Google Summer of Code

GNU Radio
THE FREE & OPEN SOFTWARE RADIO ECOSYSTEM

CEL

KIT
Karlsruher Institut für Technologie

A DAB/DAB+ Transceiver App

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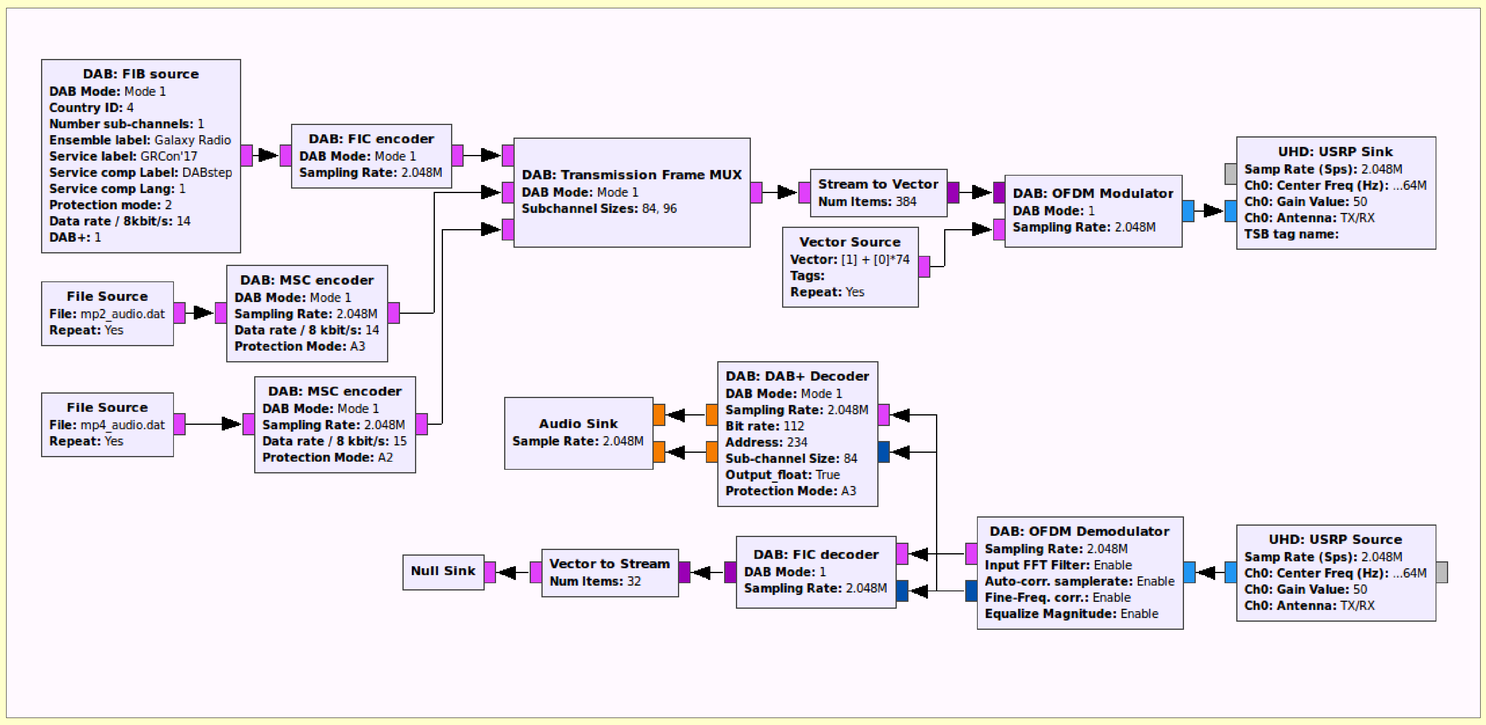
Digital Audio Broadcasting

- Digital broadcast of audio and related data based on OFDM
- Flexible service structure with multiple audio and data channels
- Widespread and increasing coverage in Europe and Asia

Data Transport

- OFDM symbols for sync, data and metadata
- Fast Information Channel (FIC) for safe transmission of Multiplex Channel Information
- Main Service Channel (MSC) for efficient transmission of audio streams or packed data



Parameters

Bandwidth	1.536 MHz
OFDM sub-carriers	192 - 1536
Data rate	2304 kbit/s
Audio bit rates	8 – 384 kbit/s

Channel Coding

- Convolutional coding with puncturing for different code rates
- Time interleaving for audio streams
- Frequency interleaving

Audio Codecs

- MPEG Audio Layer II (mp2) for DAB
  → Generic GR blocks for audio compression
- HE-AAC v2 (mp4) for DAB+
  → GR blocks are specialized for DAB+
- Reed Solomon error correction for DAB+

DABstep

GNU Radio based application, capable of transmitting and receiving DAB/DAB+ ensembles.

Receiver

- USRP or file as signal source
- Scans all available services
- Audio player with recording feature
- Displays SNR and packet error rates
- Developer Mode with additional plots of FFT, waterfall and constellation diagram

Transmitter

- User-configurable service information
- Parallel transmission of up to 5 services
- Individual channel configuration:
  1. DAB or DAB+ transmission
  2. Audio source (wave or microphone)
  3. Protection mode

Synchronization

- Time, symbol and frequency sync.
  → Based on low complexity delayed correlation
  → Very robust in low SNR regimes
- D-QPSK phase reference
  → Pilot symbol
- Propagation over stream tags

$$corr[i] = \frac{\sum_{j=1}^{T_G} x[i+j] \cdot x[i+j+T_S]^*}{\sqrt{\sum_{j=1}^{T_G} |x[i+j]|^2 \cdot \sum_{j=1}^{T_G} |x[i+j+T_S]|^2}}$$

T_G = *Cyclic prefix length*
T_S = *OFDM symbol length*