

Notes from the Special MPP-SMP v2 meeting of 21/06/2019

Present: Verena Kain, Lars Jensen, Jan Uythoven, Ivan Romera Ramirez, Markus Zerlauth, Benjamin Todd, Christophe Martin, Tom Levens, Grzegorz Kruk, Jean-Christophe Garnier, Kevin Shing Bruce Li, Andrea Apollonio, Francesco Maria Velotti, Bettina Mikulec, Nicolas Magnin, Frank Tecker, David Nisbet, Matteo Solfaroli Camillocci, Raffaello Secondo.

Link to Indico page: <https://indico.cern.ch/event/827692/>

Ivan – Overview of the Present System.

Ivan presented the layout of the present system, its evolution since the first deployment, the general dependability of the SMP and the motivation to upgrade it.

Discussion

- **Greg** commented that an LTIM class can be stopped and a CTRV/CTRP board would continue pulsing, the LTIM is needed only to configure the CTR at start-up. Therefore, a CTR board would still work without the class running, if it ever crashes. This is true if relying on the pulses, not on the interrupts. At start-up, the correct configuration of the LTIM class is critical.
- **Ivan** pointed out that in the past there was an issue of one of the BCTs. A filter to overcome this issue was realized in the SMP. **Markus** commented that changes were implemented also on the BCT side, these changes are still running in the present system. **Tom** clarified that some dedicated hardware was designed.
- **Ben** recalled an issue between BA4 and BA3 transmission which was possibly not in the list of “faults” given by Ivan.
- **Verena** also recalled an issue with transmission of data from the BCT, which resulted in once injecting into an empty machine. **Lars** put software protection in place, which never triggered since.
- Clarification on the LHC BCT Beam 2 LHC: the SMP uses 1 out of 2 logic.
- **Markus** asked if we have statistics or data referring to problems “downstream” of the SMP, meaning if there were issues from the user side in decoding SMP frames. **Ivan** replied that so far no dumps were caused by the cross-checker. There is no data referring to issues in decoding GMT frames. **Greg** commented that the Cross-checker is present only on the SMP system, no checks are executed in case of an issue of the timing distribution. However, on the CTRV side there is a check for lost frames.

Follow-up

ACTION(MPE-MI): check how the cross-checker verifies the validity of GMT distributed frames.

Matteo – Feedback from LHC operation

Matteo gave a general feedback on the SMP from the LHC operators, addressing each of the parameters broadcasted by the SMP system for the LHC machine.

Discussion

- The Energy parameter given to the BLMs was commented: it is considered highly critical, it is broadcasted via timing and so far it proved to be working reliably.
- **Matteo** pointed out that the Beam Presence Flag, used by the SPS extraction BIC, is based on the LHC BBQ, which so far worked extremely well.
- **Matteo** commented that configuration of the SMP so far was quite good and it should stay **as easy as possible**.
- **Matteo** commented that the Squeezing Factors are generated by the SIS, therefore by software at a higher level. One could ideally directly put this information into timing, without passing through the SMP, although the SMP does not constitute a problem for the broadcast of the Squeezing Factors.
- Regarding the subject of a possible Maximum Bunch Intensity parameter for the LHC, no clear/complete interlock solution/strategy is clear, therefore OP proposes to wait on this matter. **Jan** suggested nevertheless that a design for an SMP v2 version should consider the possibility of adapting to a Max Bunch Intensity connection/broadcast. **Tom** commented that it would be possible to plan a common solution with the SPS as well, which also might require a similar parameter. It was agreed that a bunch-by-bunch intensity is not needed, only values like maximum, mean and/or average bunch intensities, which can easily be provided by the FBCT.

Follow-up

- **ACTION (MPE-MI, BE-BI, BE-OP):** Define a strategy for the LHC maximum bunch intensity. Try to implement a common solution to both SPS and LHC.

Verena – Feedback from SPS operation

Verena gave a general feedback on the SMP system from the SPS operation point of view. She commented new possible requirements and needs for an upgrade of the system.

Discussion

- There was the request to adjust the probe beam flag and TED beam flag by MCS.
- **Verena** described how the SPS Ring BIS does not use the SMP for masking at present. A future North Area extraction BIC might take into account beam types and destinations directly decoded from timing or passed on by the SMP (such as flags). **Bettina** states that LINAC4 might also be interested in such a use-case in the future, and similarly also PS and PSB. In addition, right now it is hard to set masks manually, especially during MDs.
- In general **Verena** stated that it is a good idea for a circular machine to distribute beam information: in the future OP would greatly benefit from intensity and energy being

distributed, but the same can be applied to other parameters (e.g. optics, emittance maximum bunch intensity), one has to consider how “safely” to broadcast these values.

- Energy and intensity of SPS are a necessary requirement to protect instrumentation. BI instrumentation will also suffer from 288 LIU bunches, therefore **BI as well would be interested** in having SPS energy and intensity distributed on timing.
- Ideally it would be good to have the intensity distributed before injection, coming from the PS BQM system. Other parameters such as optics and emittance could be useful as well. In general, the SMP can be useful for the injectors as well to distribute information.
- SPS parameters are at present transmitted with 100 ms period on the GMT. For future frames distribution, such as for the economy cycle and probably for the injectors, 10 ms would be required. **Ben** asked if many of these parameters are in fact to be distributed safely by the SMP or rather just sent directly via GMT, in fact they might not need the same integrity as the LHC. This is yet to be clarified, one can envision an SMP and a separate “MP” only listening to beam and safety-related frames on GMT and cross-checking them with the source for safety (in this case the “S” of the SMP would be the cross-checker only)

Follow-up

ACTION (Verena): check if there was in fact any availability issue in the SPS in the past.

ACTION (MPE-MI): SHIP destination flag or NA destination flag are not energy related. They depend only on timing. Check possibilities on how this destination should be transmitted (Timing to BIS or Timing to SMP→BIS)

ACTION (MPE-MI, BE-OP, BE-BI): Clarify the needs of max, mean, average bunch intensity.

Lars – BI Connections to SMP

Lars briefly introduced the present structure of the BI sources and their connections to the SMP.

Discussion

- The Probe Beam Flag has one source with redundant connection. So far, a second source was not needed, but it can be added for redundancy.
- Regarding Bunch Intensities, for both SPS and LHC, **Tom** commented that the BCT can send to the SMP the value of maximum / mean / average instead of the individual bunch intensities. The precision of absolute values is in the percent level.
- **Lars** specified that the BCT5 was added due to its lower noise level.
- Together with a possible max bunch intensity, the **number of bunches** should be transmitted as well.
- **Lars** commented that having energy on the timing network would be of great interest for BI as well.

Follow-up

ACTION (BE-BI, MPE-MI, BE-OP): do we need redundant BA4 intensity for Probe Beam Flag calculation?

Grzegorz – LS3 plans for Timing and beyond.

Greg presented the system plans for LS3 and in particular the considerations on the implementation of White Rabbit

- **Greg** explained that the present GMT is already quite filled up. There is a possibility that it will be replaced by **White Rabbit** (WR) after LS3. This action will greatly increase the speed and bandwidth of the timing network. Within BE-CO nothing is yet decided but BE-CO is setting up a request to install the optical network between 2021 and 2025 for a possible implementation of White Rabbit between 2023 and 2029, with a prototype installation during Run3. This decision is not yet finalized, it shall be made final **by the end of this year**.
- **Greg** stated that if WR is not funded, the GMT will very likely continue as present until the end of LHC running. Therefore the CTRV will continue being supported. If WR will be installed, the present GMT is likely to be removed in the future.
- **Greg** stated that the estimated price for WR is about 4 MCHF, for all machines CERN-wide: half for the hardware and half for the installation. The argument of injectors' needs is not used for consolidation.
- **Ben** commented that the estimated price might not include the cabling to the end-users, which is to be assumed also very expensive.

Follow-up

- The SMP v2 design shall very likely be implemented with an open connectivity to the general timing network: it shall be able to interface the present GMT as well as WR.
- **ACTION (BE-BI, MPE-MI, BE-OP):** Beam Intensity and Machine Energy can also be distributed over GMT directly and not over the SMP. To be followed up in the coming weeks.
- **ACTION (BE-CO):** Keep MPE-MI updated on the planning decisions related to White Rabbit deployment.

Raffaello – SMPv2 Hardware Implementation and Timeline

Raffaello introduced the general hardware requirements for the SMP v2, in particular in terms of synergy with the BIS v2 project.

- Considering no clear decision has been taken on the timing network layout, the SMP v2 should be able to connect to both the present GMT and White Rabbit. The use of SFP transceivers as in the BIS might enhance monitoring of the transmitted flags.
- **Raffaello** stated that since the CIBF is a common hardware between BIS and SMP, if the CIBF_c will be eliminated for the BIS v2, then the same should be applied to the SMP v2 as well. This modification will require very likely a change of the present SMP backplane.

- The present CISV is based on an old CTRV board, which is developed by CO. This board is hard to maintain, and the new CTRVD has never been used to receive SMP frames.
- **Raffaello** showed an alternative layout to broadcast SMP frames/flags via a dedicated BIS channel rather than using the GMT. **Ben** commented that this solution might lead to longer development times as well as to a concept of an SMP integrated with the BIS which should rather be avoided.
- An early prototype of the SMP v2 shall be installed in 2023 for a reliability run in parallel with BIS v2.
- It was generally commented that for injectors the SMP shall be avoided for the generation of flags, but it might be interesting for broadcasting information that can be used to apply masking. In addition, if WR will be realized, the SMP v2 development shall be synchronized with WR development and installation.

Follow-up

- The present SMP shares many hardware components with the BIS. The SMP v2 shall follow the BIS v2 developments in terms of hardware choices, in particular the VME platform with its backplane, the SFP use and the CIBF design.
- The timing network is a key component of the SMP, the realization of WR will have a large impact on the SMP v2 design choices.
- Consider if the SMP is required as “intermediate” for supplying certain information, distributed over the timing system. Possibly the SMP can be used to guarantee the correctness of the information, by checking it against another source. This question is relevant for the LHC (like beta* etc...) and the injectors. For the injectors the distributed information is already less critical than for the LHC.