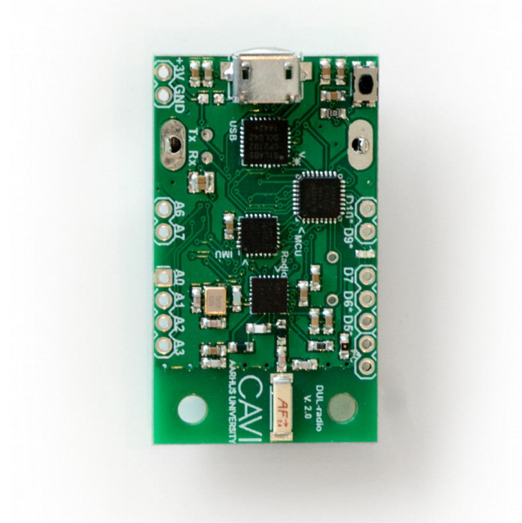
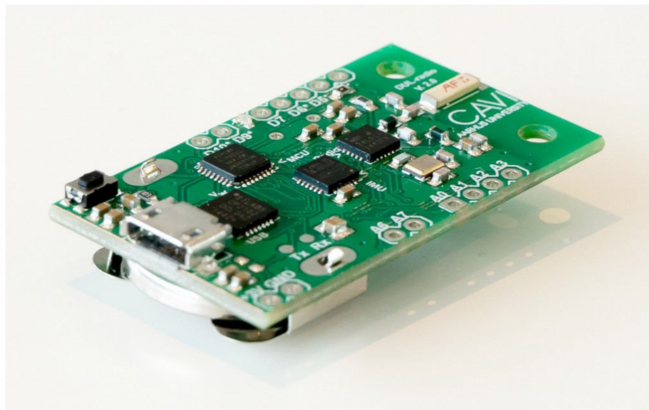
DUL-radio

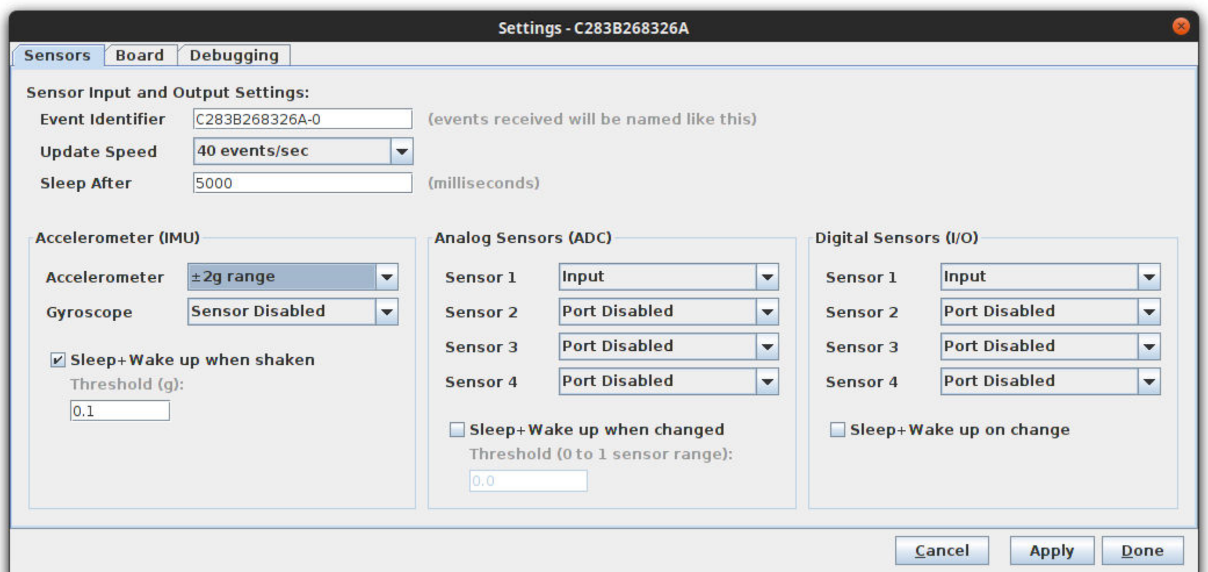
The DUL-radio is a compact, wireless sensor board utilizing the 2.4 GHz frequency band with a communications range comparable to that of Bluetooth radios. In its latest revision, it has gone from a proprietary design to a more open, Arduino-compatible platform. The DUL-radio features an onboard accelerometer with a gyroscope. Additional sensors and other peripherals can be connected to the 5 digital inputs/outputs, 6 analog inputs or the I²C-port.





DUL-radio sensor board

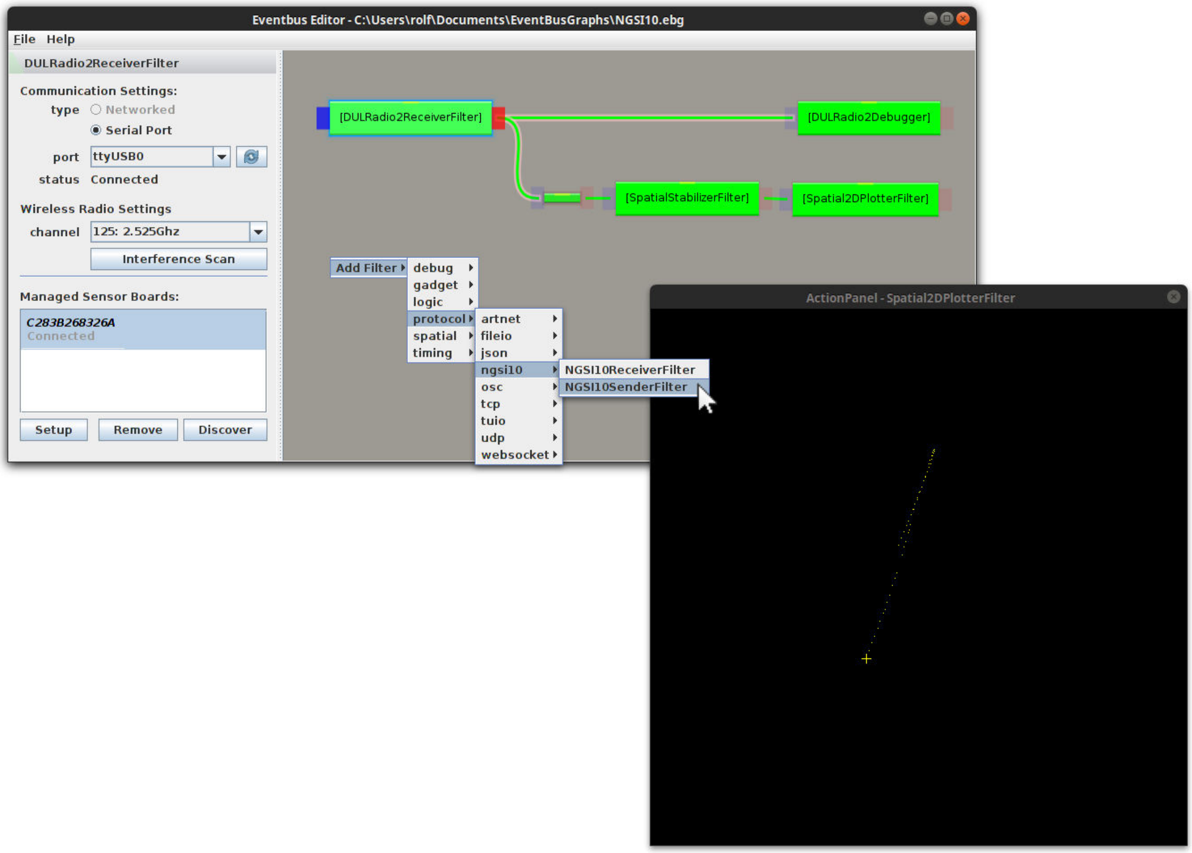
The functionality of the board is closely integrated with a piece of software, the EventBus, running on a host computer with a wireless receiver board. The DUL-radio board itself can also function as the receiver when it is connected to the host computer via USB. Multiple sensor boards can be connected to the same receiver. The host computer communicates wirelessly with the sensor boards and all the settings for the boards can be configured in the dedicated software.



Due to the compact board size (44 x 25.4 x 7mm including a button cell battery), the board can be used in many different applications where real time interactive wireless data collection is needed; e.g. wearables, hand-held interaction devices, art installations, ubiquitous devices for monitoring and

statistics.
Since battery life is crucial in many applications, it is possible to set up the DUL-radio for data sampling at rates ranging from 40 samples per second to as little as 1 sample per day. At low sample rates the expected run-time on a button cell can even extend to several years.

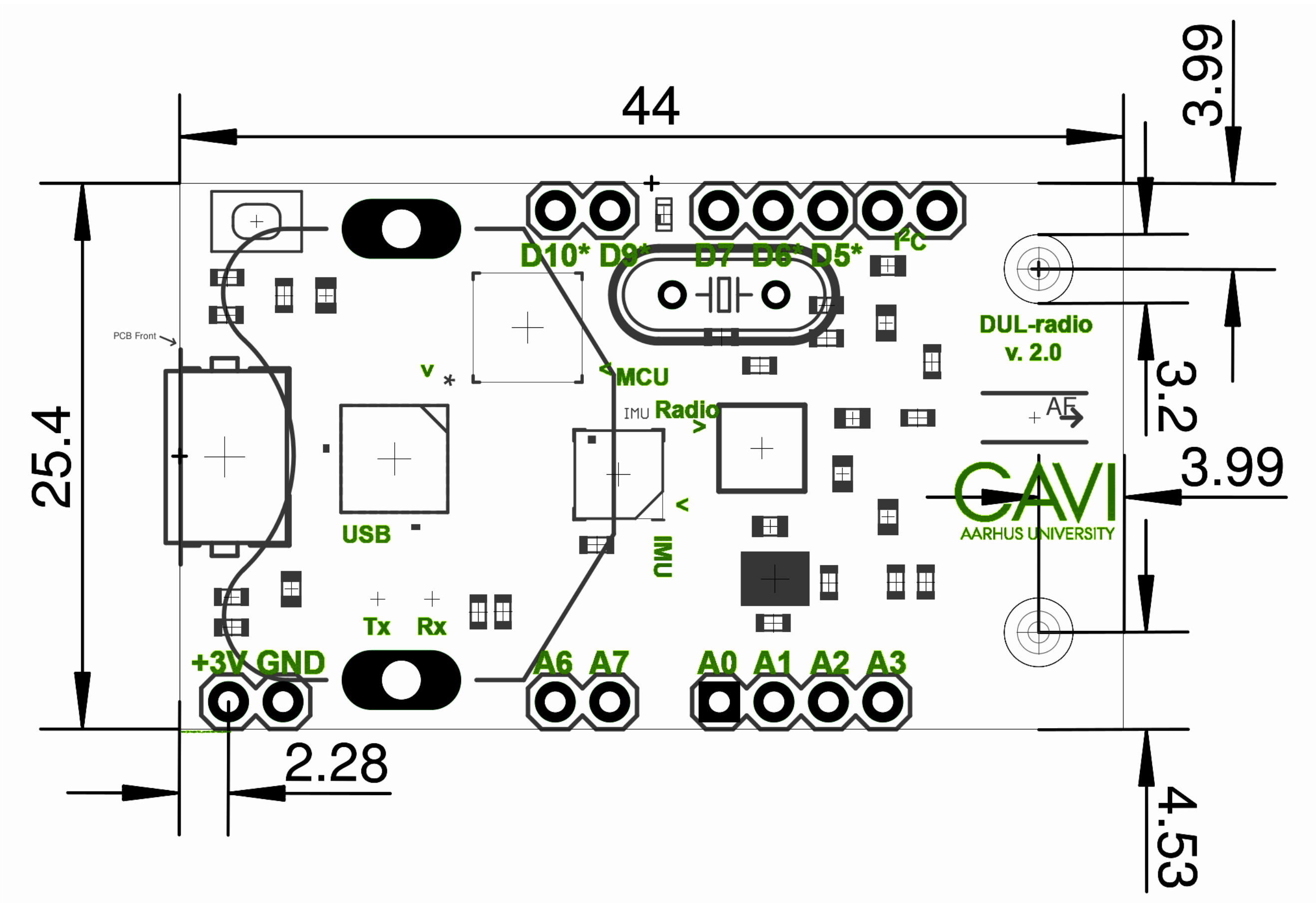
The host software, EventBus, allows for communication from and to the DUL-radio sensor board as well as interconnectivity with other services or programs, locally or remote via a local network or even via the Internet.



In the EventBus interface it is possible to easily configure, modify and filter the incoming data stream in a very flexible manner before it is sent to the final destination(s). The filters can be selected from a list of predefined, configurable filters and outputs including an output that converts the data to the NGSI9/10-protocol.
Other data sources, like incoming events from TUIO or OSC devices, can also be converted to NGSI10 and the system has configurable visualization tools for viewing and debugging the data on screen. It is easy to rapidly prototype by simply dragging connection lines between the relevant input, conversion and output components in the UI – the system automatically suggests conversions between data formats when they are necessary.

Technical Specifications

The physical layout of the board allows it to be used in many applications where small footprint is a requirement. The following figure shows the board dimensions and mounting information.
Board height is 7mm with the battery holder installed, around 4mm without.



For optimal transmission range the area immediately surrounding the antenna should be kept fairly clear of any metallic materials. If a case is used it should be made of a material that does not block radio signals.

The board is static discharge sensitive and may become unstable if any of the MCU or radio chip pins are touched during radio transmission. An on-board watchdog system detects and corrects this situation after 8 seconds; however, a case or a wrap of heat-shrink tubing to avoid direct contact is recommended for maximal stability if the board is to be handled by humans during use.

The hardware platform in combination with the the particular sensor software that connects with the Eventbus has the features and capabilities summarized in the following table.
In some cases the hardware platform is capable of more than what the current software package offers – in those cases both the hardware capabilities and the software defaults are listed in the table. It is worth noting that the software is simply an Arduino library and to some extent it allows you to add to, change or extend the features already available.

Battery life (typical use, button cell)	93.7 days
Battery life (all out crazy)	5 days
Data acquisition speed	0.125Hz – 40Hz (typical)
Analog Inputs	0 to 6 (4 default) (A0-3 + A6, A7)
Digital I/O	0 to 7 (4 default) (DIO5-7, DIO9, DIO10; PWM@5,6,9,10)
Accelerometer	3-axis, ±16g
Gyroscope	3-axis, ±2000deg/s
Magnetometer (compass)	3-axis (only with mpu6090 option)
Arduino compatible	**Yes**
USB FTDI serial port	**Yes** (115200 baud default, 1mbps max)
USB power	**Yes** (either USB **or** battery, select via jumper)
In-circuit serial programming	**Yes** (standard Arduino ICSP plug)
Breadboard mountable	**Yes**
BlueTooth LTE support	Some (BT LTE unsolicited advertisements possible)
Recommended Voltage	1.9-3.46V (abs. max 3.6V), IMU works from: 2.375V to max Radio works from: 1.9V to max
Battery Indicator	**Yes** (voltage readable via wireless)
Chip Temperature Indicators	**2** (CPU and Gyro, ~1deg precision)
Lost packet retransmission	Some (partial, like UDP, only for config)
On-Board LED	1 (one LED on pin D7)
System Clock	Dynamic: 8MHz and 4MHz depending on battery level (optionally up to 16MHz via external clock)
Size	2.54x4.4x0.7cm
Screw holes	2
Wireless Radio Range Under realistic conditions	Radio power, with high gain receiver: Min: 1.5m, Low: 2.5m, High: 5m, Max: 9m
Frequencies	2.4GHz-2.525GHz (124 channels, 1 discovery channel)
Radio Bandwidth	1Mbps (2Mbps possible)
Subchannel configuration	Automatic (at least 5 subchannels)
Configuration Setup	Automatic discovery. Automatic upload during use
Protocol	Proprietary binary
EventBus support	Since r713
Receiver	Any Arduino & nrf24L01+ (Serial via USB)
Software License	Open source : GPLv3

Table: Technical Specifications (sensor software revision r556)

Atmel Pin	Package Pin	Arduino Pin	Primary Function	Secondary Functions	End-User Port	Platform Port	Notes
PB0	12	8	NRF24L01+ CSN			*	
PB1	13	9	Digital I/O	PWM	*		
PB2	14	10	Digital O	PWM	*		Only output
PB3	15	11	SPI MOSI		(*)	*	Shared with NRF24L01+, smd on backside
PB4	16	12	SPI MISO		(*)	*	Shared with NRF24L01+, smd on backside
PB5	17	13	SPI SCK		(*)	*	Shared with NRF24L01+, smd on backside
PB6	7	---	Digital I/O	XTAL1	(*)	(*)	Must select function with flash fuses
PB7	8	---	Digital I/O	XTAL2	(*)	(*)	Must select function with flash fuses
PC0	23	A0	Analog Input	Digital I/O	*		
PC1	24	A1	Analog Input	Digital I/O	*		
PC2	25	A2	Analog Input	Digital I/O	*		
PC3	26	A3	Analog Input	Digital I/O	*		
ADC6	19	A6	Analog Input		*		
ADC7	22	A7	Analog Input		*		
PC4	27	A4	I^2C SDA		(*)	*	Shared with MPU6050 IMU
PC5	28	A5	I^2C SCL		(*)	*	Shared with MPU6050 IMU
PC6	29	---	Reset			*	smd on backside
PD0	30	0	USB Serial RX	Digital I/O	(*)	*	smd on backside
PD1	31	1	USB Serial TX	Digital I/O	(*)	*	smd on backside
PD2	32	2	MPU6050 IRQ			*	
PD3	1	3	NRF24L01+ IRQ			*	
PD4	2	4	NRF24L01+ CE			*	
PD5	9	5	Digital I/O	PWM	*		
PD6	10	6	Digital I/O	PWM	*		
PD7	11	7	Digital I/O		*		Shared with LED

Table: Pin mapping (hardware revision 2.0)