



## Web analysis tools for ethnomusicology

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funded by the French National Research Agency ANR (CONTINT)*



FMA 2015 Workshop, Paris

# Introduction

- 1 Introduction
- 2 The Telemeta platform
- 3 TimeSide, an audio analysis framework
- 4 Conclusion

# Introduction

## Context

- **Digital age**: Archiving and accessing tons of research data
- **Network age**: Internet, social networks, mutualization of resources
- **Open access to knowledge and technologies**: languages, formats, standards, licenses, open source

## Challenges

- **musicologists** need music, metadata and search engines
- **computer scientists** need music and semantic datasets
- both communities need to learn from one another to jointly develop tools for **computational ethnomusicology**
- How do we **grow and scale** data and technologies in a **sustainable way**?

# The Telemeta platform

1 Introduction

2 The Telemeta platform

- Features
- Metadata
- Architecture

3 TimeSide, an audio analysis framework

4 Conclusion

# The Telemeta platform

## Open audio platform with metadata

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

## 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 features

- Pure **HTML5** web user interface including dynamic forms.
- **On-the-fly audio analyzing**, transcoding and metadata embedding in various multimedia formats, provided through *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** (text, dates, locations, instruments, ethnic groups, etc...).
- **Multi-language support** support (currently english, german, french, chinese, arabic and portuguese).

# Metadata

- **Everything** describing the context and the content of a music record
- Valuable informations about the **source of the data** and to the related **work of peer researchers**.
- **Collaborative editing** of metadata optimizes the continuous process of knowledge gathering and the **enrichment** of the materials in the database.
- **Standardization** of audio and metadata formats of long-term preservation
- **Easy harvesting** with metadata standards protocols like *Dublin Core* and *OAI-PMH* (Open Archives Initiative Protocol for Metadata Harvesting).

# Ethnomusicological metadata

## Contextual information

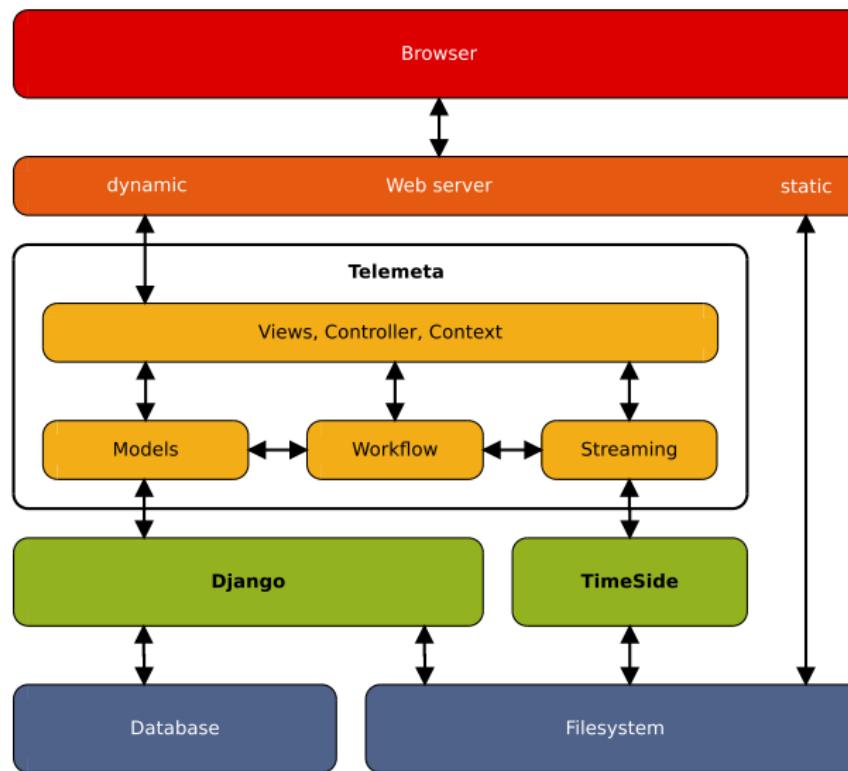
- Geographic information
- Cultural information (population, related cultural elements, etc)
- Musical information (title, instruments, etc)
- Technical information (recording technical data, depositor, collector, year of the recording, year of publication of papers describing the work, etc)

## Additional materials

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



# Telemeta architecture



# Descriptive and analytical information

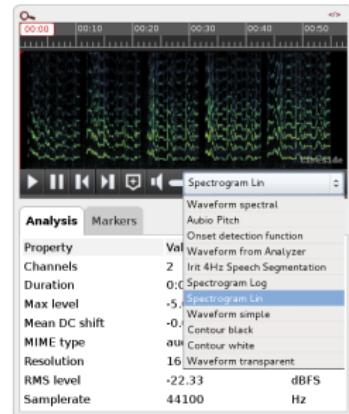
## Visual representation and segmentation

### 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).

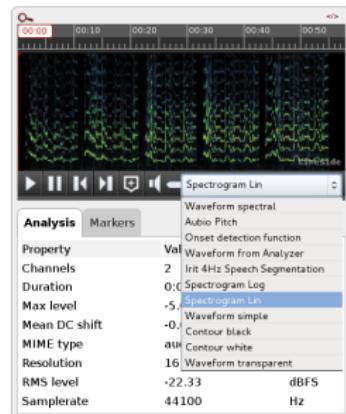


# Descriptive and analytical information

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# Descriptive and analytical information

## Annotations / Markers

### 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.



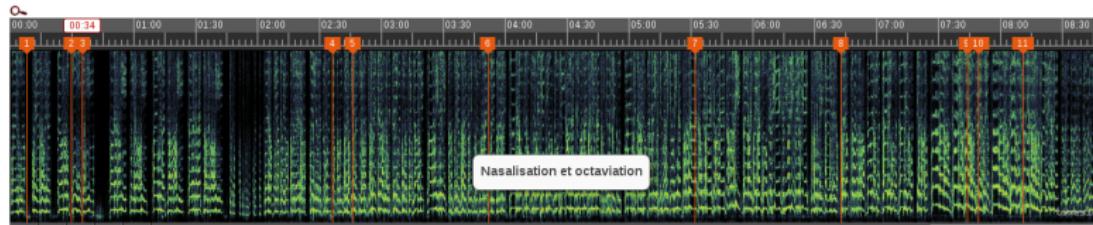
# Telemeta UI (demo)

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Centre de Recherche  
en Ethnomusicologie

Welcome, Thomas Filion | Profile | Help | Sign out

Desk Archives Geo Navigator Advanced search Users Admin

Item : Bruits iconiques de lamentation :

  
Nasalisation et octavation

Spectrogram Lin

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

Geographic and cultural informations  
Musical informations  
Archiving data

Navigation icons: back, forward, search, etc.

# TimeSide, an audio analysis framework

1 Introduction

2 The Telemeta platform

3 TimeSide, an audio analysis framework

- Audio management
- Audio features extraction
- Analyzer Result Format
- Ongoing developments

4 Conclusion

# TimeSide

An open source web audio processing framework

- TimeSide is the **audio signal processing engine** of Telemeta developed and published as a separate project.
- **TimeSide = web audio + signal processing + audio visualization + MIR**
- **Python** and **JavaScript**

<https://github.com/parisson/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's 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.

# TimeSide engine architecture

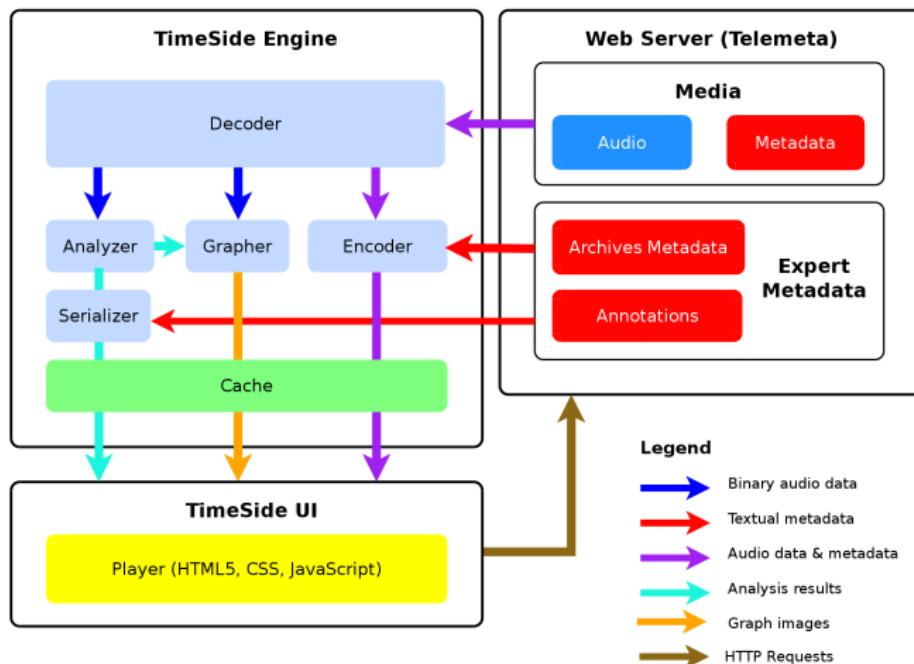
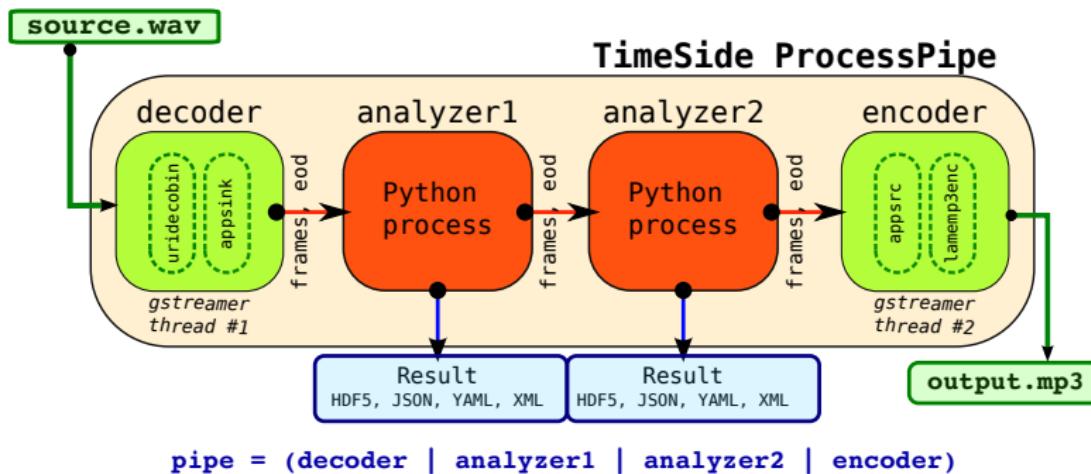


Figure: TimeSide engine architecture and data flow with Telemeta web-server

# TimeSide engine architecture



## Process Pipe

- On-the-fly audio processing by simultaneous processors (decoder, encoders, analyzers, graphers)
- Use of *Gstreamer* for audio decoding and encoding

# 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: 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*, *ELAN*, *transcriber*)

# Analyzer Result (*audio feature*) Format

Result types:

*time mode* × *data mode*

- Data modes:
  - Label
  - Value
- Time modes:
  - Global
  - Event
  - Segment
  - Framewise

## Result Container

- ID Metadata
- Audio Metadata
- Parameters
- Data object
  - Label
  - Label Metadata (label, label\_id, ...)
  - Value
  - Time
  - Duration
  - Frame Metadata (sample rate, blocksize, stepsize)

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Result types:

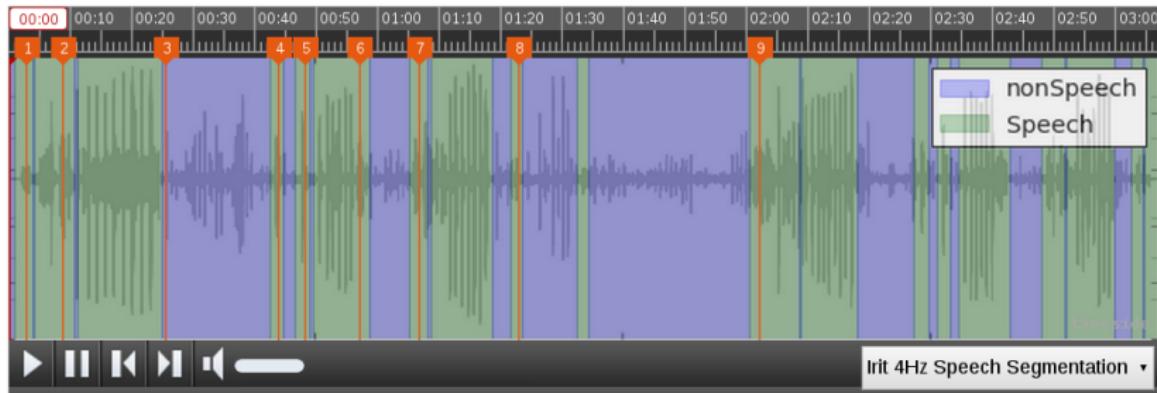
*time mode* × *data mode*

- Data modes:
  - Label
  - Value
- Time modes:
  - Global
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## Result Container

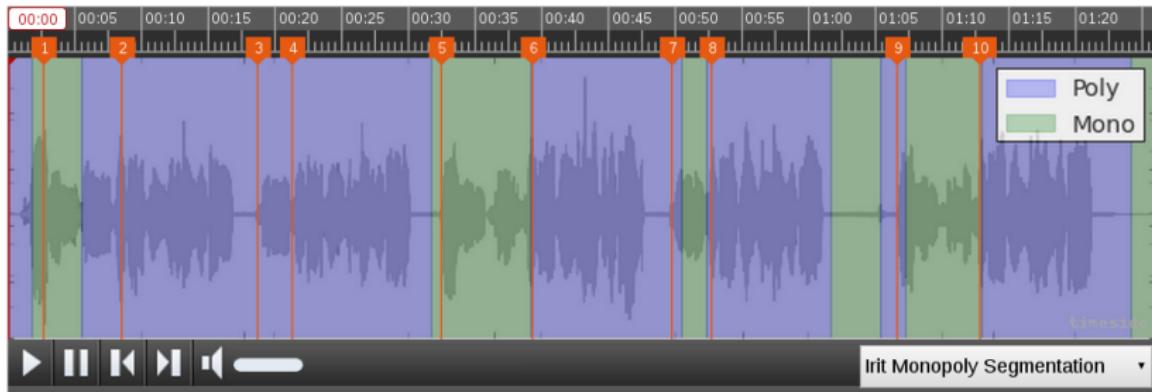
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  - Time
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# Analyzer Result examples



[http://diadems.telemeta.org/archives/items/CNRSMH\\_I\\_2013\\_201\\_001\\_01/](http://diadems.telemeta.org/archives/items/CNRSMH_I_2013_201_001_01/)

# Analyzer Result examples



[http://diadems.telemeta.org/archives/items/CNRSMH\\_I\\_2000\\_008\\_001\\_04/](http://diadems.telemeta.org/archives/items/CNRSMH_I_2000_008_001_04/)

# Ongoing developments

## Data analysis for the web

- New analyzers from Diadems project
- Advance data representations for the web: D3.js, WAVES.js (IRCAM)
- Zoom capabilities
- Online computational tasks design and management
- REST Web-API is being developed to provide audio analysis services over the web

## Annotation functions: time segments with free text and labels

- TimeSide: online annotation tool
- Telemeta: collaborative annotation platform
- Virtuous circle between automatic analysis and annotations

# Conclusion

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# Conclusion

## Lessons learned from a 7 years old project

- **Simplicity** is better than complexity (**KISS** principle)
- **Modularity** is only accessible with a flexible and **readable** object oriented language (thanks Python!)
- **Models** and **objects** are more important than technologies
- A good platform relies on **standards**, not on formats
- A good **workflow** and smart **API** are defined by the users themselves through **feedback** and constant **revisions** of the models
- **Prototyping** and **unit testing** are some crucial parts of the development process
- The **Open Source** ecosystem provides some tremendous possibilities to develop, deploy and scale a platform project

# Conclusion

- Telemeta and TimeSide are **fully operational** web audio frameworks for managing **very large** digital sound archives in the ethnomusicology context
- The collaborative nature of Telemeta enables a **continuous enrichment** of the audio content, the metadata, the analysis tools and results
- The Sound archives platform of the CNRS - Musée de l'Homme and Telemeta are now used by many ethnomusicologists around the world for research or education purposes
- Some stats: +300 active expert users, +600 revisions/month, +100k page views/month
- It's an **open-source** software: feel free to use, fork or contribute (BIG thank to all contributors!)

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# The end

Thank you!

We are looking for new partners and projects,  
let's keep in touch!

## Links

- [telemeta.org](http://telemeta.org)
- [@telemeta](https://twitter.com/telemeta)
- [github.com/Parisson/](https://github.com/Parisson/)

## Contact us

- [guillaume@parisson.com](mailto:guillaume@parisson.com) , [thomas@parisson.com](mailto:thomas@parisson.com)
- [@yomguy](https://twitter.com/yomguy)
- [+GuillaumePellerin](https://www.linkedin.com/in/guillaumepellerin)
- [fr.linkedin.com/in/guillaumepellerin](https://fr.linkedin.com/in/guillaumepellerin)

## Additional Materials

### 5 Additional Materials

- Telemeta - Geographic Navigator
- Multi language support
- Metadata

# Sponsors



# Telemeta - Geographic Navigator

Desk Archives **Geo Navigator** Advanced search Users

**Geographic Navigator**

Map | List

Map Satellite

North Pacific Ocean

North Atlantic Ocean

South Pacific Ocean

South Atlantic Ocean

Indian Ocean

Canada

United States

Mexico

Venezuela

Colombia

Peru

Bolivia

Argentina

Brasil

Iceland

Norway

Denmark

Portugal

Spain

France

Italy

Africa

Algeria

Liberia

Egypt

Sudan

Kenya

Tanzania

Uganda

Angola

Namibia

Botswana

Madagascar

Greenland

Russia

Mongolia

China

South Korea

Japan

Pakistan

India

Thailand

Myanmar

Cambodia

Vietnam

Laos

Hong Kong

Singapore

Malaysia

Indonesia

Fiji

Papua New Guinea

Australia

New Zealand

Google

Terms of Use Report a map error

back

# Telemeta - Multi language support

English



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Search

Welcome, Thomas Fillon | 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

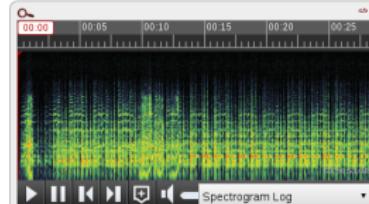
Original title / translation: OLU BOY

Collector:

Collection: CNRSMH\_I\_1970\_012

Recording date: Nov. 1, 1960 - Nov. 30, 1960

Last modification: Oct. 24, 2012, 5:39 p.m. (admin)



Spectrogram Log

 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

Markers

# Telemeta - Multi language support

## French

 Centre de Recherche en Ethnomusicologie

Recherche  Recherche

Bienvenue, Thomas Fillion | Profil | Aide | Déconnexion

Bureau Archives Géo-Navigateur Recherche avancée Utilisateurs

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

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**

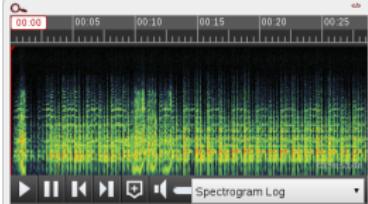
Lieu	Mali, Afrique occidentale, Afrique
Precisions lieu	SANGA
Population / groupe social	DOGON
Contexte ethnographique	

**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



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Suche

[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

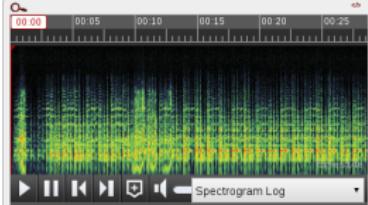
Aufnahmeort	Mali, Afrique occidentale, Afrique
Einzelheiten zum Ort	SANGA
Bevölkerung / soziale Gruppe	DOGON
Ethnographic context	

 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	
Max level	-3.816	dBFS
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MIME type	audio/x-wav	
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# Telemeta - Multi language support

Chinese

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搜索 搜索

欢迎, Thomas Fillion | 资料 | 帮助 | 注销

桌面 档案 地理导航 高级搜索 用户

Item : TROMPE ET TAMBOUR :41-15

编辑 复制 添加到播放列表 前一个 下一个

标题	TROMPE ET TAMBOUR
原始标题/翻译	OLU BOY
收集者	
选集	CNRSMH_I_1970_012
录音日期	十一月 1, 1960 . 十一月 30, 1960
上次修改	十月 24, 2012, 5:39 p.m. (admin)

**地理和文化信息**

**音乐信息**

号码	作品	当地名字	解释(翻译)
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

**存档数据**

密码	CNRSMH_I_1970_012_041_15
原始密码	BM.1970.012.001/46:41-15
项目号	:41-15
评论	LD, 1/2 piste;ATP (dupli-accél)-

**专业数据**

Spectrogram Log

分析	书签	
性能	价值	单元
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# Telemeta - Multi language support

## Portuguese

**CREM** Centre de Recherche en Ethnomusicologie

Item : TROMPE ET TAMBOUR :41-15

TROMPE ET TAMBOUR  
OLU BOY

HALI. CALAME, B.;1956-67  
1960. 1960 - 1960. 1  
مالي كالامي، ب.

Mali  
SANGA  
DOGON

Informations sur la musique

العنوان / الملف	أكسيطة المذكرة	الكلمات / الألحان	العنوان
KAKELE	Trompe	1	
BOYDUNULE	Tambour frappé	1	

CNRSMH\_1\_1970\_012\_041\_15  
BM.1970.012.001/46:41-15  
41-15:  
•(LD, 1/2 piste;ATP (dupli-acclé)  
(admin) ; 5:39 ,2012 ,24

مخطط شرارة ونطاق

Waveform spectral

Marqueurs Fichier

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

معلومات توثيق

العنوان / الملف

العنوان

الموضوع

Date d'enregistrement

Lieu

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# Telemeta - Multi language support

**CREM**  
Centre de Recherche  
en Ethnomusicologie

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Escritório Arquivo Geo navegador Pesquisa multicritérios Usuários

Item : TROMPE ET TAMBOUR :41-15

Lugar Mali  
Detalhes do lugar SANGA  
População / grupo social DOGON  
Conteúdo etnográfico

Número Instrumentação Nome vernáculo Intérpretes

1	Trompe	KAKELE
1	Tambour frappé	BOYDUNULE

Código CNRSMH\_I\_1970\_012\_041\_15  
Número original BM.1970.012.001/46:41-15  
Número da item :41-15  
Comentários LD, 1/2 piste;ATP {dupli-accèl}\*

Waveform spectral

Ficheiro	Marcadores	
Propriedade	Valor	Unidade
Channels	1	s
Duration	0:00:28.73	dBFS
Max level	-3.816	%
Mean DC shift	-0	
MIME type	audio/x-wav	
Resolution	24	bits
RMS level	-19.12	dBFS
Sample rate	48000	Hz

back

# 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	<a href="#">Editions Musée de l'Homme-CNRS, Les disques compacts (CD)</a>
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, Pashai, Peul, SENOUFO, SOUS-GROUPE FODONON, Shuar, TARABUCO, Teda, Toraja, TORIFOU, Wayapl, WE/GUERE, Xhosa, Yafar, YORUBA-IFE, Zande

**Legal notices**

**Archiving data**

**Technical data**

**Related media**

Media Preview

Online Offline back

Navigation icons: back, forward, search, etc.

**Listen to this collection (M3U, XSPF)**

Playlist content:

- Ensemble de clarinettes tûle CD2\_20
- Rituel de possession candomblé CD2\_21
- Rumba populaire de la Havane CD2\_22
- Danse pour Khevissé, Vodoun de la foudre CD1\_05
- Masque de danse degli CD1\_07
- Orchestre de xylophone jegale CD1\_08
- Chant à tenore CD1\_15
- Cérémonie de possession : morsure tareroulée CD1\_16
- Théâtre dansé kathakali CD2\_04
- Flûte kékéve CD2\_08

# Contextual Information example: Item

Desk Archives Geo Navigator Advanced search Users

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

Edit Copy Add to playlist Previous Next

Title	Danse des garçons, umtshotsho / Chant Nontyolo
Collector	Dargie, 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**

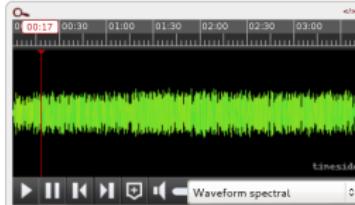
Location	Afrique du Sud, Afrique australe, Afrique
Location details	Sikhwankenqi, au sud de Lady Frere, Eastern Cape Province
Population / social group	Xhosa
Ethnographic context	Chanteuses menantes : Nothulethu Polowana et Nofuniswa Mehlo.

CD.1 - Afrique / Afrique du Sud

«Comme tous les chants des Xhosa, le chant intitulé Nontyolo est caractérisé par une forme cyclique et respiratoire. Ici, c'est l'arc musical frotté (umrhube), 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 intlubo, « 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 intlubo, 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



Analysis			Markers	
Property	Value	Unit		
Channels	2	s		
Duration	0:03:44.82	%		
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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