Building an Application with EMF Models

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The Problem...

- Build an application to support operation of a manufacturing device
  - Control pressure, temperature, position, time
  - Execute a not-yet-finalized process
  - Monitor and control variables to be defined
- Use PLC, GPIB, Serial, USB interfaces
- Timing of sequences is critical
  - Target a 10 ms cycle time

Why use EMF?

- Take advantage of the EMF class libraries
  - XMI-based persistence of models is a key feature
- Generated code -> rapid iterative prototypes
  - This leaves room to experiment until model is right
- Low barrier to entry (e.g. Library model)
- Plenty of room for enhancements
  - Query, Validation, Transactions; OCL; GMF

Where to start...

- 5 Models, each for an aspect of the system
  - Develop each model in isolation (minimize coupling)
- Facility – machine, sensors, actuators, material
- Recipe – input variables for the process
- Process – sequences of steps to follow
- Operations – results of sequences and process
- Visualization – realtime display and controls

Complications...

- Late/unfinished definition of process
  - Resulted in a more abstract design (a good thing)
- Short development cycles
  - 1-2 weeks apart (focus on most-needed features)
- Frequent change of focus
  - Client requires new feature to meet this week's goal
- Geography
  - Client is remote, machines firewalled

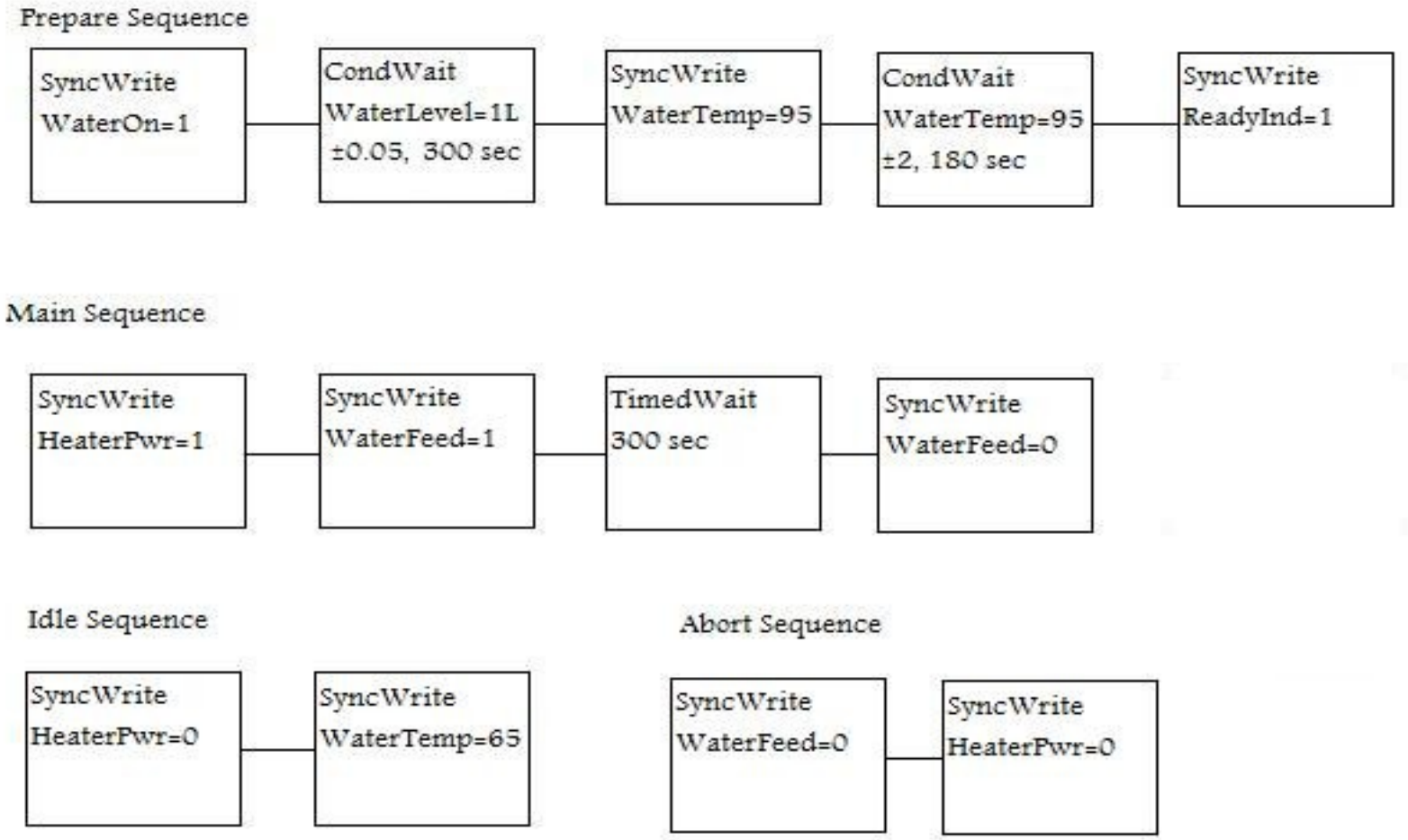
What about EMF?

- EMF allows rapid development of the models
  - Generated code allows experimentation
  - Able to simulate operation and refine quickly
- EMF facilitates a declarative process model
  - Sequences of primitive steps to define a process
  - XMI model persistence allows customer to redefine processes on-site with text editor
  - Many new requirements met with existing primitives
  - More complicated requirements – new primitives

Some Primitive Steps

- Simple Steps
  - Synchronous Read/Write - of one or more variables
  - Timed Wait - for known period
  - Event Wait - for external signal
- Complex Steps
  - Condition Wait – until variable enters range
  - Retry - repeat portion of sequence if condition fails
  - Computed Wait – for calculation using variables

Example Sequences



A Runtime for Realtime Execution

- Execute a series of sequences
  - Each sequence consists of a set of primitive steps
  - Start time of each step is carefully controlled
  - Java 5 Concurrency constructs for threading
- Simple data binding model
  - Links control variables in recipe to step variables
- Monitor threads for sampling of variables values
  - Compute statistics, drive realtime graphical displays

The Real Benefit of EMF

- Use GMF to define a Graphical Editor
  - Sequence diagrams
  - Visualization layout
- Use OCL to specify Model Constraints
  - Validate recipes and sequences before a run fails
- Query, Validation, Transactions for Editing
  - Update all recipe values matching criteria
- Teneo for Model Persistence

A Minor Problem

- Collision of differing objects with same id field
  - Monitor (samples variables periodically)
  - Target (Siemens or GE PLC)
  - Both used integer id field with value of 1
  - Resulted in ClassCastException when one was substituted for the other
- One solution was to use GUIDs (ugly)
- Refactored to use names instead of ints
  - Enforced a naming convention to prevent collision

Future Direction

- Enhance code for Realtime Process Control
  - Support a wider variety of process types
  - Support parallel sequences (fork/join)
- Flesh out Hardware Interfaces
  - OSGi Declarative Services
  - Wider variety of interface types
- Additional models
  - Templates, Expressions, and Events
- Expand usage into Realtime simulations

Questions?

Thanks for your time!