Stp Toolkit

v1.8.5 Operator Manual

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1.0 Theory of Operation

1.1 Intended Use

Excel Medical's Stp Toolkit ("Toolkit") is a package of various instruments for use with the .Stp files created by the BedMasterEx system. The .Stp files are formatted using a proprietary compression and encryption algorithm and thus are not readable without either the BedMasterEx client software or the tools included in this Toolkit. The Toolkit includes a user interface that makes using the tools easier for those not familiar with Windows command prompts. The tools can be used for file census formation, translation of data to various formats (ex. XML and JSON), filtering of parameters, anonymization, and simplifying tertiary system ingestion among other things.

This version of the STP Toolkit is compatible with .Stp files created by BedMasterEx versions 4.1.12 to the present release (5.1.1). Previous BedMasterEx versions may also be compatible. However, keep in mind, the data stored in .Stp files has become more expansive in later versions of BedMasterEx so empty attributes in the XML/JSON output may be more prevalent when using this version of the Toolkit with older .Stp files.

1.2 BedMasterEx Basic Architecture

The BedMasterEx platform consists of client and server software. BedMasterEx server software utilizes two primary components, a .NET application on a Microsoft Operating System for acquiring data and a Microsoft SQL database. The BedMasterEx application software can be hosted on a physical server(s) or virtual machine(s). The SQL database can reside on the same machine as the BedMasterEx software or on a dedicated server or networked cluster.

BedMasterEx has a dual component database. As waveform data is acquired from the patient monitors it is compressed, encrypted, and stored along with vitals and alarms in a proprietary format (.Stp) on a designated drive. Simultaneously, SQL keeps an index of the system history and stores a second copy of vitals, alarms, and waveform snippets.

The BedMasterEx client runs independent of the Windows services that handle data collection thus allowing unattended operation. The BedMasterEx client may be installed on any networked PC in the facility or pushed out as a Citrix thin client application for remote usage of all BedMasterEx functionality. A new corresponding BedMasterEx client is released with each version of the server software.

While the BedMasterEx client allows for visualization and access to stored data, researchers may desire more direct interaction with large swaths of data. With that in mind, we have developed the Stp Toolkit to assist with conversion of the .Stp data files to other formats for analysis and ingestion by tertiary systems.

2.0 Operation of Toolkit - Command Prompt

The Stp Toolkit (“the toolkit”) may be accessed in two different ways. The first way is from Windows Command Prompt. The following is a list of supported arguments, items marked in brackets represent a field that must be filled in by the user:

To run the toolkit, type into Command Prompt: StpToolkit.exe [Input .Stp file path] [Additional program arguments]

-u = Unity file (GE direct connect. Default file type if no other family flag is set)
-p = Philips Classic file
-cs = CareScape GE file
-pix = Philips PIIC iX file
-o [“FilePath”] = Output file path. If not provided, the file path with be in the location of the input Stp file.
-xp = Exclude parameter/vital sign data from the output.
-xw = Exclude waveform data from the output.
-xalrm = Exclude alarm data from the output
-utc = Export time as UTC integer. (Number of seconds since 1/1/1970)
-d = Calibrate waveform data as floating point number.
-blnk = Remove patient name information from the output.
-json = Write the output as a json file instead of an xml file.
-polldb = Query the BedMasterEx database to retrieve the patient name. The StpToolkit.exe.config file must be setup to use the correct SQL connection string.
-s [segment #] = Start segment. Choose where to start from in the file. Each segment is one minute's worth of data.
-e [segment #] = End segment. Choose where to end in the file. Each segment is one minute's worth of data.
-byte [byte offset] = Byte offset value to start from. Only use if you know the exact byte to start from in the file. (These are provided at the start of each segment)
-stime [Time] = Time to start from. Similar to Start Segment. Must wrap time in quotes (e.g. "1/1/2015 8:00:00 AM")
-etime [Time] = Time to end from. Similar to End Segment. Must wrap time in quotes (e.g. "1/1/2015 8:00:00 AM")
-dir [Directory Entry] = Flag to process multiple .Stp files at once. Following parameter must be the input directory. Will process all .Stp files in that directory, up to twenty concurrently.
-net [IP Address][Port] = Send segments of data over a socket instead of writing to a file. Each segment is one minute's worth of data.

For example, to run the toolkit on ‘C:\BedMasterEx\Data\CCU_Bed13\CCU_BED13-1494278547.Stp’ for data from the GE Unity network (-u), excluding waveform data (-xw), a command would look like:

```
StpToolkit.exe C:\BedMasterEx\Data\CCU_BED13\CCU_BED13-1494278547.Stp -u -xw
```

The same list of arguments can also be found in the readme.txt file included in the zipped folder you were provided.

The Command Prompt method may be leveraged for integration to processing software such as MATLAB, Unscrambl PULSE, and IBM Infosphere Streams among others.

2.1 Performing Census - Command Prompt

The Toolkit also supports a census operation that retrieves the patient information from the .Stp files and saves it to a Microsoft Excel file allowing the user to quickly see which file is associated with which patient(s). The following is a list of census oriented arguments, items marked in brackets represent fields that must be filled in by the user:

To use the census operation through Command Prompt, type the following: StpToolkit.exe -census [Directory] [Additional program arguments].

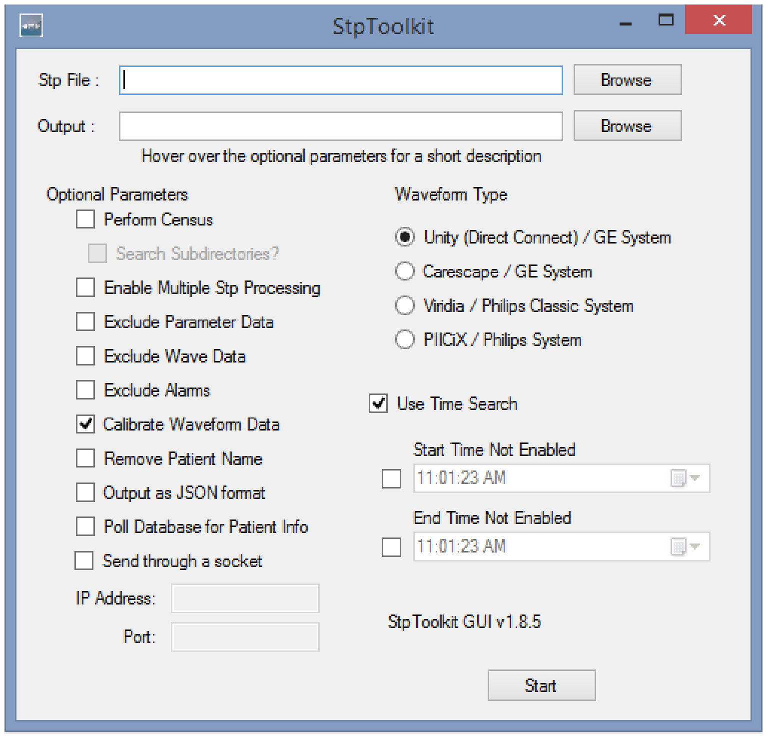
-u = Unity file (GE direct connect. Default file type if no other family flag is set)
-p = Philips Classic file
-cs = Carescape (GE) file
-pix = Philips PIIC iX file
-o [“FilePath”] = Output file name. Excel format is default (.xlsx). Other recommended format is .txt.
-xsubdir = Exclude searching sub directories.

An example of the census would look like:

```
StpToolkit.exe -census C:\BedMasterEx\Data\CCU_BED13 -u -o "C:\OutputLocation\MyOutput.xlsx"
```

3.0 Operation of Toolkit - GUI

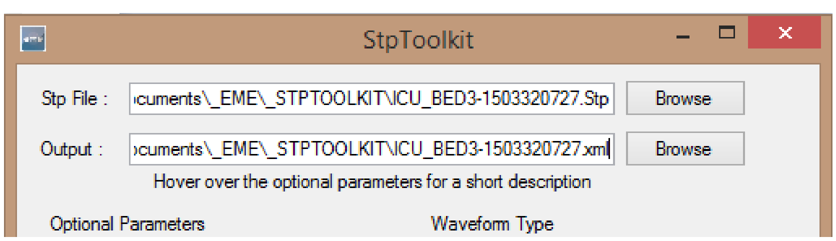
The second mode of operation is using the Stp Toolkit Graphical User Interface (GUI). To access this, run (double-click) 'StpToolkitGUI.exe'. This will bring up the graphical user interface for the toolkit:



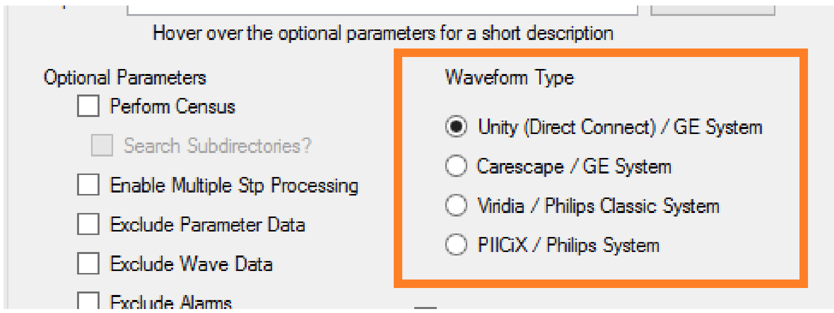
Similar to Command Prompt, you must provide an input file location, as well as specify additional arguments.

Stp File: First, select the .Stp file you want to input by clicking the 'Browse' button on the 'Stp File' line at the top of the GUI. Once the .Stp file is selected, that field will be populated with the file path and name of the file you chose.

Output: You can choose the output file path and name by clicking 'Browse' on the 'Output' line. Note that once the .Stp file is selected, this field gets auto-populated with the same file path and file name as the .Stp file, but with the .xml file extension.



Waveform Type: Choose the waveform type that corresponds with the source patient monitoring network type for the .Stp file you hope to analyze:

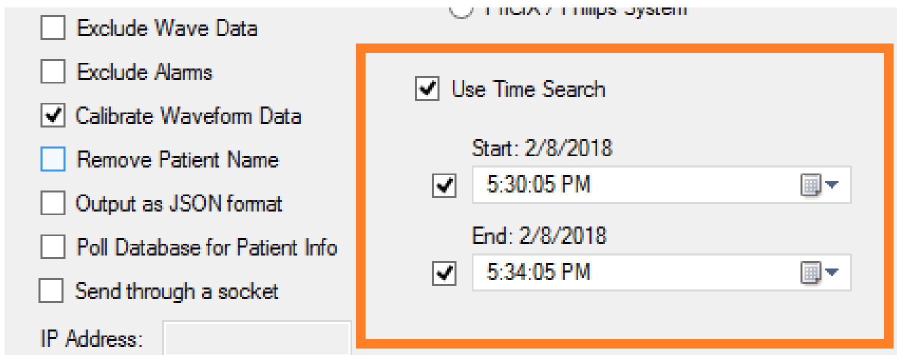


Optional Parameters: Choose the other parameters appropriate to what you need in terms of the converted output. Hovering your cursor over each optional parameter will provide you with a dialog box containing an explanation of each feature.

1. Perform Census - If enabled, will retrieve file information for each .Stp file in a given directory. Output formats should be .xlsx or .txt
    a. Search Subdirectories? - If enabled, will search in all subdirectories found inside the root directory
2. Enable Multiple Stp Processing - Flag to simultaneously process multiple Stp files. Following parameter must be the directory which contains the .Stp files. Up to twenty (20) .Stp files in that directory will be processed at once so attention should be paid to the number of files in the directory, the resources on the server, and the network requirements if not running local to the .Stp files. If more than 20 files are in the directory, the 21st file will start as soon as the first of the original 20 finishes.
3. Exclude Parameter Data - If enabled, removes parameter/vital sign data from the xml output.
4. Exclude Wave Data - If enabled, removes wave data from the XML output.
5. Exclude Alarms - If enabled, removes alarms from the xml output.
6. Export Time as UTC Integer - If enabled, times will be the total number of seconds since 1/1/1970. If disabled, time units will convert to your local time zone
7. Calibrate Waveform Data - If enabled (will be by default), waveform data will be scaled and give calibrated units of measure. See section 6.2 below for more information on scaling.
8. Remote Patient Name - If enabled, the patient name from the xml output will be removed.
9. Output as JSON format - If enabled, will change the output format from an XML file to a JSON document.
10. Poll Database for Patient Info - Requires that the StpToolkit config file has the correct SQL server information. Polls the BedMaster database to find patient information.
11. Send through a socket - If enabled, will send segments of data over a network.
    a. IP Address - The IP address of the receiving system.
    b. Port - The port that the receiving system is listening on.

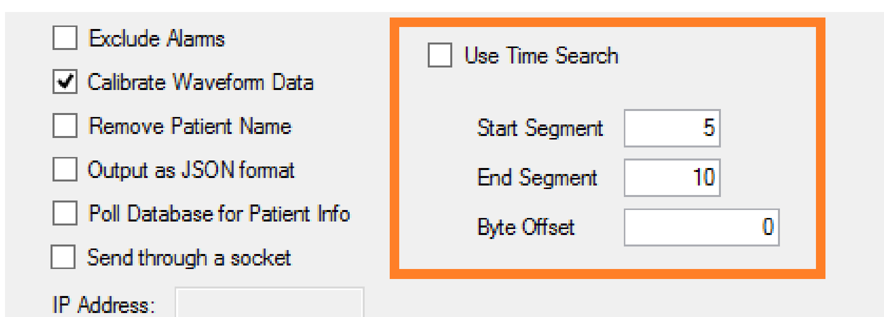
Use Time Search: If you only want a subset of the data contained in the whole .Stp file selected in the 'Stp File' line, you have two options provided through the GUI, you can identify start and end times of interest or disable the 'Use Time Search' and identify the segments (each segment = one minute) you would like to choose.

Checking the 'Use Time Search' box allows you to specify the exact time frame of interest. To choose a specific start and/or end date, click the drop-down box on the far right of the respective line and choose a date from the calendar. Set the time through manual entry into the time line.



Leaving the 'Start' or 'End' boxes unchecked means you will convert data all the way to/from the beginning/end, respectively.

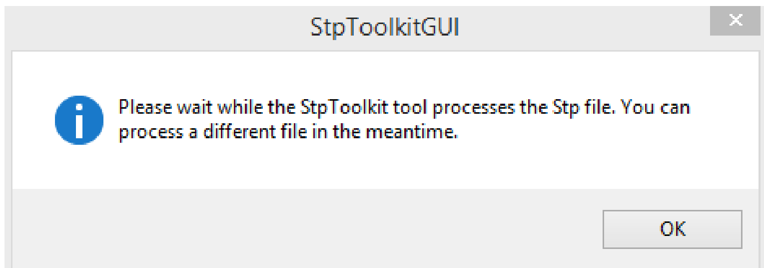
The second option is to specify the start and end segment by leaving the 'Use Time Search' checkbox empty and entering the segment range of interest. Each minute's worth of data is written into what is referred to as a 'segment'. Each data collection starts with segment zero ('segment_0') and spans up to the number of minutes (rounded up, minus one) that data was collected.



Leaving the Start segment as '0' and the End segment as '-1' will give you the full data collection.

<u>Start:</u> Clicking ‘Start’, at the bottom right of the GUI, will run the Toolkit with your selected options. Once you click the button, a Command Prompt window will be deployed that lets you know the .Stp data is being processed.

You will also see the following dialog box:



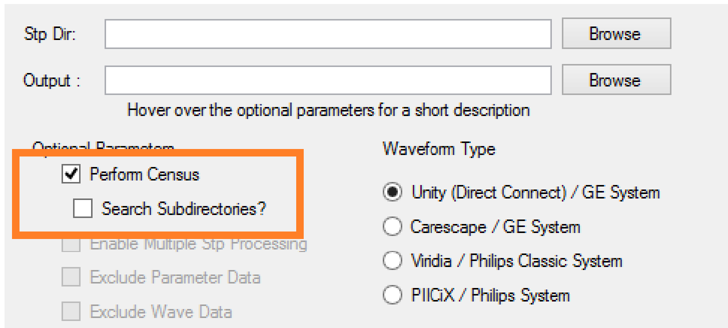
Once processing is complete, the output file will reside in the specified output location and a message will appear in Command Prompt:

Generic ratio to conversion is 1 to 10, meaning if your .Stp file is 1 GB then the associated .xml file will be approximately 10 GB. Depends on selected flags in Step 4; unchecking some flags can speed up the process of conversion and lead to smaller output files.

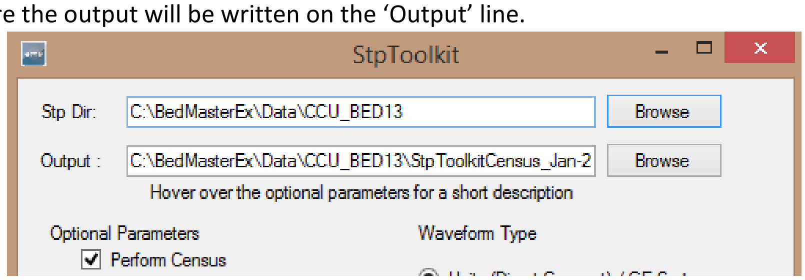
3.1 Performing Census - GUI

Checking the 'Perform Census' box allows you to create a Microsoft Excel spreadsheet containing information about an entire directory of .Stp files. This sheet will include columns for file name, patient name, patient ID (MRN), data start time, data end time, care unit, and bed label. This can be performed for all subdirectories by checking the 'Search Subdirectories' box.

Once you check the 'Perform Census' box, you will see most other options greyed-out once this is checked.

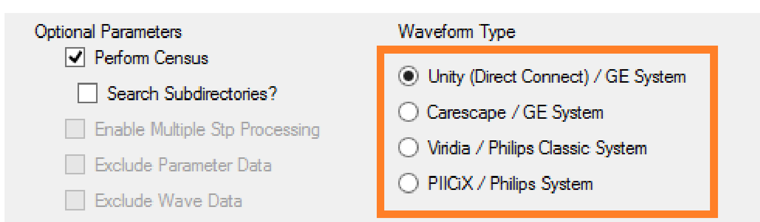


Choose the directory from which you want to perform the census by clicking 'Browse' on the 'Stp Dir' line at the top. Similarly, choose where the output will be written on the 'Output' line.



Check the 'Search Subdirectories' box if you wish to perform the census recursively over all subdirectories of your specified directory.

Choose the waveform type that corresponds with the source patient monitoring type for the .Stp files you hope to analyze.



Click 'Start' in the bottom right of the GUI. Once the census completes, you will find a .xlsx file in your specified output location.

4.0 Universal BedMasterEx XML Schema

As of version 5.1 of BedMasterEx a new universal XML/JSON schema was adopted for all export options across all monitoring type interfaces. This accomplished a long awaited normalization of data exported from the BedMasterEx system whether it be from the automated near real-time feed or the manual methods made available in the BedMasterEx client and the EME Stp Toolkit. Waveforms, vitals, alarms, and other imported data are made available in a consistent format regardless of the model and software version of the GE Healthcare or Philips source.

The data nodes are ordered by time with a vital signs node, imported data node, alarms node, and finally a waveforms node. This schema will be consistent across both GE Healthcare and Philips data collections, however the data therein will differ depending on manufacturer, model, and even monitor to monitor. The type of source monitoring system can be found in the child node FamilyType of the parent node FileInfo.

```
<?xml version="1.0"?>
<!--BedMasterEx StpToolkit Converter Version 8.5-->
<BedmasterEx>
    <FileInfo>
        <Filename>String</Filename>
        <Size>Int64</Size>
        <EndByte>Int64</EndByte>
        <Unit>String</Unit>
        <Bed>String</Bed>
        <FamilyType>String</FamilyType>
    </FileInfo>
    <Segment N="Int32" Offset="Int64">
        <PatientName ID="String" Time="DateTime" TimeUTC="Int32" AgeCode="Int32">String</PatientName>
        <PatientUpdate Time="DateTime" TimeUTC="Int32" NewPatientName="String" NewPatientID="String"
NewPatientAgeCode="Int32" />
        <VitalSigns CollectionTime="DateTime" CollectionTimeUTC="Int32">
            <VitalSign DeviceName="String">
                <Parameter>String</Parameter>
                <BpChannel>Int32</BpChannel>
                <Time>DateTime</Time>
                <TimeUTC>Int32</TimeUTC>
                <Value UOM="String" Q="Int32">Float</Value>
                <AlarmLimitLow Label="String">Float</AlarmLimitLow>
                <AlarmLimitHigh Label="String">Float</AlarmLimitHigh>
            </VitalSign>
        </VitalSigns>
        <ImportedData>
            <VitalSigns CollectionTime="DateTime" CollectionTimeUTC="Int32">
```

```
                <VitalSign DeviceName="String">
                    <Parameter>String</Parameter>
                    <BpChannel>Int32</BpChannel>
                    <Time>DateTime</Time>
                    <TimeUTC>Int32</TimeUTC>
                    <Value UOM="String" Q="Int32">Float</Value>
                    <AlarmLimitLow Label="String">Float</AlarmLimitLow>
                    <AlarmLimitHigh Label="String">Float</AlarmLimitHigh>
                </VitalSign>
            </VitalSigns>
        </ImportedData>
        <Alarms CollectionTime="DateTime" CollectionTimeUTC="Int32">
            <Alarm>
                <Message>String</Message>
                <ID>Int32</ID>
                <Level>String</Level>
                <StartTime>DateTime</StartTime>
                <StartTimeUTC>Int32</StartTimeUTC>
                <SilenceTime>DateTime</SilenceTime>
                <SilenceTimeUTC>Int32</SilenceTimeUTC>
                <EndTime>DateTime</EndTime>
                <EndTimeUTC>Int32</EndTimeUTC>
                <Kind Level="Int32">String</Kind>
                <Severity Level="Int32">String</Severity>
            </Alarm>
        </Alarms>
        <Waveforms CollectionTime="DateTime" CollectionTimeUTC="Int32" TTX="Int32" DisplayOrder="String">
            <WaveformData ID="Int32" Label="String" UOM="String" Cal="String" SampleRate="Int32"
SamplePeriodInMsec="Int32" Samples="Int32">String</WaveformData>
        </Waveforms>
    </Segment>
</BedmasterEx>
```

Level = BedMasterEx normalized nomenclature for level (i.e. Patient Crisis, Patient Warning, Patient Advisory, or System Warning)

Kind = for PIIC iX only; indicates numeric category and type of the alarm per source monitor system

Severity = numeric severity level and color of the alarm per source monitor system

5.0 Sample Output

As of version 5.1 of BedMasterEx a new universal XML/JSON schema was adopted for all export options across all monitoring type interfaces. This accomplished a long awaited normalization of data exported from the BedMasterEx system and the EME Stp Toolkit.

Empty imported data and alarms nodes should not be a concern. The ImportedData node will only be populated at each ten (10) second interval. The Alarms node will only be populated when new alarm data is available.

Values of -32768 and January 1, 1900 represent missing or invalid data or timestamps respectively.

5.1 XML Sample


```
<?xml version="1.0"?>
<!--BedMasterEx StpToolkit Converter Version 8.5-->
<BedMasterEx>
    <FileInfo>
        <Filename>C:\BedMasterEx\Data\CCU_BED13\CCU_BED13-1517523510.Stp</Filename>
        <Size>359549</Size>
        <EndByte />
        <Unit>CCU</Unit>
        <Bed>BED13</Bed>
        <FamilyType>GEMarquette</FamilyType>
    </FileInfo>
<Segment N="0" Offset="0">
    <PatientName ID="123456789" Time="2/1/2018 5:18:31 PM" TimeUTC="1517523511" AgeCode="0">
        Smith,Michael
    </PatientName>
    <VitalSigns CollectionTime="2/1/2018 5:18:31 PM" CollectionTimeUTC="1517523511">
        <VitalSign DeviceName="Monitor">
            <Parameter>HR</Parameter>
            <BpChannel>0</BpChannel>
            <Time>2/1/2018 5:18:31 PM</Time>
            <TimeUTC>1517523511</TimeUTC>
            <Value UOM="Bpm" Q="">69</Value>
            <AlarmLimitLow Label="HR LO">50</AlarmLimitLow>
            <AlarmLimitHigh Label="HR HI">130</AlarmLimitHigh>
        </VitalSign>
    </VitalSigns>
    <ImportedData>
        <VitalSigns CollectionTime="2/1/2018 5:18:31 PM" CollectionTimeUTC="1517523511">
            <VitalSign DeviceName="Somanetics">
```

<Parameter>S_1_rSO2</Parameter>
<BpChannel />
<Time>2/1/2018 5:18:31 PM</Time>
<TimeUTC>1517523511</TimeUTC>
<Value UOM="" Q="">50</Value>
<AlarmLimitLow />
<AlarmLimitHigh />
</VitalSign>
</VitalSigns>
</ImportedData>
<Alarms CollectionTime="2/1/2018 5:18:31 PM" CollectionTimeUTC="1517523511">
<Alarm>
<Message>ASYSTOLE</Message>
<ID>0</ID>
<Level>Patient Crisis</Level>
<StartTime>2/1/2018 5:18:31 PM</StartTime>
<StartTimeUTC>1517523511</StartTimeUTC>
<SilenceTime />
<SilenceTimeUTC />
<EndTime />
<EndTimeUTC />
<Kind />
<Severity Level="7">Red</Severity>
</Alarm>
</Alarms>
<Waveforms CollectionTime="2/1/2018 5:18:31 PM" CollectionTimeUTC="1517523511" TTX="0" DisplayOrder="">
<WaveformData ID="7" Label="I" UOM="mV" Cal="2.44µV" SampleRate="240" SamplePeriodInMsec="1000"
Samples="480">-0.022,-0.029,-0.024,-0.017,-0.027,-0.029,-0.022,-0.017,-0.024,-0.029,-0.024,-0.02,-0.027,-0.032,-
0.017,-0.012,-0.017,-0.022,-0.017,-0.012,-0.012,-0.017,-0.01,-0.005,-0.012,-0.015,-0.002,0.005,-0.002,-
0.005,0.002,0.012,0.007,0.007,0.022,0.032,0.032,0.029,0.041,0.046,0.041,0.041,0.051,0.059,0.051,0.044,0.051,0.054,
0.051,0.044,0.044,0.049,0.039,0.032,0.037,0.034,0.024,0.01,0.01,0.01,0.005,-0.002,-0.002,0,-0.007,-0.015,-0.012,-
0.01,-0.012,-0.02,-0.015,-0.007,-0.015,-0.024,-0.02,-0.015,-0.022,-0.029,-0.032,-0.027,-0.029,-0.034,-0.029,-0.029,-
0.027,-0.029,-0.024,-0.024,-0.027,-0.027,-0.024,-0.02,-0.022,-0.029,-0.027,-0.024,-0.027,-0.032,-0.029,-0.027,-0.029,-
0.032,-0.027,-0.024,-0.027,-0.029,-0.022,-0.022,-0.024,-0.027,-0.022,-0.017,-0.024,-0.027,-0.024,-0.02,-0.024,-0.029,-
0.022,-0.017,-0.022,-0.027,-0.027,-0.017,-0.024,-0.032,-0.024,-0.022,-0.024,-0.032,-0.027,-0.024,-0.027,-0.027,-0.022,-
0.017,-0.022,-0.029,-0.027,-0.02,-0.022,-0.029,-0.029,-0.024,-0.024,-0.032,-0.024,-0.012,-0.01,-0.01,-
0.002,0.007,0.005,0.002,0.01,0.017,0.017,0.005,0.002,0.002,-0.002,-0.01,-0.01,-0.01,-0.015,-0.024,-0.024,-0.022,-
0.02,-0.027,-0.024,-0.02,-0.022,-0.027,-0.024,-0.02,-0.02,-0.027,-0.027,-0.027,-0.029,-0.037,-0.039,-0.041,-0.041,-
0.022,0.037,0.117,0.195,0.261,0.303,0.3,0.246,0.161,0.078,0.002,-0.049,-0.063,-0.061,-0.049,-0.039,-0.034,-0.037,-
0.032,-0.022,-0.022,-0.027,-0.024,-0.022,-0.024,-0.029,-0.027,-0.022,-0.027,-0.027,-0.022,-0.02,-0.024,-0.027,-0.024,-
0.02,-0.02,-0.022,-0.017,-0.01,-0.015,-0.015,-0.01,-0.002,-0.005,-0.007,-
0.007,0.002,0,0,0.002,0.01,0.007,0.012,0.02,0.029,0.027,0.032,0.041,0.044,0.044,0.041,0.051,0.056,0.049,0.046,0.049

,0.049,0.046,0.046,0.049,0.049,0.041,0.039,0.039,0.041,0.032,0.017,0.02,0.012,0.007,0.002,0.002,0,-0.005,-0.012,-0.007,-0.01,-0.015,-0.017,-0.015,-0.01,-0.017,-0.02,-0.02,-0.015,-0.024,-0.027,-0.022,-0.024,-0.027,-0.034,-0.029,-0.024,-0.027,-0.027,-0.027,-0.024,-0.029,-0.029,-0.024,-0.022,-0.027,-0.029,-0.027,-0.022,-0.027,-0.032,-0.024,-0.022,-0.027,-0.032,-0.027,-0.027,-0.032,-0.032,-0.027,-0.024,-0.032,-0.032,-0.027,-0.02,-0.024,-0.027,-0.022,-0.022,-0.027,-0.024,-0.022,-0.017,-0.024,-0.027,-0.027,-0.022,-0.024,-0.027,-0.022,-0.02,-0.027,-0.029,-0.024,-0.02,-0.027,-0.032,-0.029,-0.022,-0.022,-0.027,-0.022,-0.017,-0.022,-0.029,-0.027,-0.02,-0.024,-0.029,-0.027,-0.02,-0.02,-0.02,-0.007,0.002,0.002,-0.002,0.01,0.015,0.012,0.01,0.01,0.012,0,-0.007,-0.01,-0.002,-0.01,-0.02,-0.02,-0.015,-0.022,-0.024,-0.022,-0.02,-0.017,-0.027,-0.024,-0.017,-0.02,-0.027,-0.024,-0.017,-0.022,-0.032,-0.032,-0.029,-0.037,-0.049,-0.022,0.041,0.115,0.185,0.256,0.305,0.3,0.242,0.166,0.088,0.007,-0.054,-0.071,-0.061,-0.049,-0.044,-0.037,-0.032,-0.032,-0.032,-0.024,-0.02,-0.027,-0.029,-0.022,-0.017,-0.022,-0.029,-0.022,-0.017,-0.022,-0.029,-0.022,-0.012,-0.017,-0.024,-0.017,-0.007,-0.012,-0.017,-0.012,-0.005,-0.005,-0.012,-0.012,-0.002,-0.002,-0.007,-0.002,0.007,0.005,0,0.005,0.022,0.022,0.017,0.029,0.044,0.046,0.037,0.044,0.054,0.051,0.049,0.051,0.059,0.054,0.041,0.044,0.054,0.051,0.039,0.041,0.046,0.039,0.032,0.029,0.034,0.024,0.012,0.007,0.015,0.007,-0.007,-0.005,0,-0.005,-0.017,-0.017</WaveformData>
  </Waveforms>
</Segment>
</BedMasterEx>

5.2 JSON Sample


```
{
 "BedMasterEx": {
  "@Version": "8.5",
  "FileInfo": {
   "Filename": "C:\BedMasterEx\Data\CCU_BED13\CCU_BED13-1517523510.Stp",
   "Size": "359549",
   "EndByte": null,
   "Unit": "CCU",
   "Bed": "BED13",
   "FamilyType": "GEMarquette"
  },
  "Segment": {
  "@N": "0",
  "@Offset": "0",
  "PatientName": [
   {
    "@ID": "123456789",
    "@Time": "2/1/2018 5:18:31 PM",
    "@TimeUTC": "1517523511",
    "@AgeCode": "0",
    "#text": "Smith,Michael"
   }
  ],
  "VitalSigns": [
   {
    "@CollectionTime": "2/1/2018 5:18:31 PM",
    "@CollectionTimeUTC": "1517523511",
    "VitalSign": [
     {
      "@DeviceName": "Monitor",
      "Parameter": "HR",
      "BpChannel": "0",
      "Time": "2/1/2018 5:18:31 PM",
      "TimeUTC": "1517523511",
      "Value": {
       "@UOM": "Bpm",
       "@Q": "",
       "#text": "69"
      },
      "AlarmLimitLow": {
```

```
          "@Label": "HR LO",
          "#text": "50"
        },
        "AlarmLimitHigh": {
          "@Label": "HR HI",
          "#text": "130"
        }
      },
    ]
  },
],
"ImportedData": [
  {
    "VitalSigns": [
      {
        "@CollectionTime": "2/1/2018 5:18:31 PM",
        "@CollectionTimeUTC": "1517523511",
        "VitalSign": [
         {
          "@DeviceName": "Somanetics",
          "Parameter": "S_1_rSO2",
          "BpChannel": null,
          "Time": "2/1/2018 5:18:31 PM",
          "TimeUTC": "1517523511",
          "Value": {
            "@UOM": "",
            "@Q": "",
            "#text": "50"
          },
          "AlarmLimitLow": null,
          "AlarmLimitHigh": null
         },        ]
      }
    ]
  },
],
"Alarms": [
  {
    "@CollectionTime": "2/1/2018 5:18:31 PM",
    "@CollectionTimeUTC": "1517523511",
    "Alarm": [
      {
```

"Message": "ASYSTOLE",
"ID": "0",
"Level": "Patient Crisis",
"StartTime": "2/1/2018 5:18:31 PM",
"StartTimeUTC": "1517523511",
"SilenceTime": null,
"SilenceTimeUTC": null,
"EndTime": null,
"EndTimeUTC": null,
"Kind": null,
"Severity": {
"@Level": "7",
"#text": "Red"
}
]
},
]
"Waveforms": [
{
"@CollectionTime": "2/1/2018 5:18:31 PM",
"@CollectionTimeUTC": "1517523511",
"@TTX": "0",
"@DisplayOrder": "",
"WaveformData": [
{
"@ID": "7",
"@Label": "I",
"@UOM": "mV",
"@Cal": "2.44µV",
"@SampleRate": "240",
"@SamplePeriodInMsec": "1000",
"@Samples": "480",
"#text": "-0.022,-0.029,-0.024,-0.017,-0.027,-0.029,-0.022,-0.017,-0.024,-0.029,-0.024,-0.02,-0.027,-0.032,-0.017,-0.012,-0.017,-0.022,-0.017,-0.012,-0.012,-0.017,-0.01,-0.005,-0.012,-0.015,-0.002,0.005,-0.002,-0.005,0.002,0.012,0.007,0.007,0.022,0.032,0.032,0.029,0.041,0.046,0.041,0.041,0.051,0.059,0.051,0.044,0.051,0.054,0.051,0.044,0.044,0.049,0.039,0.032,0.037,0.034,0.024,0.01,0.01,0.01,0.005,-0.002,-0.002,0,-0.007,-0.015,-0.012,-0.01,-0.012,-0.02,-0.015,-0.007,-0.015,-0.024,-0.02,-0.015,-0.022,-0.029,-0.032,-0.027,-0.029,-0.034,-0.029,-0.029,-0.027,-0.029,-0.024,-0.024,-0.027,-0.027,-0.024,-0.02,-0.022,-0.029,-0.027,-0.024,-0.027,-0.032,-0.029,-0.027,-0.029,-0.032,-0.027,-0.024,-0.027,-0.029,-0.022,-0.022,-0.024,-0.027,-0.022,-0.017,-0.024,-0.027,-0.024,-0.02,-0.024,-0.029,-0.022,-0.017,-0.022,-0.027,-0.027,-0.017,-0.024,-0.032,-0.024,-0.022,-0.024,-0.032,-0.027,-0.024,-0.027,-0.027,-0.022,-0.017,-0.022,-0.029,-0.027,-0.02,-0.022,-0.029,-0.029,-0.024,-0.024,-0.032,-0.024,-0.012,-0.01,-0.01,-0.002,0.007,0.005,0.002,0.01,0.017,0.017,0.005,0.002,0.002,-0.002,-0.01,-0.01,-0.01,-0.015,-0.024,-0.024,-0.022,-

0.02,-0.027,-0.024,-0.02,-0.022,-0.027,-0.024,-0.02,-0.02,-0.027,-0.027,-0.027,-0.029,-0.037,-0.039,-0.041,-0.041,-0.022,0.037,0.117,0.195,0.261,0.303,0.3,0.246,0.161,0.078,0.002,-0.049,-0.063,-0.061,-0.049,-0.039,-0.034,-0.037,-0.032,-0.022,-0.022,-0.027,-0.024,-0.022,-0.024,-0.029,-0.027,-0.022,-0.027,-0.027,-0.022,-0.02,-0.024,-0.027,-0.024,-0.02,-0.02,-0.022,-0.017,-0.01,-0.015,-0.015,-0.01,-0.002,-0.005,-0.007,-0.007,0.002,0,0,0.002,0.01,0.007,0.012,0.02,0.029,0.027,0.032,0.041,0.044,0.044,0.041,0.051,0.056,0.049,0.046,0.049,0.049,0.046,0.046,0.049,0.049,0.041,0.039,0.039,0.041,0.032,0.017,0.02,0.012,0.007,0.002,0.002,0,-0.005,-0.012,-0.007,-0.01,-0.015,-0.017,-0.015,-0.01,-0.017,-0.02,-0.02,-0.015,-0.024,-0.027,-0.022,-0.024,-0.027,-0.034,-0.029,-0.024,-0.027,-0.027,-0.027,-0.024,-0.029,-0.029,-0.024,-0.022,-0.027,-0.029,-0.027,-0.022,-0.027,-0.032,-0.024,-0.022,-0.027,-0.032,-0.027,-0.027,-0.032,-0.032,-0.027,-0.024,-0.032,-0.032,-0.027,-0.02,-0.024,-0.027,-0.022,-0.022,-0.027,-0.024,-0.022,-0.017,-0.024,-0.027,-0.027,-0.022,-0.024,-0.027,-0.022,-0.02,-0.027,-0.029,-0.024,-0.02,-0.027,-0.032,-0.029,-0.022,-0.022,-0.027,-0.022,-0.017,-0.022,-0.029,-0.027,-0.02,-0.024,-0.029,-0.027,-0.02,-0.02,-0.02,-0.007,0.002,0.002,-0.002,0.01,0.015,0.012,0.01,0.01,0.012,0,-0.007,-0.01,-0.002,-0.01,-0.02,-0.02,-0.015,-0.022,-0.024,-0.022,-0.02,-0.017,-0.027,-0.024,-0.017,-0.02,-0.027,-0.024,-0.017,-0.022,-0.032,-0.032,-0.029,-0.037,-0.049,-0.022,0.041,0.115,0.185,0.256,0.305,0.3,0.242,0.166,0.088,0.007,-0.054,-0.071,-0.061,-0.049,-0.044,-0.037,-0.032,-0.032,-0.032,-0.024,-0.02,-0.027,-0.029,-0.022,-0.017,-0.022,-0.029,-0.022,-0.017,-0.022,-0.029,-0.022,-0.012,-0.017,-0.024,-0.017,-0.007,-0.012,-0.017,-0.012,-0.005,-0.005,-0.012,-0.012,-0.002,-0.002,-0.007,-0.002,0.007,0.005,0,0.005,0.022,0.022,0.017,0.029,0.044,0.046,0.037,0.044,0.054,0.051,0.049,0.051,0.059,0.054,0.041,0.044,0.054,0.051,0.039,0.041,0.046,0.039,0.032,0.029,0.034,0.024,0.012,0.007,0.015,0.007,-0.007,-0.005,0,-0.005,-0.017,-0.017"
        },
      ]
    },
  ]
},
}
}

6.0 Data Information

6.1 Waveforms Frequency

The XML node ‘WaveformData’ contains the attributes SampleRate, SamplePeriodInMsec, and Samples. In order, these give the sampling frequency [Hz], the collection period of the waveform [milliSeconds] as received from the patient monitoring network, and the number of data points contained in the specific WaveformData node.

BedMasterEx acquires waveform data from the Philips PIIC iX monitoring network, via the Philips Mobility Server, in 256 Hz, 128 Hz, or 64 Hz sampling rates depending upon the specific waveform channel. BedMasterEx gets all waveforms data from the Philips PIIC Classic monitoring network at a normalized 125 Hz sampling rate.

BedMasterEx gets waveform data from the GE MC network in 240 Hz, 120 Hz, or 60 Hz sampling rates depending upon the specific waveform channel.

6.2 Waveforms Scaling

There are two choices for how data in the XML node ‘WaveformData’ is presented. If the ‘Calibrate Waveform Data’ is not selected (it is selected by default), the node will contain the raw waveforms data that was collected from the source monitoring system. If ‘Calibrate Waveform Data’ is selected, as it is by default, the node will contain scaled values.

For data acquired from a Philips PIIC Classic or PIIC iX monitoring system, the scaled data points are derived using the ‘Cal’ attribute located in the WaveformData node which uses the following convention:

$$Cal = "Cal_{Lo}, Cal_{Hi}, Grid_{Lo}, Grid_{Hi}"$$

Each WaveformData node’s scaling constant is computed as:

$$Scale = \frac{Cal_{Hi} - Cal_{Lo}}{Grid_{Hi} - Grid_{Lo}}$$

So the i^{th} raw data point is scaled as:

$$ScaledData_i = Cal_{Lo} + Scale \times [Grid_{Lo} - RawSample_i]$$

Note: if Cal_{Hi} = NaN, then Scale = -0.025.

For waveforms acquired from a GE monitoring system, scaling is handled a bit differently adhering to the following hard coded calibrations:

- ECG leads data are 2.44µV per least significant bit (LSB);
- Invasive pressure waveforms are 0.2mmHg per LSB;
- CO2 waveforms are 0.25 mmHg per LSB;
- O2 waveforms are 0.1 % per LSB;
- Respiration and SpO2 waveforms are scaled variably depending on the module used in the source monitor with “AutoSize” as the UOM.