the platform provides a wide array of teaching materials to illustrate the work of students as well as support teaching curricula.

# Uses and users of digital sound archives

## A collaborative experience

- The sharing of data offer resources to researchers from all over the world and allows several people to **collaborate on the enrichment of the database**.
- Researchers from different institutions can work together on specific audio materials and conduct individual research from both synchronic and diachronic perspectives on their own material, the material of others, or both.
- Users can submit their own archives to protect them.
- Furthermore, it facilitates the ethical task of **returning the recorded music to the communities who produced it** and to get local populations involved in their own cultural heritage.

# The DIADEMS project

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5 The DIADEMS project

- Consortium and goals
- The method of a new interdisciplinary research
- Evaluation and future improvements

# The DIADEMS project

Started in January 2013, the French national research program DIADEMS is a multi-disciplinary project dedicated to the **Description, Indexation, Access to Ethnomusicological and Sound Documents**.

## The consortium

### Science and Technology of Information and Communication domain



Institute of research in computing science of Toulouse  
Laboratory of computing and mechanics for engineering sciences

Bordeaux Computer Science Research Laboratory

Laboratory of Musical Acoustic, Jean Le Rond d'Alembert Institute

### Musicology and Ethnomusicology domain



Laboratory of Ethnology and Comparative Sociology

Research Center for Ethnomusicology

National Museum of Natural History

## Development



Parisson, the company involved in the development of Telemeta.



# Goals of the DIADEMS project

## Goals and on-going development

- The goal of the DIADEMS project is to develop computer tools to **automatically index** or assist the indexation of the recording content from the audio signal.
- Ongoing work consists of implementing advanced **classification, indexation, segmentation and similarity analysis** methods.
- **Besides music analysis**, such automatic tools also deal with speech and other types of sounds present ethnomusicological recordings like **speech, environmental noises and noises generated by the recording process**

# The method of a new interdisciplinary research

- In this research program, groups from **different backgrounds** are working together.
- The first challenge was to initiate a common interest and a **mutual understanding**.
- In this process, DIADEMS gave us the opportunity to improve our understanding on the **link between the semantics and acoustics of voice production** in order to be able to specify the classification and indexation tasks.

# Evaluation and Future improvements

## Development and Evaluations

- Interesting preliminary results have been obtained regarding the detection of start times of recording sessions, speech recognition, singing voice recognition and musical instrument family classification.
- The robustness of these processings is assessed using **criteria defined by the final users**: teachers, students, researchers and musicians.
- **After validation**, Analysis and Annotation tools, as well as the provided annotations, will be integrated in the Telemeta platform.

# Conclusion

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- Telemeta is a **fully operational** web audio framework for managing digital sound archives
- It's an **open-source** software (-> feel free to use, fork or contribute)
- Through the Sound archives of the CNRS - Musée de l'Homme, it is now used by many ethnomusicologists around the world for research or education purposes.
- Its collaborative nature enable a **continuous enrichment** of the audio content, the metadata and the analysis tools.
- Ongoing developments will turn Telemeta into:
  - an efficient annotation platform (with zoom and segment selection)
  - an social and collaborative platform (user access management and social stuff)
  - an interdisciplinary collaborative platform between IT and ethno with the joint development of automatic analysis and indexation tools

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# Thank You !

- Contact: [thomas@parisson.com](mailto:thomas@parisson.com)
- Telemeta:

<http://telemeta.org>

@telemeta

- TimeSide:

<https://github.com/yomguy/TimeSide/>

- Sound archives of the CNRS - Musée de l'Homme:

<http://archives.crem-cnrs.fr>

- The DIADEMS project:

<http://www.irit.fr/recherches/SAMOVA/DIADEMS/>



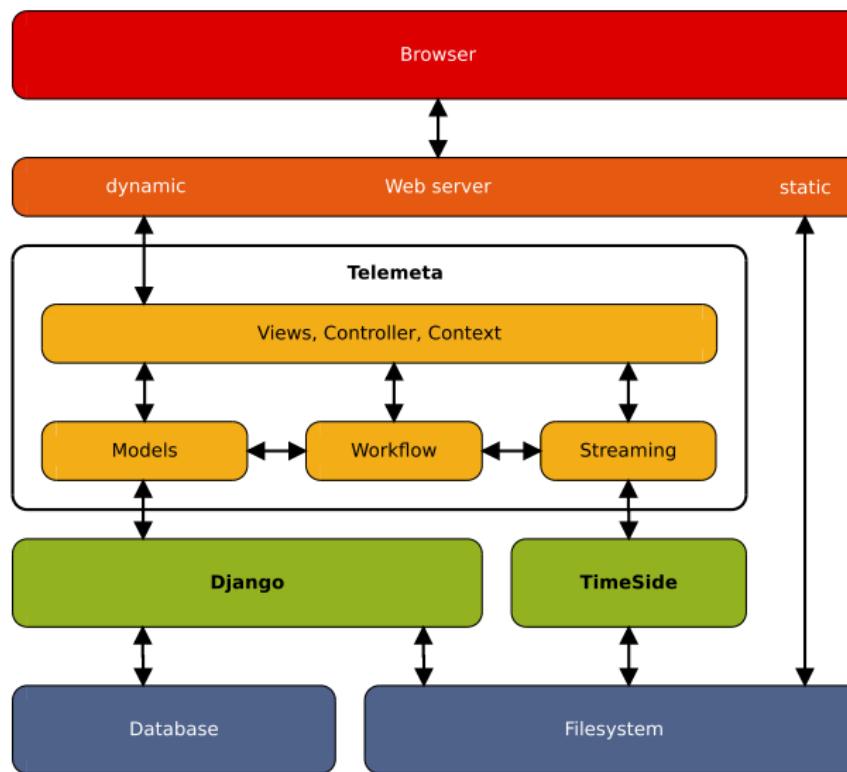
# Additional Materials

7

## Additional Materials

- Telemeta
  - Telemeta Architecture
  - Telemeta - Geographic Navigator
  - Multi language support
  - Metadata

# Telemeta architecture



# Telemeta - Geographic Navigator

back

# Telemeta - Multi language support

English


 Search

Welcome, Thomas Filion | Profile | Help | Sign out

Desk Archives Geo Navigator Advanced search Users

## Item : TROMPE ET TAMBOUR :41-15

Edit Copy Add to playlist Previous Next

Title	TROMPE ET TAMBOUR
Original title / translation	OLU BOY
Collector	
Collection	CNRSMH_I_1970_012
Recording date	Nov. 1, 1960 - Nov. 30, 1960
Last modification	Oct. 24, 2012, 5:39 p.m. (admin)

### Geographic and cultural informations

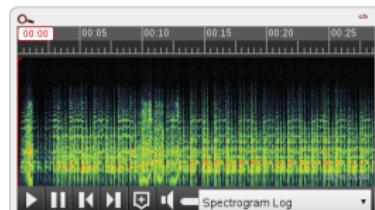
Location	Mali, Afrique occidentale, Afrique
Location details	SANGA
Population / social group	DOGON
Ethnographic context	

### Musical informations

Number	Composition	Vernacular name	Interprets
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

### Archiving data

Code	CNRSMH_I_1970_012_041_15
Original code	BM.1970.012.001/46:41-15
...	



Analysis		
Property	Value	Unit
Channels	1	
Duration	0:00:28.73	s
Max level	-3.816	dBFS
Mean DC shift	-0	%
MIME type	audio/x-wav	
Resolution	24	bits
RMS level	-19.12	dBFS
Samplerate	48000	Hz

# Telemeta - Multi language support

French


 Recherche

Bienvenue, Thomas Fillion | Profil | Aide | Déconnexion

**Bureau Archives Géo-Navigateur Recherche avancée Utilisateurs**

**Item : TROMPE ET TAMBOUR :41-15**

**Editor Copier Ajouter à la liste**

**Précédent Suivant**

Titre	TROMPE ET TAMBOUR
Titre original / traduction	OLU BOY
Collecteur	
Collection	CNRSMH_I_1970_012
Date d'enregistrement	1 novembre 1960 - 30 novembre 1960
Dernière modification	24 octobre 2012 17:39:17 (admin)

**Indications géographiques et culturelles**

Lieu	Mali, Afrique occidentale, Afrique
Precisions lieu	SANGA
Population / groupe social	DOGON
Contexte ethnographique	

**Informations sur la musique**

Nombre	Voix / Instruments	Nom vernaculaire	Interprètes
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

**Données d'archivage**

Cote	CNRSMH_I_1970_012_041_15
Cote originale	BM.1970.012.001/46:41-15

**Analyse** **Marqueurs**

Propriété	Valeur	Unité
Channels	1	
Duration	0:00:28.73	s
Max level	-3.816	dBFS
Mean DC shift	-0	%
MIME type	audio/x-wav	
Resolution	24	bits
RMS level	-19.12	dBFS
Samplerate	48000	Hz

# Telemeta - Multi language support

German


 Suche

Willkommen, Thomas Fillion | Profil | Hilfe | abmelden

Arbeitsfläche   Archive   Kartennavigation   erweiterte Suche   BenutzerInnen

**Item : TROMPE ET TAMBOUR :41-15**

bearbeiten

kopieren

zu Wiedergabeliste hinzufügen

vorhergehend

nächste

---

Titel	TROMPE ET TAMBOUR
Originaltitel / Übersetzung	OLU BOY
Sammlerin	
Sammlung	CNRSMH_I_1970_012
Aufnahmedatum	1. November 1960 - 30. November 1960
Letzte Änderung	24. Oktober 2012 17:39:17 (admin)

---

**geographische und kulturelle Informationen**

Aufnahmeort	Mali, Afrique occidentale, Afrique
Einzelheiten zum Ort	SANGA
Bevölkerung / soziale Gruppe	DOGON
Ethnographic context	

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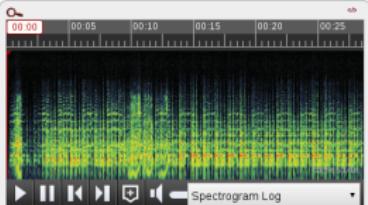
**Musical informations**

Nummer	Komposition	Umgangssprachlicher Name	InterpretInnen
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

---

**Archivdaten**

Code	CNRSMH_I_1970_012_041_15
------	--------------------------



Analyse   Marken

Eigenschaft	Wert	Einheit
Channels	1	s
Duration	0:00:28.73	s
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Samplerate	48000	Hz

Telemeta - Multi language support

Chinese

# Contextual Information example: Collection

Desk Archives Geo Navigator Advanced search Users

Collection : Les danses du monde

Edit Copy Add item Add to playlist

41 items

Reference	CNR-5741106/07
Title	Les danses du monde
Depositor / contributor	Zemp, Hugo et al.
Recording context	Terrain
Recording period	1952 - 1998
Year published	1998
Corpus	Editions Musée de l'Homme-CNRS, Les disques compacts (CD)
Last modification	May 29, 2013, 4:29 p.m. ( <a href="#">e.beaumont</a> )

Geographic and cultural informations

States / nations	Afghanistan, Afrique du Sud, Bénin, Bolivie, Brésil, Bulgarie, Burkina Faso, Centrafrique, Côte d'Ivoire, Cuba, Dahomey, Empire Centrafricain, Ethiopie, France, Gaule, Guinée, Guinée française, Guyane française, île des Amis, Inde, Indes néerlandaises, Indonésie, Iran, Italie, Maroc, Nouvelle-Calédonie, Oubangui-Chari, Papouasie-Nouvelle-Guinée, Perse, Philippines, République de l'Équateur, Roumanie, Royaume d'Italie, Royaume de France, Salomon, Tchad, Territoire de Papouasie et Nouvelle Guinée, Tonga, Vietnam
Populations / social groups	'Are'Are, Dan, Dorzé, Iatmul, Ida Ounidif (Berbères), JORAI, Kaluli, Kanak, LLAMERO, Malinké, Palawan, Pashal, Peul, SENOUFO, SOUS-GROUPE FODONON, Shuar, TARABUCO, Teda, Toraja, TORIFOU, Wayapi, WE/GUERE, Xhosa, Yafar, YORUBA-IFE, Zande

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▶ M H 00:00:00 00:00:40

- Ensemble de clarinettes tule CD2\_20
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- Masque de danse degli CD1\_07
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- Cérémonie de possession : morsure tarantulée CD1\_16
- Théâtre dansé kathakali CD2\_04
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# Contextual Information example: Item

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**Item : Danse des garçons, umtshotsho / Chant Nontyolo CD1\_01**

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Title	Danse des garçons, umtshotsho / Chant Nontyolo
Collector	Dargle, Dave
Collection	CNRSMH_E_1998_017_001
Recording date	Jan. 1, 1982 - Dec. 31, 1982
Last modification	June 24, 2013, 11:35 a.m. (e.beaumont)

**Geographic and cultural informations**

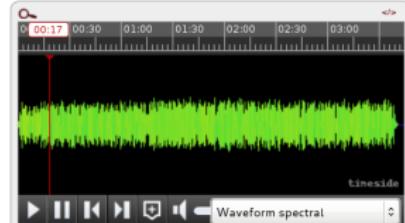
Location	Afrique du Sud, Afrique australe, Afrique
Location details	Sikhwankqeni, au sud de Lady Frere, Eastern Cape Province
Population / social group	Xhosa
Ethnographic context	Chanteuses menantes : Nothulethu Polowana et Nofuniswa Mehlo.

CD.1 - Afrique / Afrique du Sud

"Comme tous les chants des Xhosa, le chant intitulé Nontyolo est caractérisé par une forme cyclique et responsoriale. Ici, c'est l'arc musical frotté (umrhuhube), joué par une jeune fille, qui tient le rôle de la chanteuse menante (ligne H1 de la transcription; H = hlabeli ; « menant »). Six autres filles chantent les parties des suivantes (L1 à L5 ; L = landela, « suivant »). Elles choisissent leurs lignes mélodiques pendant que l'arc musical continue à jouer la même ligne mélodique (H1). En modifiant le volume de la cavité buccale, la joueuse de l'arc musical sélectionne les harmoniques des deux sons fondamentaux pour en faire la mélodie.

Les lignes des « suivantes » (L1 et L2) sont en fait des parties en polyphonie parallèle (appelées en xhosa iintlubo, « variations ») de la ligne « menante » (H1). Pour cette raison, ces lignes commencent au même point rythmique que H1 (indiqué par une double barre). Les lignes L3, L4 et L5 sont des parties polyphoniques en tullage, commençant à un autre point du cycle (L3 et L4 sont iintlubo, c'est-à-dire des parties parallèles utilisant le même texte et les mêmes tons de la langue). La polyphonie est basée sur les harmoniques de l'arc musical, mais d'autres « sons non harmoniques » sont également utilisés.

Les Xhosa emploient des rythmes complexes, souvent deux ou plusieurs rythmes simultanément, et l'art du déguisement rythmique est très



Property	Value	Unit
Channels	2	
Duration	0:03:44.82	s
Max level	-8.327	dBFS
Mean DC shift	0.072	%
MIME type	audio/x-wav	
Resolution	16	bits
RMS level	-22.108	dBFS
Samplerate	44100	Hz

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