Ashametrics Stored Data Format for Mobile Phone Apps

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I.   Introduction

This document describes the data format used by Ashametrics phone software to store data on the mobile phone. While, Ashametrics provides mobile apps that will automatically upload the data to a remote server, this document is intended to serve as a guide for those wishing to download the data directly from the phone to a PC.

In order to retrieve the data from the phone, the phone can be connected via USB to a PC computer and used as a mass storage device (like a USB memory stick) to view the files and copy them to the hard drive on the PC (assuming the proper mobile phone USB drivers are installed).

II.   Sensor Band Types

Ashametrics provides several different data formats, depending on the type of band and the operating mode. Current sensor band types include the following:

- **Type 0** – Basic sensor band (usually wrist of ankle band), which measures EDA, Temp, and accelerometer.
- **Type 1** – Heart rate monitor (ECG) – calculates IBI (inter-beat intervals) and transmits over Bluetooth the IBI information in groups of 8 per data packet.
- **Type 2** – Heart rate monitor (ECG) – calculates the current IBI and average IBI and continuously transmits a these two parameters in each data packet.
- **Type 3** – Heart Rate monitor (ECG) – this mode of operation is used to collect the heart waveform data (which is sampled at approx 320 Hz.) (this mode does not compute any IBI's – it is just the waveform)
- **Type 4** – This mode is used for wrist/ankle bands that include a heart rate monitor (using photoplethysmography). Data includes EDA, Temp, and accelerometer, plus PPG heart rate sensor with pulse oximetry (Same parsing as Type 0)
- **Type 5** – Multi-parameter device which measures heart rate (ECG), EDA, Temp, and 3-axis accelerometer.
- **Type 6** – Heart Rate monitor (PPG – photoplethysmography). The band samples the optical signal at 320 Hz and streams this data out over Bluetooth. This is used to study the PPG waveform.
- **Type 7** – Wrist or ankle band Sensor band which includes: EDA, skin temp, ambient temp, ambient humidity, and 3-axis accelerometer. This sensor band streams data out over Bluetooth.
- **Type 8** – Wearable light monitor – This device is generally worn in the form of a necklace or pendant and is designed for measuring ambient light exposure. The data from this device includes: Total visible light (lux), Infrared light, Blue light level, Red light level, Green light level, 3-axis acceleration, temperature, and sound level.

Sensor band parameters contained in the data files:

The exact sensor parameters that are recorded and the data format used depend on the sensor band being used. Some sensor bands (such as the Ashametrics chest band) also support more than one mode of operation and therefore more than one data format. (for example the sensor band can transmit the heart waveform or it can be set to only transmit the heart rate and heart rate variability parameters). Several different data formats are supported by the Ashametrics sensor bands. Please refer to the "sensor protocol document" which describes how to calculate each of these numbers form the raw data packets.

Time stamp: every line of raw data contains a time stamp. The time stamp used for data collection is based on the JAVA "epoch time", which is the number of milliseconds elapsed since Jan 1. 1970. A useful tool for translating conventional time to epoch time and vice versa, is the following web site: http://www.epochconverter.com/ (Remember that the time stamp must be divided by 1000 if you want units of seconds) For those people who are traveling through multiple time zones, we recommend that you use GMT time, to provide better continuity with your data across multiple time zones. For convenience, the data recorded on the phone also includes an additional human-readable time stamp that is derived from the epoch time.

Temperature: several different temperature sensors are used in the Ashametrics products. Some Ashametrics sensor bands contain multiple temperature sensors, such as an ambient sensor and a skin temperature sensor. The ambient temperature sensor is digital and the skin temperature sensor is generally an analog sensor (thermistor). Please refer to the Ashametrics wireless protocol document or your sensor band manual for a description of the specific temperature sensors used on your sensor band.

Humidity: Some Ashametrics sensor band also offer humidity measurement, which is given in units of percent relative humidity.

Accelerometer: A 3-axis accelerometer is provided on all the Ashametrics sensor bands. This accelerometer is also capable of measuring static g-forces, so a measure of the sensor band orientation is possible even if the sensor band is not moving. The formula for converting the raw values to units of g is described in the Ashametrics wireless protocol manual.

Skin conductance: Skin conductance is recorded in the form of two separate parameters – one related to the baseline value and one related to the short term changes in the skin conductance. These values are denoted as EDA-B and EDA-P. The phone software automatically calculates the total skin conductance (EDA) from the EDA-B and EDA-P values. However, the EDA-B and EDA-P are still listed separately so that the total EDA can be re-calculated later, if desired, using the raw values and perhaps using a different calibration factor.

Heart Rate: Certain Ashametrics products provide the ability to measure heart rate in various ways. The heart rate data is recorded in the form of a time interval between successive heart beats, otherwise known as the "interbeat interval" or IBI, also known as the R-R interval in the case of ECG data. (the "R-peak" is the large spike that is clearly visible in the classic ECG waveform, generally labeled as PQRST. The Ashametrics sensor bands will automatically detect heart beats and will calculate the <u>instant IBI</u> as well as the <u>average IBI</u>, averaged over 10 heart beats as a running average. These two values can then be used to easily calculate the instantaneous heart rate, and also calculate the heart rate variability. The heart rate variability or HRV, can be calculated using the SDNN formula, which is essentially the standard deviation of N consecutive valid heart beats:

$$HRV = SDNN = \frac{1}{N}\sum_{i=1}^{N}\left(IBI_i - IBI_{avg}\right)^2$$

III.   Available Mobile Phone Applications:

There are currently 2 different mobile phone applications used with the sensor bands that record data on the phone:

- **Ashametrics Sympatico (a.k.a iHeal, CalmMom)** is a cognitive behavioral therapy application that presents ecological momentary assessments and also delivers interventions in the form of therapeutic messages (images, videos, text) that are presented to the user in response to certain physiological events. The application is intended to be used as a simple therapeutic tool that can be an adjunct to a counseling or treatment program.

- **Ashametrics Ashaview** is a real-time physiological monitoring application that provides live plotting and analysis of the sensor data. It is intended for use by clinicians for laboratory experiments, although it can also be used by patients themselves as a form of biofeedback, provided the patient can understand the display of the various physiological parameters that are displayed.

## IV.   Using FileConverter Software without a Phone:

All Ashametrics sensor bands have the capability of storing data internally on the sensor band (microSD card) without the use of a mobile phone. To same memory space, an abbreviated data format is used for the raw data.

In order to convert the raw data from the sensor band into the same file format used on the phones, Ashametrics provides a simple software utility called "Ashametrics FileConverter."

Instructions for using this software can be found on YouTube: http://youtu.be/H3vaD2GQUxs

V.   Ashametrics File formats for Stored on the Phone

   This section described the output data fields (otherwise known as "Column headings") for the .csv data files. Ashametrics makes several different mobile applications (shown in the photos below), and different types of wearable sensor bands.
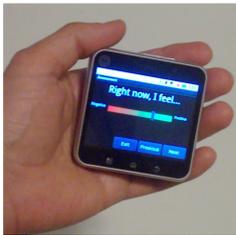
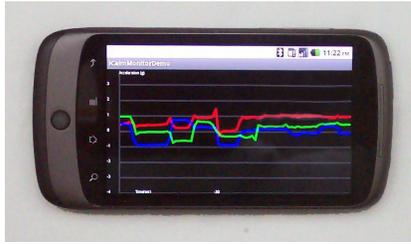**Sympatico (iHeal, CalmMom) file format (.csv)**

Version 0 bands:
Each line of data is comprised of the following fields:
Epoch time, human time stamp, rev0 or battery, raw packet, EDA total, EDA-B, EDA-P, accel-X, accel-Y, accel-Z, ambient temp, Sensorband ID, Bluetooth MACID

Version 7 bands:
Each line of data is comprised of the following fields:
Epoch time, human time stamp, rev7 or battery, raw packet, EDA total, EDA-B, EDA-P, accel-X, accel-Y, accel-Z, ambient temp, ambient humidity, skin temperature, Sensorband ID, Bluetooth MACID

AshaView data format (.csv)

Each line of data is comprised of the following fields:

<u>Version 0 bands:</u>
Epoch time, human time stamp, rev0, raw packet, EDA-bias, EDA-P, EDA total, accel-X, accel-Y, Accel-Z, temp, not used, not used, Sensorband ID, Bluetooth MACID.

<u>Version 5 bands:</u>
Epoch time, human time stamp, rev5, raw packet, EDA-bias, EDA-P, EDA total, accel-X, accel-Y, Accel-Z, temp, HeartRate, avg HeartRate, Sensorband ID, Bluetooth MACID.

<u>Version 7 bands:</u>
Epoch time, human time stamp, rev5, raw packet, EDA-bias, EDA-P, EDA total, accel-X, accel-Y, Accel-Z, skin temperature, ambient temperature, ambient humidity, Sensorband ID, Bluetooth MACID.

<u>Version 8 bands:</u>
Epoch time, human time stamp, rev5, raw packet, Visible light, Infrared light, Red Light, Blue light, Green light, Accel-X, Accel-Y, Accel-Z, Sound Level, Sensor ID, Bluetooth MACID.

AshaView data format produced by FileConverter software(.csv)

The file converter software will produce a nearly identical file format, with 2 exceptions: the a separate "short ID" field is added at the end for convenience (this field is just the rightmost 2 digits of the Sensorband ID), and the Bluetooth MACID is simply set to "AA:AA:AA:AA:AA:AA", since no mobile phone or Bluetooth transmission was used.

<u>Version 0 output:</u>
Epoch time, human time stamp, rev0, raw packet, EDA-bias, EDA-P, EDA total, accel-X, accel-Y, Accel-Z, temp, not used, not used, Sensorband ID, Bluetooth MACID, short D.