

# Is WorldFIP a reliable rad-hard fieldbus for the long term?

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## Short answer

YES

## Short answer

BUT...

# Outline

- 1 Background
- 2 WorldFIP insourcing
- 3 Latest News

# Introduction to WorldFIP

## General features

- 5V differential signaling.
- Twisted pair multi-drop.
- Up to 2.5 Mb/s.

## Why it was chosen for LHC

- Fully deterministic. Master grants media access to slaves.
- Radiation-tolerant slave chipset.
  - At least this was the case for the old generation MicroFIP.
  - A feature size change in the latest MicroFIPs has driven rad-tolerance down.

# WorldFIP usage in the LHC

- Over 450 km of cables.
- More than 12000 nodes.
- Used in many critical LHC subsystems: Cryo, QPS, power converters, BI, RF, RadMon...

## Organization so far

### End users

Equipment groups design solutions based on Alstom technology.

### Local support

BE-CO-FE has a coordinating role:

- Procurement.
- Cabling coordination and commissioning.
- General know-how.

### Technology provider

Alstom is the supplier of technology: chipsets and cards.

## What changed

- Alstom decided to gradually stop support of WorldFIP technology.
- Preliminary tests showed new generation of MicroFIP chips is much less tolerant to radiation.
- CERN decided to buy the designs from Alstom and start an insourcing effort:
  - Short term goal: provide a rad-tol replacement for the MicroFIP.
  - Long term goal: have BE-CO-HT replace Alstom as a provider of technology.



# The NanoFIP Project

<http://www.ohwr.org/twiki/bin/view/OHR/CernFIP/CernFIP>

- A rad-hard alternative to MicroFIP in FPGA technology.
- Collaborative effort driven by BE-CO, with the participation of EN-STI, TE-CRG, TE-EPC and TE-MPE.
- Main deliverable can be used in two ways:
  - A Wishbone-compliant soft core to include in the client's global FPGA-based application.
  - The core instantiated on its own in a radiation-tested flash-based Actel FPGA.

## NanoFIP Project Status 1/2

- WP1. Alstom MicroFIP preliminary VHDL code interpretation. ✓
- WP2. Write project management doc for insourcing of MicroFIP. ✓
- WP3. Write functional specification of MicroFIP replacement. ✓
- WP4. Rewrite and extend Alstom MicroFIP VHDL code. *WP1 concluded that new VHDL code (WP5) was needed.* ✓

## NanoFIP Project Status 2/2

- WP5. Write new NanoFIP VHDL code.
  - Without triplication, mostly done: scheduled for end of February.
  - Will try automatic triplication in Synplify. If not OK, will triplicate by hand.
- WP6. VHDL Testbench creation and simulation of NanoFIP. Very basic so far. **Need help from users.**
- WP7. Stand-alone mode test board design and test. Combined with WP8 (see below).
- WP8. Design board for functional and radiation test. Outsourced to HLP Technologies. Specs done. Boards expected in June.
- WP9. Radiation tests. Not planned yet.

# Radiation Tests

See D. Kramer's talk for details.

Very difficult to do an apples-to-apples comparison, but. . .

## Old MicroFIP

MTBF of >18 days for nominal beam using Cryo gear.

## New MicroFIP

MTBF of around 1h with nominal beam as observed in the tests with nQPS cards.

## Cu/Cu repeaters

- Lifetime of around 16 years, only two units tested.
- These contain only a FieldDrive and an FPGA. Proves problem is with MicroFIP.

## MicroFIP3

A potential collaboration with PH-ESE on a new ASIC for MicroFIP drop-in replacement.

### Pros

- Many cards would not need a redesign.
- Software can also be completely re-used.
- Extreme radiation tolerance possible.

### Cons

- High upfront cost.
- Less flexible than NanoFIP.
- High validation effort required.
- Many unknowns for the time being. Risk of not being ready for 2011 is higher than for NanoFIP.

# Proposal for 2010-2011

We propose to pursue both paths:

## NanoFIP: target startup 2011

- Low-risk development.
- Allows integration into larger designs.
- Useful on its own for many clients. Backup solution for MicroFIP3 clients.

## MicroFIP3: target startup 2012

- Can save lots of redesign work.
- Can achieve higher levels of rad-tolerance.
- BUT: responsibilities to be clarified between PH and BE from day 1.

# Summary

- Key technology for LHC. Problems with radiation confirmed  
→ [insourcing decision was right](#).
- NanoFIP project delayed due to LHC startup pressure (other FIP users could not provide help). Will get [more priority in 2010](#) (new post in BE-CO-HT, more help from TE-CRG...).
- Strategic decision to be taken on MicroFIP3.
  - Needs strong collaboration with PH-ESE.
  - And [clarification of responsibilities](#).