RF Synchronization

General Schedule and Possible Issues
Discussion

Krzysztof Czuba
Warsaw University of Technology
Institute of Electronic Systems

MSK Collaboration Workshop 2015
General layout. Approved in 2014 (CDR, PRR)

- Worked out as a compromise between signal loss, distribution distance and unification of system components for manufacturing
- Biggest Issue: series connection of main (IMx.y) links – single point of failure
- Cabling designed for redundant links but doubling electronics and adding switches would create large complexity and not sure if would warranty better reliability of the system – see last slide.
General To Do List

- Design Interferometer Links
  - General layout
  - Modular hardware (InCon, TapPoint, …)
  - Software
- Design cabling
- Design REFM boxes
- Build prototypes
- Test
- Mass Production
- Installations

Due to late beginning and lack of manpower must be done in parallel risking mistakes and necessity of unplanned iterations
Interferometer Links

> Relatively simple principle. Robust. Proven by Fermilab.

> Very time consuming manual tuning/adjustments

> We have 44 interferometer links with total of 65 tap points
  ▪ Manual adjustments would be a disaster

> Need to implement automatic tuning (previous talk by P. Kownacki)
  ▪ Demonstrated working
  ▪ Complicated hardware and software
  ▪ Fortunately developed scheme with unbreakable operation. Even, if software fails, signal will be there with limited performance!
Interferometer Development and Integration

> Despite of obvious limitations the „mess” shown below gives good results

> Work delayed but this will improve soon

> We expect significant progress after running PCB versions
Interferometer Development and Integration - Status

- TapPoint v1 debugging and tests started (P. Jatczak)
- Board must be proven in June
- TapPoint v2 design in progress (adding one signal branch for interruptible operation) (T. Owczarek)
- TapPoint v2 review and production after proving v1
- InCon v1 produced and tested successfully
- InCon v2 in design (D. Kołcz)
  - correcting bugs and adding automatic adjustment features
  - start of production planned in June, aiming for final version
- Biggest Issue: software development and integration tests
  - Must be done in short time, will be possible with Incon v2 and TapPoint v2
  - Must assemble team for extensive tests in July/August
REFM Boxes

➢ There is 83 boxes to be designed and produced

➢ Fortunately design is modular, all will be done by small modifications after one is designed.

➢ Main issues:
   - Missing final shape of all internal components (fixed recently)
   - Missing mechanical designer. Daniel too busy. There was proposal of Robert Wedel to take care about it, but this is still not clarified
   - Preparing documentation for mass production -> we need to deal with it in parallel with extensive testing and developments (lack of manpower)
   - Mass production (see next slides)
   - Quality assurance, tests…
General Plan

- Interferometer development
  - InConv2 design, production and tests - aim end of July
  - TapPoint v1 tests - end of June
  - TapPoint v2 design, production and tests - July/August
  - Sfotware development and integral tests - June-August

- REFM mechanical design - ASAP but probably until August

- Diagnostics - All time in parallel (see next slide)

- Prototype production - September

- Documentation - All time in parallel

- Mass production - Autumn (see next slide)

- Installations - After production

- Tests (how to verify performance?) - see next slides

Steps critical for further activities. Hard to guarantee time schedule
Open Points 1

➢ Diagnostics
  - General plan exists, but many details to be worked out
  - Still not decided how to finish it. AD plans to leave us in Autumn
  - Automatic adjustment algorithms from Przemek should be integrated with server software. Still not decided on who and how will do it.

➢ Mass production of REFM boxes
  - Need to prepare ASAP (mechanics, documentation, start collecting components)
  - Some
  - Not clear who will manufacture
  - Shall we produce components (InCon, TapPoint, …), assembly by ZE, company?
  - Shall we start ordering long delivery time components (phase shifters, amplifiers, …)?
Open Points 2

> Installations

- Bridging mixed out of order module installation:
- either work out a temporary scheme with amplifiers. Do we have enough of them?
- or rely on temporary reference sources not synchronized to MO? We can easily build cheap (120 EUR) PLL with 1.3 GHz sources. Old student thesis design is ready.

> Commissioning

- A lot of work in the tunnel
- Even though automatic adjustments will save a lot of time
- Link performance verification in the tunnel
  - test against REFM-OPT
  - Use Szymon’s link in parallel? Will it be available end of 2015?
Open Points 3 – Redundancy of Main Links

- Cables are there but limited space for doubling REFM-L1 and L12
- It will probably decrease performance
- No clear benefit of redundancy but risk of not having it
- Last chance to decide is now