ECEN 5053-002

Developing the Industrial Internet of Things

Week 12 - Lecture

Introduction to SystemC

Dave Sluiter - Spring 2018

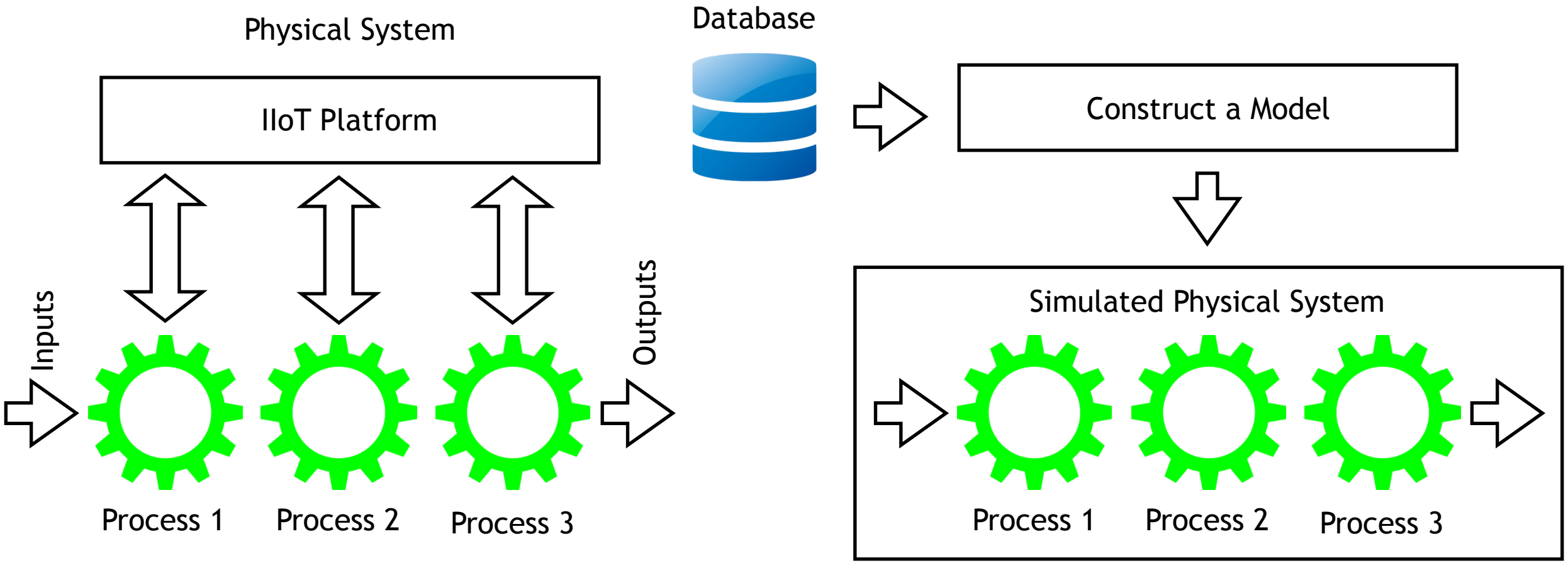
Material

- SystemC

Learning Outcomes

- Gain an understanding of the types of models that can be created with SystemC
- How we can apply SystemC to model physical systems

Example Physical System



SystemC

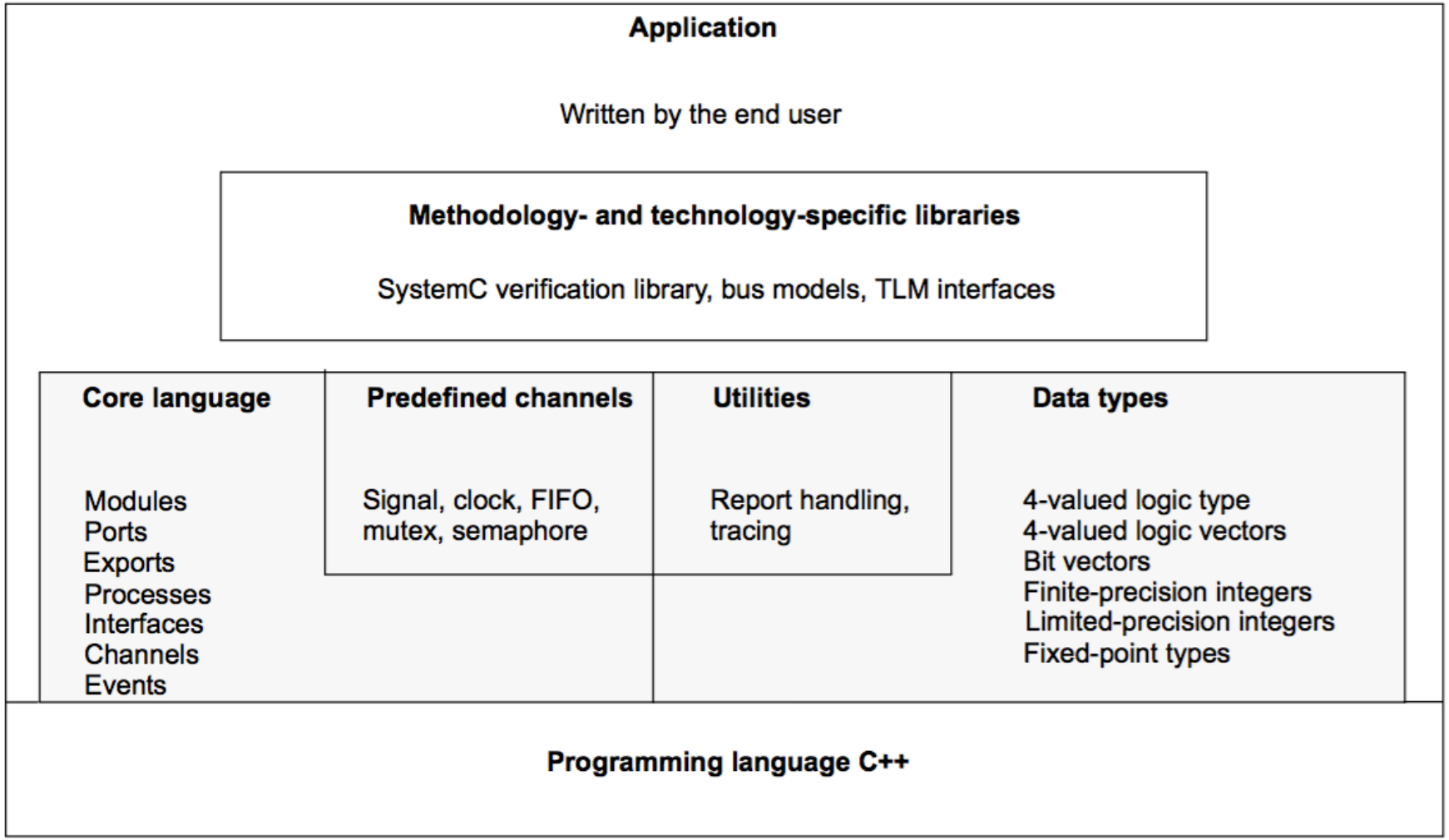
- It's a free C++ class library that gives C++ the notion of time
- Available for free from: http://accellera.org/downloads/standards/systemc
- See the file in D2L
  - SystemCinstallationWindows.pdf for instructions on downloading and installing for Windows and Microsoft Visual Studio
- A better choice may be Oracle Vbox and Ubuntu

Vbox download: http://www.oracle.com/technetwork/server-storage/virtualbox/downloads/index.html

SystemC Documentation

- Uses Doxygen (http://www.stack.nl/~dimitri/doxygen/)
- Creates HTML files
- See also: Annex A in the IEEE SystemC 1666-2011.pdf file
  - Introduction to SystemC
- See also Open SystemC Initiative (OSCI): https://sourceforge.net/projects/systemc/

From Annex A


Application
Written by the end user
Methodology- and technology-specific libraries
SystemC verification library, bus models, TLM interfaces
Core language
Modules
Ports
Exports
Processes
Interfaces
Channels
Events
Predefined channels
Signal, clock, FIFO, mutex, semaphore
Utilities
Report handling, tracing
Data types
4-valued logic type
4-valued logic vectors
Bit vectors
Finite-precision integers
Limited-precision integers
Fixed-point types
Programming language C++

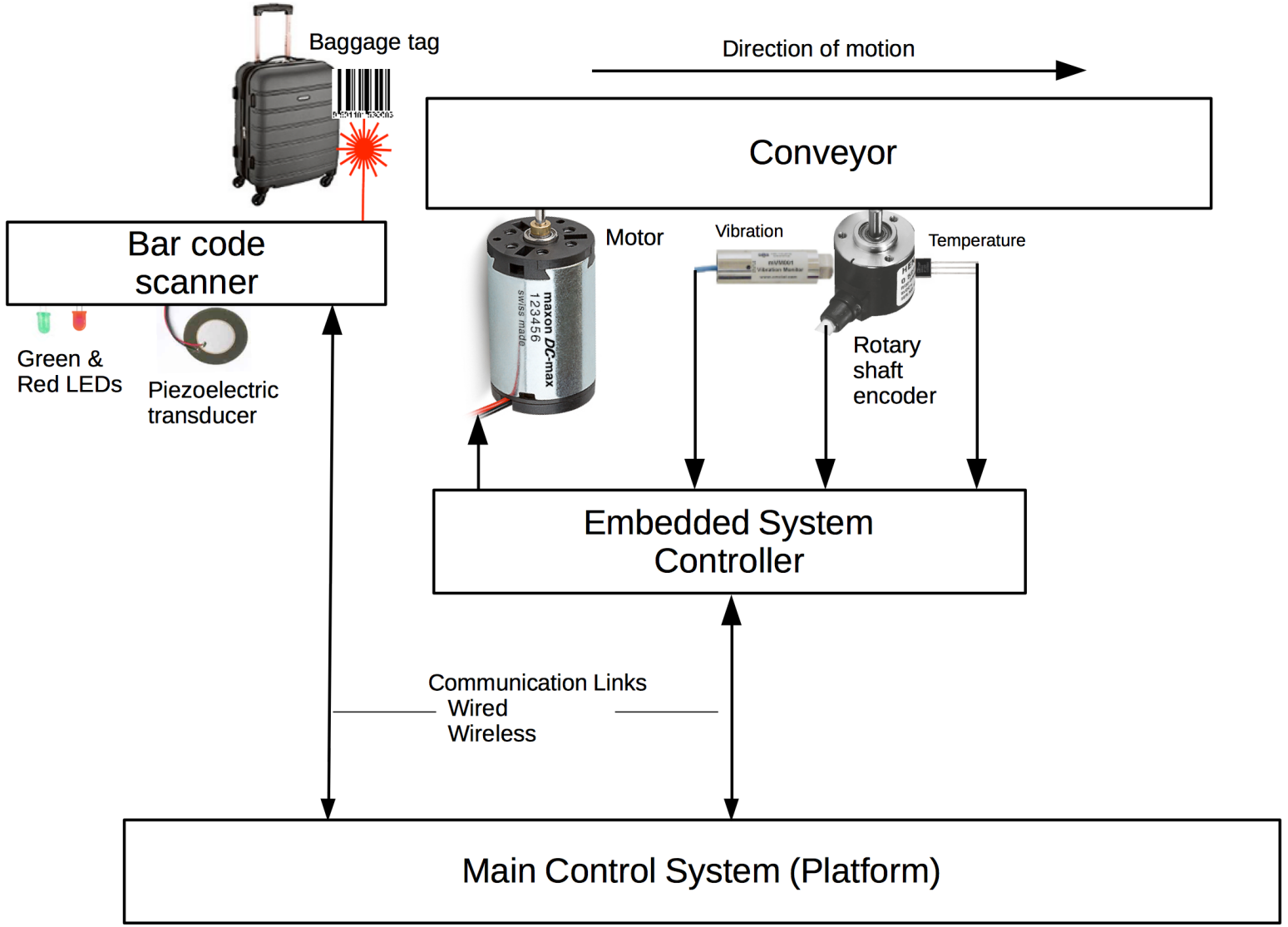
Classes provide:

- Hierarchy of modules
- Structural connectivity between modules
- Scheduling and synchronization
- The passing of time
- Separation of computation and communication
- Hardware oriented data types for modeling hardware

Levels of Abstraction

- RTL-like
  - Notion of a clock signal
- Processes
  - no clock, but notion of time passage
- TLM (Transaction Level Modeling)
  - Approximately timed
  - High-level system abstractions

Example System



What is a rotary shaft encoder?

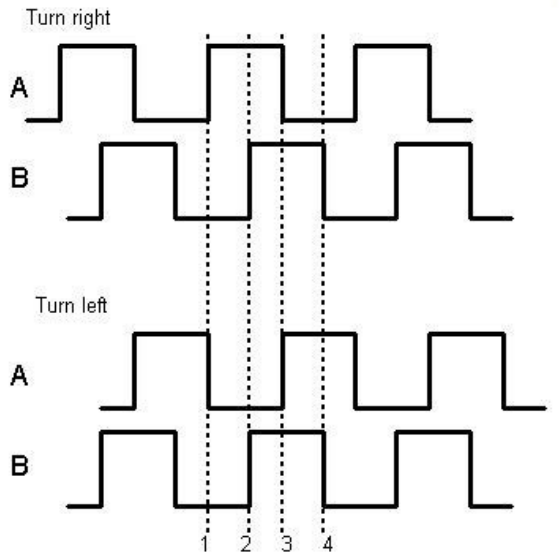
Encoder

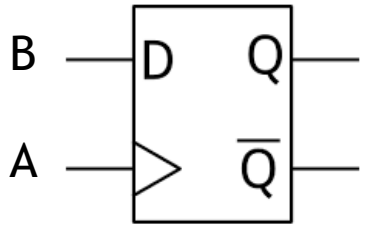
Example of a rack and pinion gear set

Source: https://www.indiamart.com/proddetail/rack-and-pinion-gear-set-18174553830.html
http://www.rotaryencoder-yumo.com/products/isc25-series-solid-shaft-incremental-rotary-encoder-ID84.html

What is a rotary shaft encoder?

- Outputs a pulse train as the shaft rotates
  - Distance can be measured by counting pulses
- Output is referred to as a **quadrature output** (quadrature signal pair)
  - Phase tells you which direction shaft is rotating





Source: http://www.learningaboutelectronics.com/Articles/D-flip-flop-circuit-with-NAND-gates.php

Brief Diversion Down Memory Lane

- In my last year of college (1983) I had a co-op job at Challenge Machinery
- I used a rotary shaft encoder on a computerized guillotine paper cutter to measure the **backgauge** position
  - The backgauge is the device that pushes paper into position
  - It was the first paper cutter with a video display
- https://www.youtube.com/watch?v=lfTgUxvfkNw

Paper Cutter Video

There I am

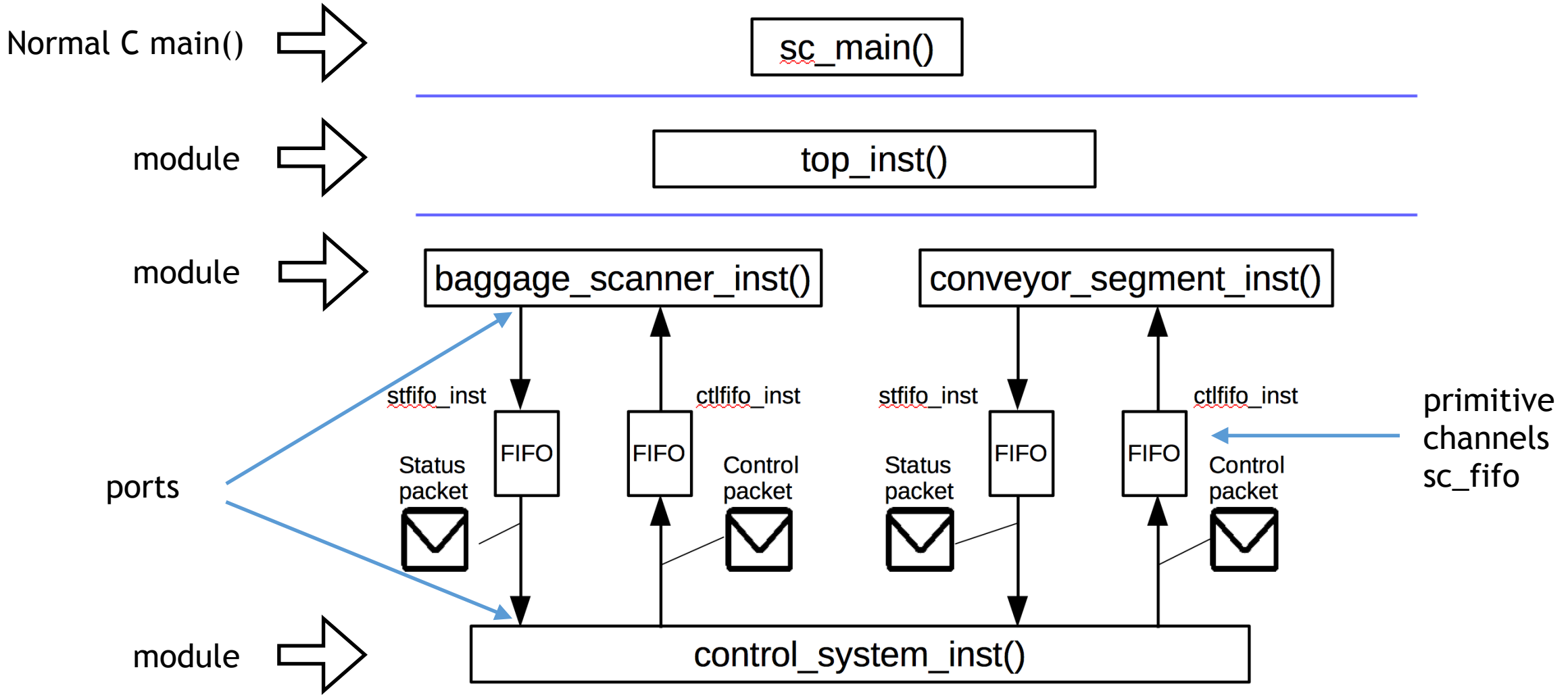
August 1983

Back to the Material

A Look at Some Examples

- Included examples:
  - Pipe example, clock (very RTL like)
  - Process example: simple_fifo, no time
  - Process example: simple_perf, time
- Process example: My baggage_system, time

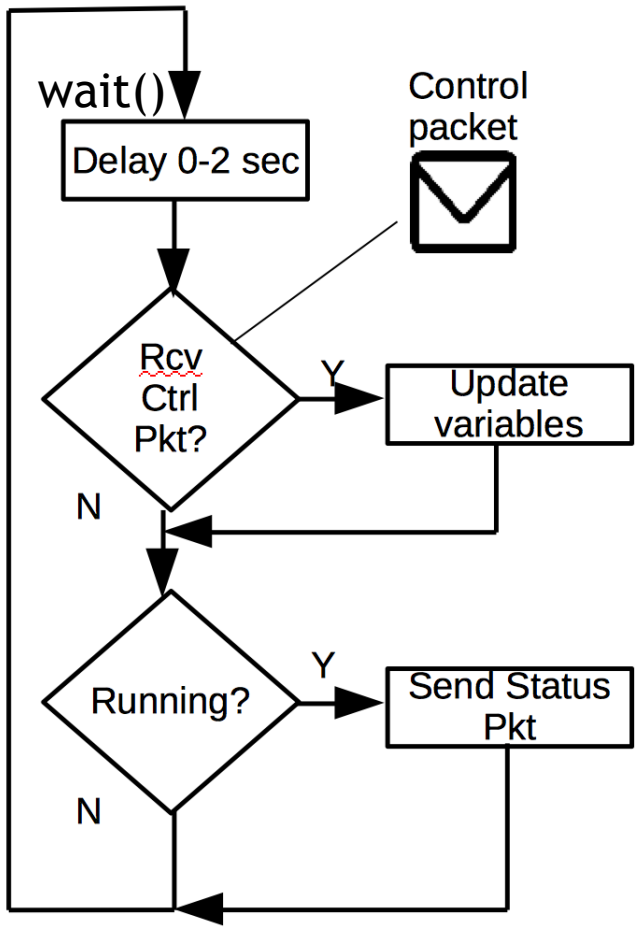
Model Hierarchy



Design Structure

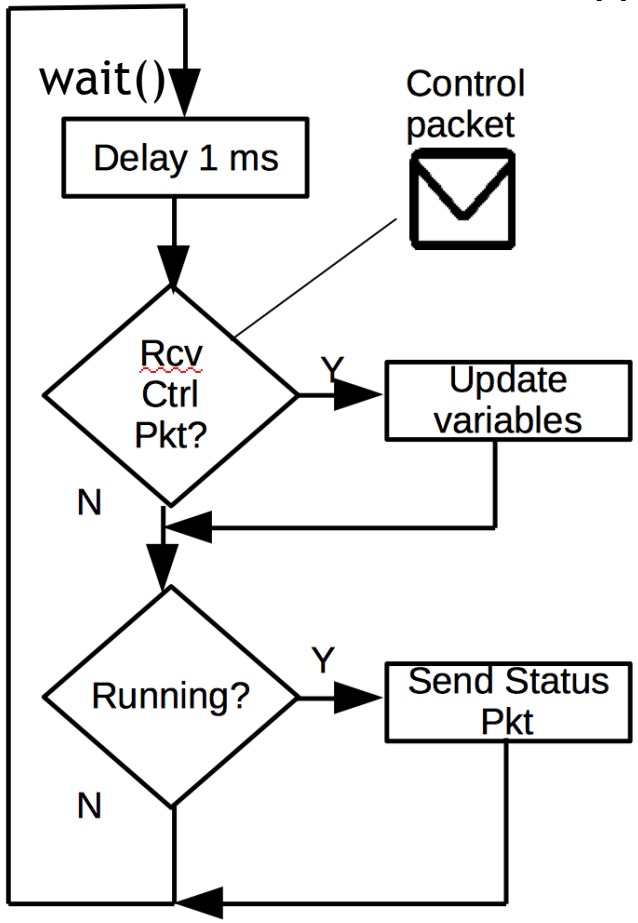
Module
baggage_inst ()

Process:



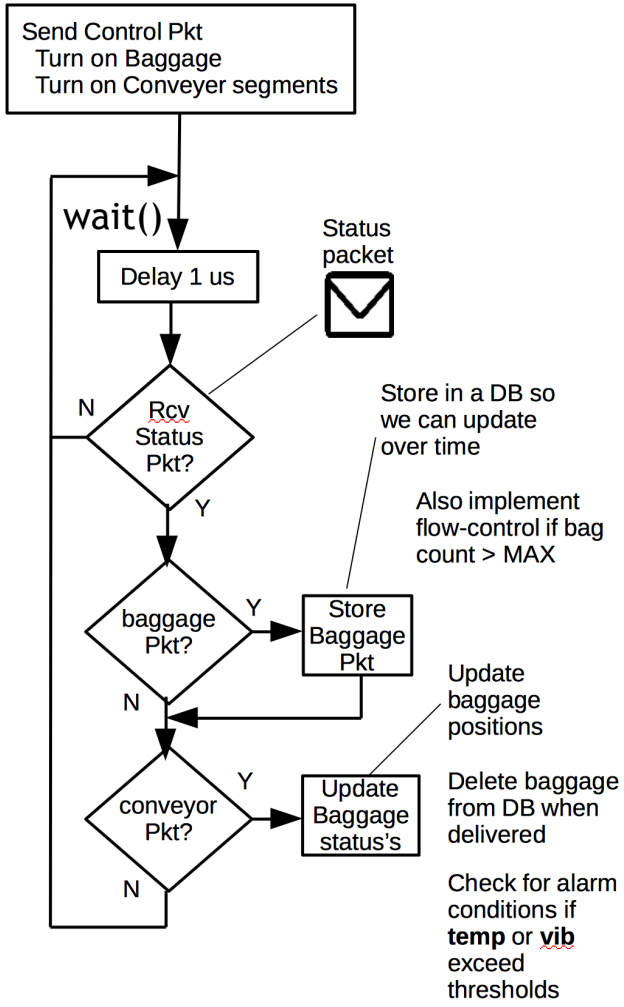
Module
conveyor_inst ()

Process:



Module
control_system_inst ()

Process:



End