
High-Level System Design Using Foresight

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Outline

- ▶ Development Process
- ▶ HW/SW Co-Design
- ▶ Foresight: a Modelling and Simulation tool
- ▶ ALICE DAQ System

Development Process (1)

■ Separate Functionality from Architecture

- Design system functionality before thinking at hardware/software implementation details

■ Formal Specification and Verification

- Mathematical definition of system (unambiguous)
- Semantics of specification provides a model
- Behaviour of model = behaviour of system
- Verification: model behaves correctly (simulation, model checking)

Development Process (2)

■ First Phase: Functional Requirements

- **Abstract specification:** interfaces, functionality
- **Verification:** incomplete/inconsistent functional requirements, performance problems, design errors
- **Analysis:** critical parameters, maximum (minimum) performances, particular conditions

■ Second Phase: Architectural Concerns

- **Detailed specifications:** algorithms, hardware choices, alternative architectures
- **Verification, analysis:** check requirements and performances

HW/SW Co-design

◆ Foresight Systems, Inc.

◆ System Design

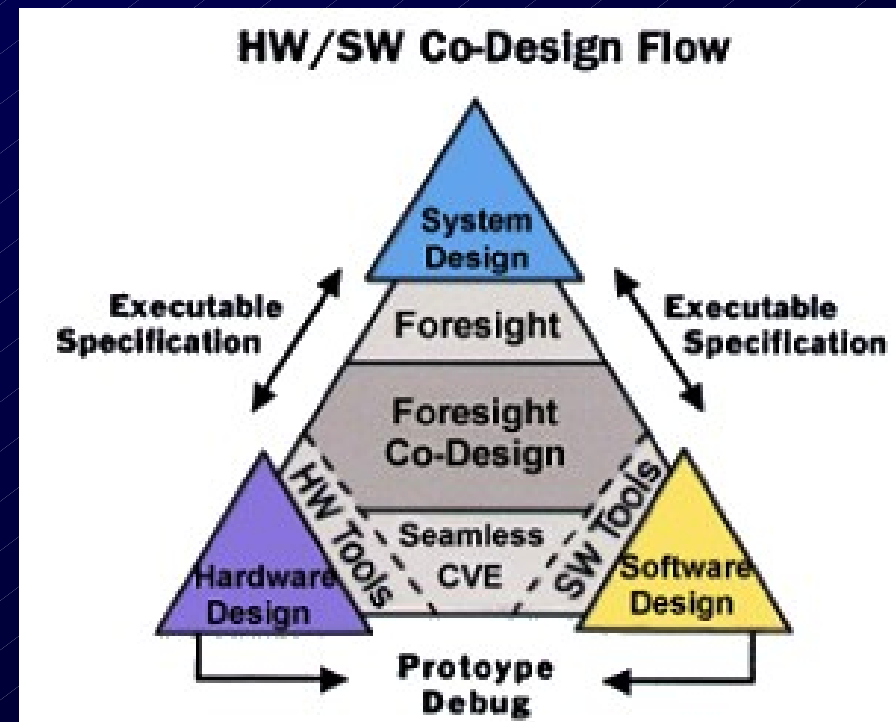
- Foresight tool
- Specification Execution

◆ System Co-design

- Foresight co-design tool
- Foresight specification with hw/sw components
- Specification Execution

◆ HW/SW Components

- HDL simulation environment
- Seamless CVE



Foresight (1)

▶ Foresight Tool

- System Level Modeling and Simulation Tool

▶ Specification

- Hierarchical Specifications
- Data Flow Diagrams (event-driven processes, events, control)
- State Transitions
- Mini-specs
- Real-time parameters

Foresight (2)

▶ Analysis

- Type checking, input/output checking, syntax errors

▶ Execution of Specification (Simulation)

- Real-time execution of specification
- Stand-alone executable specification
- Animation of Diagrams
- Real-time constraint validation
- Debugging functions (breakpoints, monitors windows)
- Simulation is NOT formal verification !
- Works on Sun workstation

ALICE DAQ

► Model of whole ALICE DAQ System

- Trigger System (L0, L1, L2)
- Trigger and Tracking Detectors
- DAQ (with sub-event building, event building, storage)
- Parameters (buffer sizes, etc.)

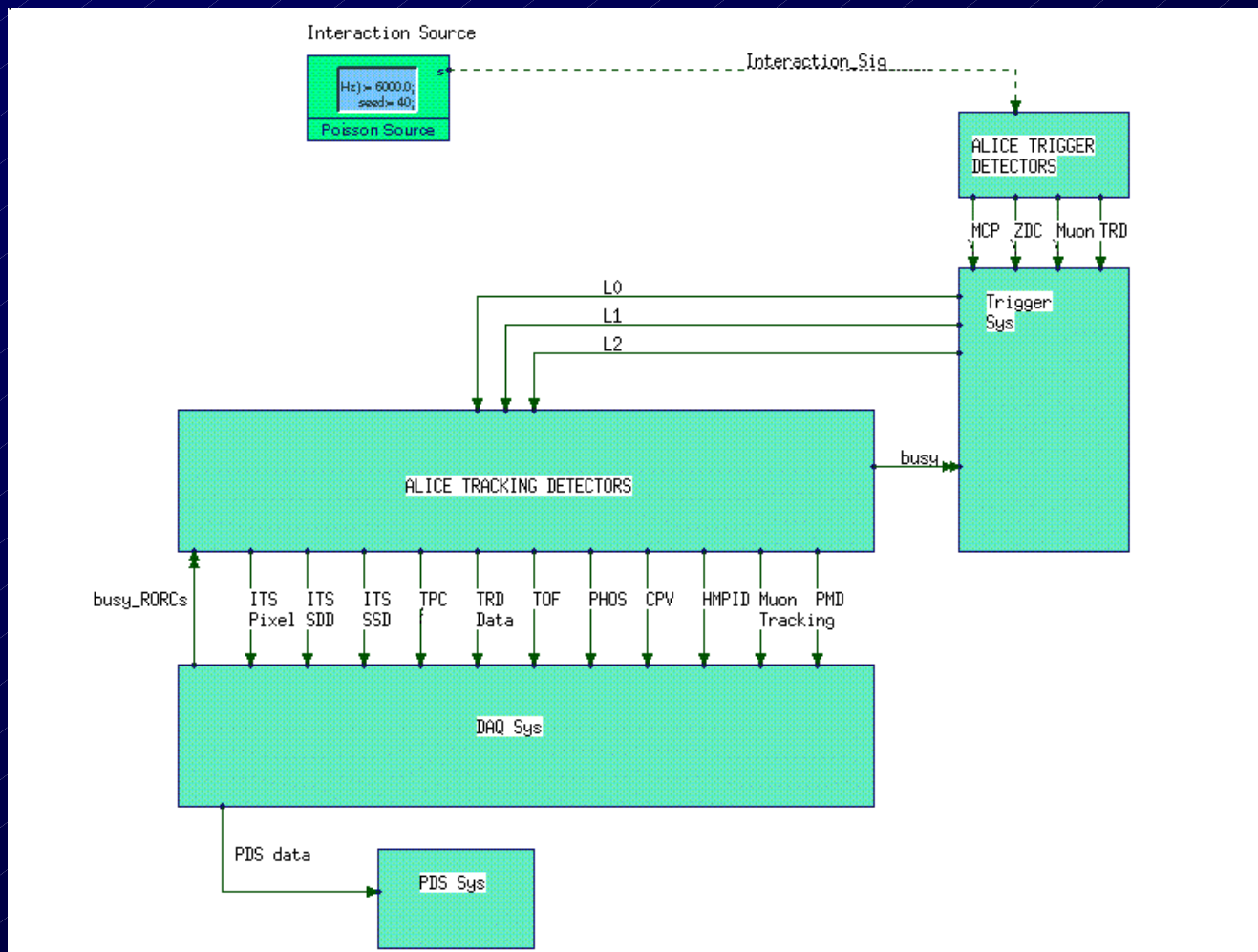
► Evaluation of Performances

- Whole system: maximal bandwidth / real bandwidth
- For each detector: buffer occupancy, bandwidth usage

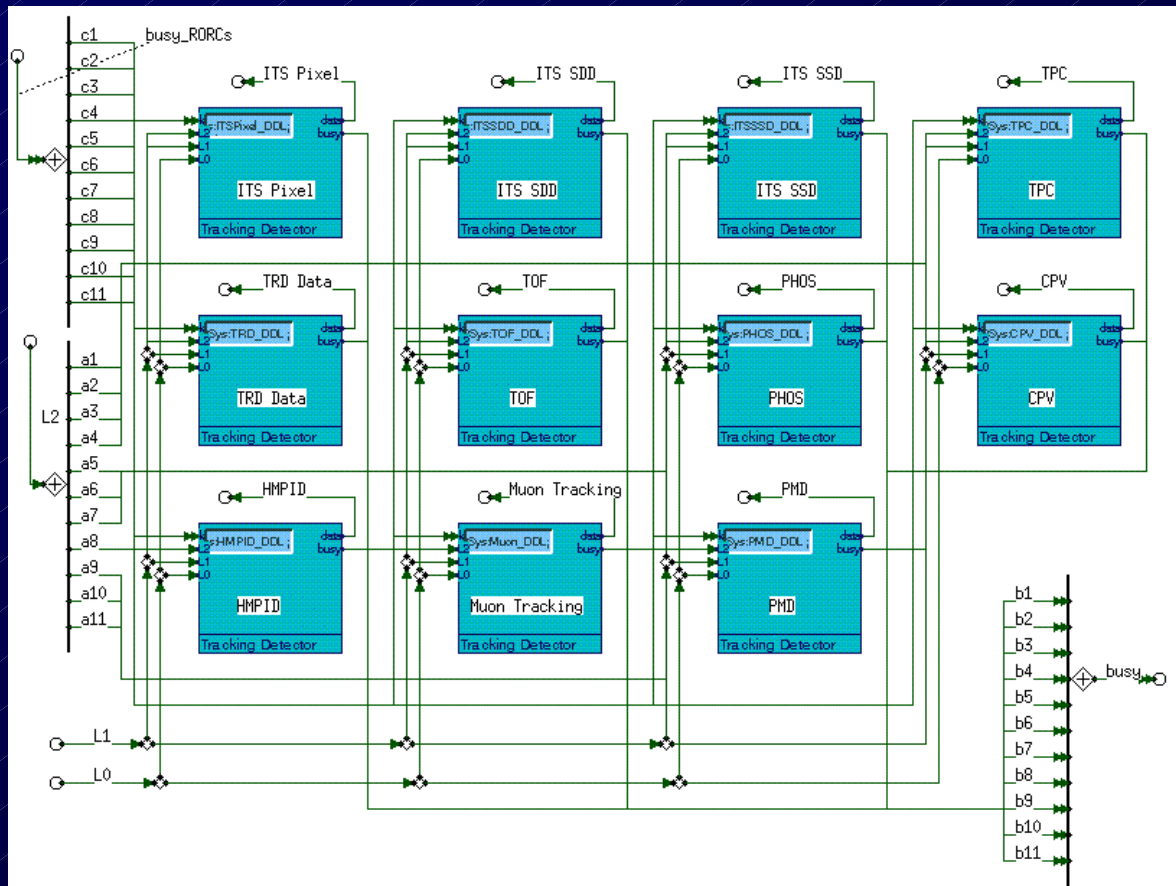
► Alternative Algorithms

- Event building computing
- L2 trigger decision

ALICE: Overall System



ALICE: Tracking Detectors



Results

Maximal Bandwidth

	L0	L1	L2
Central	137	133	92
Dimuon	462	457	585
Dielectron	159	152	197
Minbias	747	714	409
Misc	203	197	
Interaction	1997		

After 1 sec (6038 ev)
Expected at L2:

	Buffer Full	Bandwidth	Maximum
TPC	23%	14200 MB/s	18000Mb/s
TRD	43%	1627 MB/s	1800MB/s

	C	MB	DM	DIEL	Total
L2	20 Hz	20 Hz	650 Hz	200 Hz	890 Hz

Conclusion

- ▶ Separate Functionality from Architecture
- ▶ Foresight Systems provides integrated tools
 - Formal Specification and Execution
 - Seamless replacement of formal components by hardware/software components
 - <http://www.nuthena.com/>
- ▶ Advantage
 - Correct errors before implementation
 - Think about the functional level (correct interfaces)