FLASH LLRF Injector re-cabling and improvements.

Matthias Hoffmann
FLASH Seminar, 12.10.2010
LLRF Upgrade during Shutdown.

- Upgrade all RF stations to SIMCON DSP
- Installation of new 3.9 GHz hardware
- Unified & upgrade FPGA controller firmware
- New & unified control software (Server, HLA, ...)
- New rack installation & cabling
LLRF Upgrade during Shutdown.

Part 1.
- Upgrade all RF stations to SIMCON DSP
- Unified & upgrade FPGA controller
- New & unified control software (Server, HLA, ...)

Part 2.
- Installation of new 3.9 GHz hardware
- New rack installation & cabling
FLASH Overview.
Old LLRF Injector Racks.
Problems with the old system.

Critical RF cable and connector (e.g. at ACC1)

FLASH Seminar, 21.4.2009
“Beam Stability at FLASH – update”, F. Ludwig
Problems with old System.

- **Amplitude Drift:**

- **Phase Drift:**

FLASH Seminar, 10.11.2009
“LLRF: Long-term stability improvements of ACC1”, F. Ludwig, M. Hoffmann

RF Gun pulse on ACC1
What was the plan.

> Move old LLRF system to racks of the development system

> Redistribution of the LLRF hardware

  - One rack for each system (ACC1, ACC39, RF Gun)
  - One MO signal (1.3GHz and 81 MHz) for each system (incl. decoupling by attenuators)

> Integration of new LLRF hardware for 3.9GHz system

  - 3.9GHz downconverter incl. external power supply.
  - 3.9GHz reference generation and distribution
  - 3.9GHz LO generation and distribution (3.954GHz)
  - Placeholder for drift calibration setup (probe signal of ACC1 and ACC39)

> Installation of new racks with doors and air-condition

  - For new development systems (xTCA)
  - Parallel system for RF Gun, ACC1 and ACC39
What was the plan.
What was done.

- Create system overview and cable lists of old LLRF system
- Remove old LLRF system and racks
- Reorganization of the system distribution within the racks
- Update system overview and cable lists for new LLRF system
- Organize and coordinate companies for cabling work:
  - Fa. ELSPEC for rack cabling
  - Fa. Wille for external cabling

- Optimization
  - Added patch panels within the racks for critical signals (mechanical stability)
  - Upgraded external cabling (½ inch cable)
  - Improved external cabling structure by patch panels
  - Power level adjustment
  - ...
Rack reorganization.

Previous LLRF rack layout

Current LLRF rack layout
<table>
<thead>
<tr>
<th>Cable No.</th>
<th>Cable name</th>
<th>From</th>
<th>Description</th>
<th>To</th>
<th>Cable name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>W1/Probe PPT A1</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 1</td>
<td>LMR400UF</td>
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<tr>
<td>2</td>
<td>W1/Probe PPT A2</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 2</td>
<td>LMR400UF</td>
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<tr>
<td>3</td>
<td>W1/Probe PPT A3</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 3</td>
<td>LMR400UF</td>
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<tr>
<td>4</td>
<td>W1/Probe PPT A4</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 4</td>
<td>LMR400UF</td>
</tr>
<tr>
<td>5</td>
<td>W1/Probe PPT A5</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 5</td>
<td>LMR400UF</td>
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<td>6</td>
<td>W1/Probe PPT A6</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 6</td>
<td>LMR400UF</td>
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<td>W1/Probe PPT A7</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 7</td>
<td>LMR400UF</td>
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<td>W1/Probe PPT A8</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 8</td>
<td>LMR400UF</td>
</tr>
<tr>
<td>9</td>
<td>W1/Probe PPT A9</td>
<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 9</td>
<td>LMR400UF</td>
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<tr>
<td>10</td>
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<td>ACC1</td>
<td>Patch Panel Top</td>
<td>A</td>
<td>1200 MHz Probe signal 10</td>
<td>LMR400UF</td>
</tr>
</tbody>
</table>

9 x DIN A3 pages ~ 200 cables
New LLRF Injector Racks.

ACC1  ACC39  RF Gun

ACC39 patch panel
New racks for Development System
LLRF Upgrade during Shutdown.

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**Part 2.**
- Installation of new 3.9 GHz hardware
- New rack installation & cabling
3.9GHz Hardware Installation.

3.9GHz Generation Box

M. Żukociński, F. Ludwig

LO & CLK Generation Box
3.9GHz Hardware Installation.

3.9GHz Downconverter

J. Piekarski
LLRF Upgrade during Shutdown.

**Measurable Improvements?**

- Upgrade all RF stations to SIMCON DSP
- Installation of new 3.9 GHz hardware
- FPGA controller firmware
- New & unified control software (Server, HLA, ...)
- New rack installation & cabling
RF Gun Crosstalk.

Before

After

FLASH eLogbook
Energy stability.

Before

- FLASH elogbook 22.1.09 18.08h
- ACC1 off-crest
- Typical values of $dE/E = 1.5e^{-4}$

Christopher Gerth, et al.

After

- FLASH elogbook 29.9.10 03.21h
- ACC1, ACC39 on-crest
- Best results: $dE/E = 0.5e^{-4}$
Summary & Outlook.

➢ Cleaned up the LLRF injector racks

➢ System overview and cable lists are available
  ▪ Wall in the injector hut, MSK folder, LLRF elogbook

➢ 3.9 GHz hardware installed succesfully

➢ Common statement from Operators: Machine is more stable

➢ New LLRF racks for development system installed
  ▪ External cabling already prepared
  ▪ Installation of air-condition
  ▪ Installation of new hardware based on xTCA

➢ Before changes in hardware and/or cabling, MSK has to be informed!
Thanks to all people involved

P. Barmuta, Th. Büttner, K. Czuba, M. Grecki, O. Hensler,
D. Kühn, F. Ludwig, B. Sparr, B. Wendland,
H. Weddig, F. Wien, Fa. Wille,
Hr. Dietsche, Hr. Lill, Th. Weber (Fa. ELSPEC)

and

thanks for your attention!