Requirements for the BigRips data sender for combined data logging with the MBS time sorter for the EURICA experiment

General:
It is proposed to make combined data logging of BigRips data and MBS data (two subsystems) online into single files with the help of the MBS time sorter and merger system. This kind of solution was running successfully in the RISING fast beam campaign. In the EURICA setup it requires the usages of time synchronized LUPO time stamp modules. This note will not describe the functionality of the complete system. Instead all fields of adoption work will be addressed in detail. No change in the BigRips daq and/or control is required and wished. Also the BigRips data will not be changed at all by this procedure.

LUPO time stamp data format:
The first 3 BigRips payload data words are required for each event as follows:

1. 32 bit data word: 0x200 (sub-system identifier for BigRips, fixed)
2. 32 bit LUPO time stamp low
3. 32 bit LUPO time stamp high  (only lower 16 bits used)

BigRips data sender:
A new data sender needs to be programmed for sending BigRips data to the MBS foreign data receiver for further combining with other sub-systems. The following process flow is required:
First it connects (try to connect every 1-3 seconds in a loop) to an existing TCP socket on port 6500. The name of the node to connect must be entered as a parameter to this data sender. It might be helpful if the port number may also be a setup parameter.
After successful connection this data sender shall send first a fixed protocol buffer with a size of 1024 bytes. It contains two 32 bit words: In the first word the data sender writes a 1. This will be used by the MBS receiver as a tag for the endian type of the sender. The second data word contains the buffer size of the event data, which will be send afterwards. The sensible values for the data buffer size are 4096, 8192, 16384 or 32768 or larger numbers.
With these values the full network bandwidth can be utilized. At the same time they give some freedom for the number of events stored in a single buffer. The size of a BigRips event shall never be larger than the buffer size minus 12 bytes for header (see below):
The data sender sends now in an infinite loop buffers all BigRips events into the connected socket, whenever a buffer is completely filled. The receiver expects for each BigRips event a sub-event header of 12 bytes (see format below), which has to be filled and put just before the BigRips event data (In fact just before the sub-system identifier (0x200) described above.).
If the MBS receiver disconnects, the BigRips data sender stops sending data to TCP and enters again in a loop, trying to connect again to a socket on port 6500 on a predefined node.
The 12 bytes sub-event header C structure to be filled by the BigRips data sender (see
protocol flow above) depends on the endian type of the processor node, where the data sender is running:

/* ================= GSI VME Sub-event header ================= */
#ifdef BIGENDIAN
typedef struct
{
   INTS4 l_dlen; /* Data length (in 16 bits) + 2 */
   INTS2 i_subtype;
   INTS2 i_type;
   CHARS h_control;
   CHARS h_subcrate;
   INTS2 i_procid;
} s_veshe;
#endif /* BIGENDIAN */
#ifdef LITTLEENDIAN
typedef struct
{
   INTS4 l_dlen; /* Data length (in 16 bits) + 2 */
   INTS2 i_type;
   INTS2 i_subtype;
   INTS2 i_procid;
   CHARS h_subcrate;
   CHARS h_control;
} s_veshe;
#endif /* LITTLEENDIAN */

l_dlen: data size in 16 bit words + 2. This data size must cover the three (sub-system identifier, 2x LUPO time stamps) 32 bit words plus the original BigRips event data size.

Please note the + 2!

i_subtype    1
i_type:      10    used for analysis control
h_control:   20    used for analysis control
h_subcrate:  0
i_procid:    11

**Checking time stamp synchronization:**
The standard operation will be probably, that a trigger will be sent simultaneously in all sub-systems synchronized via time stamps. This will result in a constant difference between time stamps of all sub-systems belonging to an identical trigger (event). The (constant) time difference is caused by different cable (and electronics) delays of the time stamp input signals.
Finding a peak in the time difference of time stamps of two different LUPO modules is not a full proof for a proper synchronized system. Therefore it is proposed to use in each sub-system a TDC channel for test purposes. A time generator (stop) signal that varies in a saw tooth manner for a few (8) time steps shall be simultaneously fed into these TDC channels. Plotting the times (not time stamps) measured by two of these channels two dimensionally, after time stamp matching, would show (8) spots on a diagonal, if the synchronization is working properly. If a spot outside the diagonal appears, it is spoiled. Checking all sub-systems against each others shall be integrated into the analysis package.

**Low rate trigger:**
The time stamp system requires a low rate (pulser) trigger of ca. 1 Hz. The time (stamp) sorting process requires that at least one event is seen from each sub-system before sending it for data logging. Due to the multi stage data buffering it may be, that data is delayed (i.e. network hang ups), but the time sorting process cannot distinguish if a sub system delivers no data or if it is delayed. A low rate trigger to all sub-systems forces the arrival of an event after a maximum time, depending on the transfer buffer sizes and the frequency.