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Slow timing

Slow timing :

- 1 ms clock plus event codes
- time of day

LEP: resolution 1 millisecond, coherency as seen by users 2 microseconds

Events I

- Start ramp
  - different events for different classes of equipment
- Start & stop squeeze, unscheduled stop, resumption
- Injection warning
- RF events
  - during filling,
  - ramp (200-400 MHz)
  - before physics to synchronize rings.
  - In general a lot simpler than the SPS (Philippe). The SPS has something like 400 events defined (dampers, 100, 200, 400 MHz systems etc..)..
- Stop ramp - possibly obsolete, suspend ramp, resume ramp, ramp abort, power abort
- Collide
- Soft beam dump

Events II

- Synchronized set
  - for standard trim
  - + perhaps repeat, step back functions
- Synchronized collimator movement
- Post mortem freeze
  - note need for different time scales depending on equipment, BST in some case, millisecond in other
- Measurement acquisition
  - orbit
  - beam loss
  - synchronized measurement acquisition
- Communication with experiments
  - for example, scans, mini-ramps
- K-modulation
- Wake-up calls

Issues courtesy Michel Jonker

- Need to establish how many events we should allow for
- Slot size
  - 10 ms instead of 1 ms was discussed but didn't engender much enthusiasm.
- No of events per slot.
  - 3 per slot was just about OK for K-modulation at LEP... for the LHC?
- Latency - is 100 ms (LEP) good enough?
- Reliability -
  - can we tolerate missing event delivery (NO).
  - Do we need acknowledgment of receipt?
- Separate events for both rings?
- Do we need to synchronize the millisecond tick with the SPS?

Distributed data

Clear need for distribution of commonly used data, such as:

- **Mode**
- **Beam current**
- **Energy**

Can this be piggy-backed on to the timing system?

Alternatives- a brief look I

- **1. Classical**
  - **A standard, reliable solution. MTG & TG8s, equipment groups look after distribution into tunnel. Safe.**
- **2. BST (TTC)**
  - **BST unit of time is turn number. Need to re-synchronize to ms plus nonrandom jitter (acceptable) and an intrinsic granularity of 89 microseconds.**
  - **the 40 MHz TTC is somewhat over specified to deliver 1 ms events (comparisons with a sledgehammer) it was felt that a solution was possible:**
  - **Jean-Jacques Savioz sketched out a possible implementation. By using one of the free FIFOs for a milli-second tick synched with absolute time a technical solution appeared feasible.**
  - **Quentin expressed his discomfort at the possibility of both a TTC receiver and GPS in the gateways, but sketched a possible solution which used just the TTC.**

Alternatives- a brief look I

- **3. Absolute time - time triggered**
  - **please ramp at 12 o'clock**
  - **lots of work, question of reliability, not favoured.**
- **4. Real-time**
  - **could be very useful and allow "elimination" of dedicated slow timing system (MJ)**

Final decision depends on such issues as:

- cost
- reliability
- responsibility
- ease of use

Other questions

- **Using turn clock instead of absolute time**
  - turn clock is an ideal reference for the RF system,
  - many systems wherein this is not true.
  - revolution time varies (particularly with heavy ions) and the need to lock to, say, the injection revolution frequency when there was no beam were raised as objections.
  - Clearly a translation between absolute time and turn number would be required...
- **Reliability :**
  - Do we need handshaking? i.e. confirmation of receipt of events. System such as that used in LEP seems a good compromise, enable hardware and check response, if OK send event and assume it gets through.
  - TTC based system was thought to be inherently very reliable.
  - TG3 like system has a simple output and is easily programmable - an important consideration (PB).