Music & the Internet
MUMT301

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Plan

- Potential final projects

- Mid-term review

- Music discovery tools

- API and Webservices

- Music APIs

- JavaScript

- Assignment #6

MPEG-1 Layer-3 audio standard

- MPEG audio standard is **informative instead of normative**
  - minimum amount of **normative elements**:
    - the **data representation** (i.e., format of the compressed audio)
    - the **decoder** (however there is freedom in how to implement it)
- **Encoding** of MPEG audio is **left to the implementer**
  - the standard only gives description of example encoders
  - MPEG audio **encoders can vary in quality**

Intellectual property

Compiled from http://www.cipo.ic.gc.ca/

- Copyright Act: **any original** literary, dramatic, musical (musical compositions with or without words) or artistic work is **automatically protected by copyright the moment it is created**

- In the simplest terms, "**copyright**" means "**the right to copy**": the right to reproduce a work, or a substantial part of it, in any form

- In the case of music or sound:

  - **a recording consisting of sounds**

  - **a performance of a musical work**

  - **an improvisation of a musical work**

- Copyright in Canada

Recorded sound

- Audio file data is stored in a **binary representation**

  - it is necessary to have a **format specification** in order to know how to read a given format's data

- Sustainability of Digital Sound Formats. Library of Congress Collections

- Comprehensive list of audio file formats

- The most common audio file formats are/were:

  - SND or AU (NeXT, Sun)

  - AIFF (Apple, SGI)

  - WAV (Microsoft)

  - MP3 (MPEG)

  - FLAC (OpenSource)

- Audio data can be stored in compressed or uncompressed formats

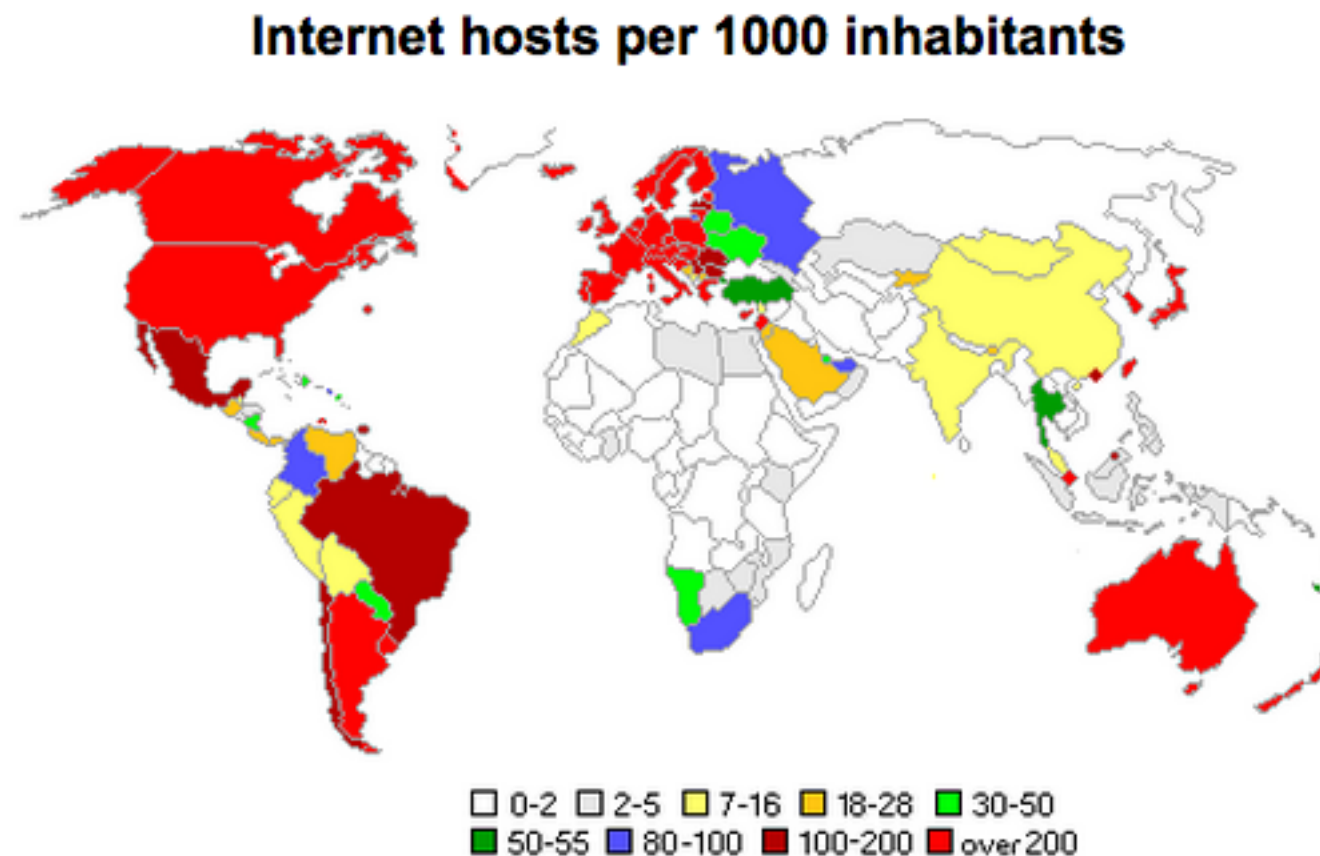# History of WWW: Browsers
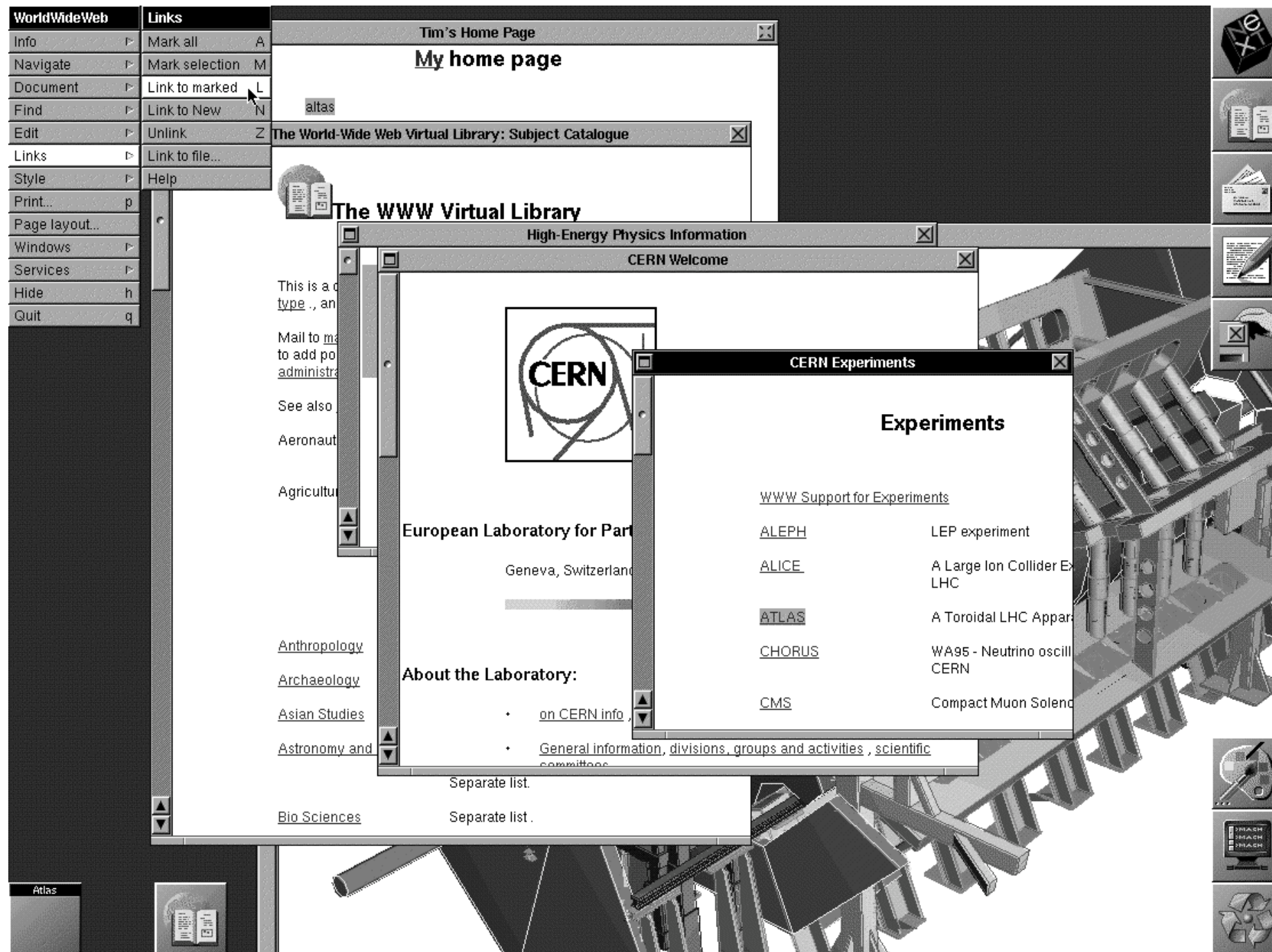
1990: WorldWideWeb by Tim Berners-Lee

Structured Audio

- Structured audio **does not convey audio**, the sounds are generated in a dynamic manner at *runtime.* Most common formats are:

- **MIDI** (1983)

  - **technical standard** to allow the **communication between electronic music instruments** (and computers)

  - Organized by the MIDI association

  - MIDI 1.0 Detailed specification, MIDI message example

  - MIDI classical archives

  - MIDI world

- **Module files or MOD**s (late 80s) are used in music *tracker* software

  - Arrangement of discrete musical notes positioned at discrete chronological positions on a timeline

  - E.g., OpenMPT, 16bitshock, Soundbox, FruityLoops, Renoise

  - http://modarchive.org/

Internet penetration by country

Internet hosts per 1000 inhabitants

☐ 0-2 ☐ 2-5 ☐ 7-16 ☐ 18-28 ☐ 30-50
☐ 50-55 ☐ 80-100 ☐ 100-200 ☐ over 200

Somewhat arbitrarily, the density area in this map
covers only part of the Russian federation
because it's reasonable to assume that online activity
is concentrated mostly in European Russia

A few small islands in the Pacific with a relatively
high hostcount are not shown in this map

Taken from http://www.gandalf.it/data/data1.htm,
data up to December 2012

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Internet stats

- Internet usage and population in the world

  - http://www.internetworldstats.com/stats.htm

- Internet traffic

  - http://www.internetlivestats.com/

The Web (WWW)

- W3C (World Wide Web Consortium) appeared as the new **organization for the coordination and evolution of the various protocols**. Initially led by Tim Berners-Lee @ CERN

- He designed the Web as a **system of interlinked hypertext documents** that are accessed via the Internet

- With a web browser, people can view **web pages that may contain text and media**, and can be **navigated between them by hyperlinks**

- The **first website** in the world was **dedicated to the WWW** project itself and was hosted on Berners-Lee's computer

- The site was restored in its original address and **can be accessed** at http://info.cern.ch/hypertext/WWW/TheProject.html

Transformations in the music industry

- Several transformations in the media environment have had tremendous impact on the structure and logic of the music industry

  - Phonograph recordings by end of 19th century

  - Broadcast radio programming in the 1920s

  - Magnetic tape in the 1930s

  - Compact cassette in the 1970s

  - Deregulation of media ownership in the 1990s

  - Shift from physical to virtual in the 2000s

Widespread infrastructure

- **US Federal agencies** made and implemented **policy decisions** that shaped Internet by the late 80s

  - Federal agencies **shared the cost of common infrastructure** (e.g., trans-oceanic circuits)

  - NSF encouraged regional networks to **look for non-academic customers** to lower costs

  - However, NSF **prohibited the use of its national network for non-academic or research purposes** with the intention of **stimulate the growth of private networks**

  - 1995: The NSF national network was defunded in 1995, but its policies led the Internet to grow to around 30,000 networks just in the US

- 1995: FNC passed a resolution defining the term Internet:

  - **"Internet" refers to the global information system that:**

    - is linked together by a globally **unique address space** based on the IP

    - is able to **support communications using TCP/IP**

    - provides **high level services** layered on the communications and infrastructure previously described

NIN's Ghosts I-IV

- "Ghosts I-IV is licensed under a Creative Commons Attribution Non-Commercial Share Alike license."

- http://remix.nin.com

- remix.nin.com in waybackmachine

- http://www.ninwiki.com/Multitracks

- http://www.ninremixes.com/multitracks.php

- https://soundcloud.com/zardonic/nine-inch-nails-35-ghosts-iv-zardonic-remix-2008

- https://archive.org/details/10-ghosts-iinin-remix-by-antuan_graftio

  - Pioneering "stem mixing"

  - Arcade Fire's Colin Stetson and Sarah Neufeld

MAC and IP Addresses

- IPv4 (32 bits = 4 bytes)

  - 4,294,967,296 possible IP addresses

    - More than one billion already used

- IPv6 (128 bits)

  - $3.4*10^{38}$ (340 trillion trillion trillion, or 3.4 undecillion)

    - Bacterial cells on earth: $5*10^{30}$

- MAC addresses:

  - MAC-48: 2^{48} = 281,474,976,710,656 addresses (2.8 x 10^{14}, trillions)

    - All fish in the ocean: $3.5*10^{12}$

MPEG-1 Layer-3 characteristics

- **Flexibility**
  - **Different operating modes**:
    - **Single channel**
    - **Dual channel** (two independent channels, e.g., two different language versions of an audio piece)
    - **Stereo** (no joint stereo coding, the two channels are encoded independently)
    - **Joint stereo** (information about differences from each channel is stored in one channel, whilst identical information is stored in the other. Help to reduce bit-rate)
- **Sampling frequency**
  - **MPEG-1**: **32kHz, 44.1kHz, 48kHz**
  - MPEG-2: extends MPEG-1 to half rates: 16kHz, 22.05kHz, 24kHz
  - MPEG-2.5: Fraunhofer-proprietary: 8kHz, 11.05kHz, 12kHz
- **Bit-rate**
  - the MPEG-1 standard defined a range of **bit-rates from 32 kbits/s up to 320k bits/s**
  - MPEG-2 standard extends the bit-rate to 8 kbits/s
  - **selection of bit-rate left to the operator of the audio coder**

Potential final projects

- Music recommendation site

- Web-based musical instrument or controller

- Music playlist maker

- History of the recording industry in the age of the Internet

- Statistical / historical analysis of music industry based on web-based data

- Study of international music copyright laws

- Study of fair use and copyright infringement music cases

- Substantial music composition (20-30 min) strictly using web resources with substantial write up (2-3 pages)

- Comprehensive comparison of on-demand music streaming services

Music discovery tools

- Music blog aggregators

    - http://shuffler.fm (RIP)

    - http://pause.fm/ (Play Store)

    - http://hypem.com

    - http://later.fm

    - http://clearplayer.me/

Music discovery tools

- By mood
  - http://musicovery.com (check API)
  - http://moodagent.com (check products)
- By activity or time of the day
  - http://songza.com (acquired by Google Play Music)
- Crowdsourced data
  - http://last.fm
- Visualization
  - http://musicroamer.com (social features)
  - Music Intelligence Solutions (acoustic features)
- Commercial applications: http://www.mtvmusicmeter.com/ (behind scenes: http://the.echonest.com/app/mtv-music-meter/)

API and Webservices

- **API** (Application Programming Interface)

  - Specifies a software component in terms of:

    - their **inputs** and **outputs**

    - the underlying **data types**

    - and its **operations**

  - APIs can come as a **specification** of **remote calls** exposed to the API consumers

API and Webservices

- Web service:

  - "...a software system designed to support interoperable **machine-to-machine interaction** over a network." (W3C)

  - **method of data exchange** that **doesn't depend upon a particular programming language**

  - Web services can be **used by other applications**

API and Webservices

- Examples:

  - <u>Weather</u>: <u>ex.1</u>

  - <u>Exchange rate</u>: <u>ex. 1</u> , <u>ex. 2</u> (check response data types)

  - <u>Stock prices</u>

  - Social data: <u>Instagram</u>, <u>Twitter</u>, <u>Facebook</u>

  - Music APIs!

API and Webservices

- Query formats (protocols to access Web services)

  - **SOAP**: focuses on exposing pieces of operations logic (not data) as services

    - `switchCategory(User, OldCategory, NewCategory)`

  - **REST**: focuses on accessing named resources through a single consistent interface

    - `getUser(userName)`

- Results formats

  - XML (Extensible Markup Language)

  - JSON (JavaScript Object Notation)

  - HTML

REST

- REpresentational State Transfer

- Message format can be: XML, JSON, HTML, plain text, etc.

- Language and platform independent

- Uses HTTP

- Standard HTTP methods (e.g., GET, PUT, POST, or DELETE)

REST

- standard HTTP methods (e.g., GET, PUT, POST, or DELETE)

RESTful API HTTP methods

Resource	GET	PUT	POST	DELETE
Collection URI, such as `http://example.com/resources`	**List** the URIs and perhaps other details of the collection's members.	**Replace** the entire collection with another collection.	**Create** a new entry in the collection. The new entry's URI is assigned automatically and is usually returned by the operation.[16]	**Delete** the entire collection.
Element URI, such as `http://example.com/resources/item17`	**Retrieve** a representation of the addressed member of the collection, expressed in an appropriate Internet media type.	**Replace** the addressed member of the collection, or if it doesn't exist, **create** it.	Not generally used. Treat the addressed member as a collection in its own right and **create** a new entry in it.[16]	**Delete** the addressed member of the collection.

Taken from http://en.wikipedia.org/wiki/Representational_state_transfer

JSON

- JSON (JavaScript Object Notation)

  - open-standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs

  - http://json.org/example.html

- Download a JSON viewer for your browser

  - http://jsonview.com/example.json

- XML and JSON example

  - http://musicbrainz.org/ws/2/artist?query=fever+ray&fmt=xml

  - http://musicbrainz.org/ws/2/artist?query=fever+ray&fmt=json

Music APIs

- MusicBrainz API

- LastFM API

- Echonest API (RIP)

- and many others ...

    - http://musicmachinery.com/music-apis/

MusicBrainz API

- An **interface** to the MusicBrainz Database

  - https://musicbrainz.org/doc/MusicBrainz_Database/Schema

- Aimed at any applications requiring **music metadata**

- The service's architecture follows the **REST design** principles

- Interaction with the web service is done **using HTTP** and all **content is served in XML and JSON**

- https://musicbrainz.org/doc/Development

  - The **web service root URL** is http://musicbrainz.org/ws/2/

- **Lookup:**

  - http://musicbrainz.org/ws/2/artist/f467181e-d5e0-4285-b47e-e853dcc89ee7

- **Search:**

  - http://musicbrainz.org/ws/2/artist?query=ratatat

  - http://musicbrainz.org/ws/2/artist?query=miles+davis

- **Query:**

  - http://musicbrainz.org/ws/2/release?artist=f467181e-d5e0-4285-b47e-e853dcc89ee7&type=album

  - http://musicbrainz.org/ws/2/release-group?artist=f467181e-d5e0-4285-b47e-e853dcc89ee7&type=album

BREAK

JavaScript

- mumt301.github.io

- In-class assignment: create a small website that asks a user for an artist and returns the Musicbrainz ID for that artist

- Assignment #6