

## Summary of Working Group 3

### 1. Digital vs. Analog

Analog:

- Easier implementation
- Better suited for single input / single output systems
- Easier to de-bug
- Fastest speed

Digital:

- Flexible
- Less drift / noise (greater dynamic range)
- Easier to implement feed-forward
- Future of electronics?

### 2. In-house vs. out-house design for digital control

Outsourcing:

- Quick turn around for "standard" products
- Less expensive for "standard" products

In-house:

- Valuable knowledge base
- Easier to upgrade in future
- Second system will be easier and cheaper than first

### 3. DSP & FPGA/CPLD vs. ASIC's

DSP & FPGA/CPLD:

- No need for large order
- Flexible
- Can re-program to keep current

ASIC's:

- Cheaper for large scale orders
- Faster
- Greater density / more compact

\* Would there be any interest in a joint lab ASIC?

ASIC could be used for digital IQ modulation with feed back and feed forward control. Possibly a DAC or even direct digital IQ modulation.

4. What is the best family set? FPGA/CPLD: Altera / Xilinx / Quick Logic DSP: TI / AD / Motorola

FPGA/CPLD:

- Xilinx – Good tools; more accurate timing
- Altera – Very large and powerful
- Quick Logic – Blazing speed

\* No one has switched systems; what you have is what you use.

DSP: Above statement applies.

5. Reliability / maintainability / operability of LLRF control systems

- Commissioning is where everything starts: all designs become non-ideal once commissioning starts.
  - Keep system flexible for commissioning
  - Build in self-test / self calibration
  - Bring signals out for test
- Very few labs (~1) have ever upgraded an RF control system, a long and painful process.

6,7,8 Automated operation of large scale RF systems. Integration with other sub-systems. Global vs. Local controls.

- Work with global controls people (EPICS for example) from the design stage.
- Expect to use control system in stand alone / manual mode when commissioning.
- Control system should be able to function without global controls for long periods of time. Fast-protect must function without global controls.
  - Control system will come down if network must re-boot.
  - Dump data to global controls in case of fault.

9. Calibration of RF systems. Parameters and commissioning issues.

- Commissioning is easier when the system has a lot of flexibility
- Self calibration of RF control system is desirable. Can use RF control system as network analyzer in open loop with feed forward as stimulus
- Put spare ADC's on board to provide for extra signal inputs when commissioning.