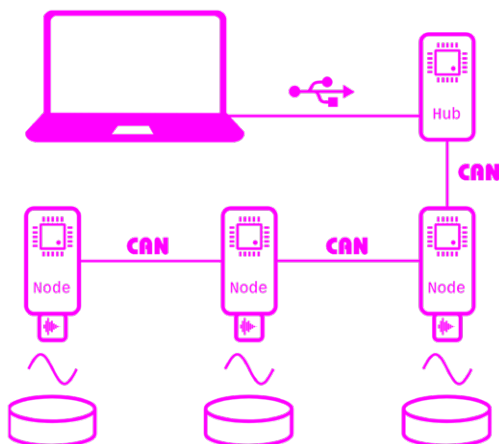# ARCANE - Audio Related CAN Exchange

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ARCANE is a protocol for a network of sensor devices. It describes the manner in which devices can exchange music-related data, in the form of MIDI messages, via a CAN network. A hub is used to connect this network to a host computer via USB-MIDI connection, thus enabling integration into any MIDI-compatible music software.

The Protocol

The ARCANE protocol is a higher-level protocol built on top of CAN. An ARCANE network consists of one hub and a number of nodes. Nodes interact with the world through sensors and translate captured information into MIDI data. As a prototype, a percussive trigger system is implemented. However, the limits are only given by what can be reasonably represented by MIDI. The hub collects the MIDI data and forwards it to a host computer, which can then assign the data to instruments or control values. The protocol defines different priorities for MIDI messages, with the first four bits of an ARCANE message ID dedicated to a function code. CAN uses message ids in an arbitration process that gives precedence to lower ids. The remaining 7 bits of the id are used to address individual nodes. Standard CAN messages can carry up to 8 bytes, which is enough to encapsulate the 2-3 byte MIDI messages. The ARCANE protocol also defines ways to manage and configure nodes on the fly, using an index to indicate which configuration parameter it wants to read or write. As part of this project, both a firmware for a hub and a node have been implemented.

The Hardware

Both the hub and the node use the Adafruit nrf52840 Express Feather board in combination with the Adafruit MCP2515 CAN Feather Wing. The node also features an Adafruit PDM MEMS microphone. The hub and nodes are connected via a 5-pin cable for both CAN networking and power supply.
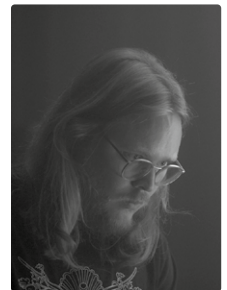
The Hub

The ARCANE hub firmware is implemented in C. It uses nrfx, FreeRTOS, tinyUSB and a semi-custom CAN driver. This stack is built around tinyUSB because it supports the USB-MIDI device class out of the box. The firmware reads ARCANE messages generated by the nodes and forwards MIDI messages to the host via USB-MIDI. It also showcases different ways to configure nodes.

The Node

The ARCANE node firmware is implemented in Rust. It uses the RTIC framework, the nrf52-hal and an mcp2515 driver. There is a simple algorithm that detects peaks in the PDM audio signal. When a peak is detected, an ARCANE message - containing MIDI note events - is sent. The node also reads incoming configuration messages and adjusts its configuration accordingly. In addition, the node can be configured using a JSON file.

Laurens Inauen

Topology of an ARCANE network.
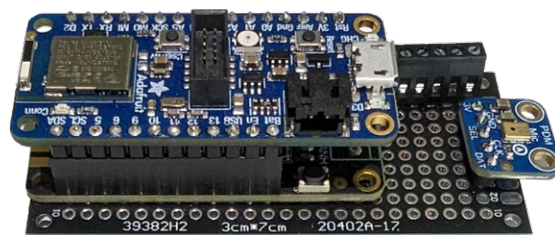
The prototype for the ARCANE node.