WHAT HURDLES DO YOU NEED TO JUMP TO USE AN FPGA IN HEP

ANDY ROSE, IMPERIAL COLLEGE LONDON

IN THE BEGINNING…

- … the FPGA was empty and without form

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- Access from the outside world for
  - Configuration
  - Monitoring
  - DAQ

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- Access to elements within the chip for
  - Configuration
  - Monitoring

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- Synchronization to your experiment
  - Clocking
  - Triggering

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- The ability to test your algorithm
  - On the PC
  - In the chip

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- The ability to test your communications between chips
  - Standalone
  - Error-checking in-situ
    - That means external link protocols

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- Validation of what firmware is running in your system
  - Chain-of-custody over your data

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- The ability to develop firmware within a collaboration
  - Needs tools for collaborative development

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- A whole bunch of components around the FPGA
  - Some of which will need configuring
  - Some of which will need monitoring

BUT TO USE AN FPGA FOR SCIENTIFIC APPLICATIONS, YOU NEED:

- Flexibility to port between devices for future upgrades and improvements to your experiment

NONE OF THIS COMES INCLUDED WITH YOUR DEVICE

OBSERVATION

- It is easy to “bodge” a solution to any one of these problems
- It is a lot of work to validate and maintain such a solution

OBSERVATION

- It is easy to “bodge” a solution to any one of these problems
- It is a lot of work to validate and maintain such a solution
- It is exponentially harder to validate and maintain such a solution to each problem

DO WE DESPAIR NOW?

- No!

DO WE DESPAIR NOW?

- No!
- UK-CMS has tried to come up with coherent, rigorous, generic solutions to all the above challenges
  - UK-CMS was first at CMS to create generic FPGA-hardware
  - UK-CMS was first at CMS to promote common approaches across all FPGAs
  - UK-CMS was first at CMS to push for porting software-like best-practices to firmware

External access

Internal access

Synchronization

Algorithm testing capability

System testing capability

Firmware validation

Collaborative development tools

External component management

Cross-device portability