# Asynchronous Reconfigurable Computing

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# Introduction

Run-time reconfiguration is a promising paradigm.

But, there are problems:

- Difficult design.
- Lack of tools.
- Traditional development methods poor.

# Desirable Features

- Ease of design.

- Suitable Architectures — Faster reconfiguration and full support for partial reconfiguration.

- Applications — To demonstrate the usefulness of RTR and encourage commercial exploitation.

# Asynchrony

Advantages of asynchrony for RTR:

- Sub-circuits can be easily connected to each other.
- Circuits can be split across several FPGAs.
- Shape of a circuit can be quickly changed.

# Conventional FPGAs

Conventional FPGAs have many problems which make implementation of asynchronous circuits difficult:

- Hazards — Extraneous signals can be generated.
- Signal ordering — Routing architectures can cause signals to be reordered.
- Analogue Components — Implementing synchronisers and arbiters is not possible using solely digital circuitry.

Therefore asynchronous FPGA architectures are required.

# Asynchronous FPGAs

Montage:

- Development of the Triptych synchronous architecture.
- Supports both synchronous and self-timed designs.
- Two types of functional unit — routing and logic block and arbiter unit.
- Unused routing and logics blocks are used to satisfy local timing constraints.

PGA-STC:

- Two-phase signalling.
- Bundled data protocol.
- Self-timed designs only.
- Uses a programmable delay element to satisfy local timing constraints.

# STACC

- Developed by Rob Payne at Edinburgh.
- Based on the Xilinx XC6200 series of FPGAs.
- Designed for the implementation of self-timed reconfigurable systems.

The clock is replaced by an array of timing cells giving several advantages:

- Functional units are unchanged — design tools for synchronous architecture can be used.
- Self-timing control logic is separated — the timing cells can be optimised for this specific task.
- Architecture is not limited to an FPGA.

# Current Research

Building on Rob Payne's work at Edinburgh.

- Architectures.
- High-level representation.
- Operating System.
- Design tools.
- Applications.