Collaborative Project: PackML State Machine for ROS-I

Consortium Participants/Collaborators: 3M, ARTC, SwRI, PlusOne Robotics

While ROS-Industrial is a foundational technology abstracting robot applications for industry, it is typically deployed on PC hardware (generally Linux based), which makes complete sense to the roboticist. To the manufacturing plant, however, the automation systems tend toward Programmable Logic Controller (PLC) hardware. Rockwell, Siemens, Mitsubishi and many other industrial vendors supply PLCs to factories all over the world. One challenge with PLC automation is developing complex manufacturing solutions that integrate hardware from multiple vendors.

Bringing together hardware from multiple vendors using a combination of new and legacy technologies (heterogeneous machines) with a standard control paradigm would simplify the problem. Fortunately, the ISA-88 standard includes a subset called PackML, which provides PLC programmers with a state machine (see figure below) and messaging protocol that allows disparate machines to work together. As more and more robots are integrated into manufacturing environments, it makes sense to extend the PackML standard into the ROS-I world.

ROS-I and PackML are a natural fit for each other. Both create a new way to solve old problems. Analogous to the way that ROS standardizes messaging, PackML has standard state definitions and standard messages to pass information about state transitions. Integration of robots into complex manufacturing environments will be made simpler with the new ROS-I/PackML library.

Project objectives:

- Prototype a ROS-I PackML state machine using an existing state machine library to get started.
- Test the prototype against a remote PLC with a standard PackML implementation and note needed improvements.
- Develop an open-source C++ library (think Boost) to implement the PackML state machine abstraction for use in ROS-I.
- Test the new ROS-I PackML library first with the remote PLC used for the prototype phase, and then integrate into existing ROS-I projects.

Design documentation and source code for the PackML project is being collected here: https://github.com/ros-industrial-consortium/bohr_devel

To join future discussions about the PackML project for ROS-I, please email Min Ling Chan, Program Manager for the ROS-I Consortium Asia Pacific with your interest: chanml@artc.a-star.edu.sg.

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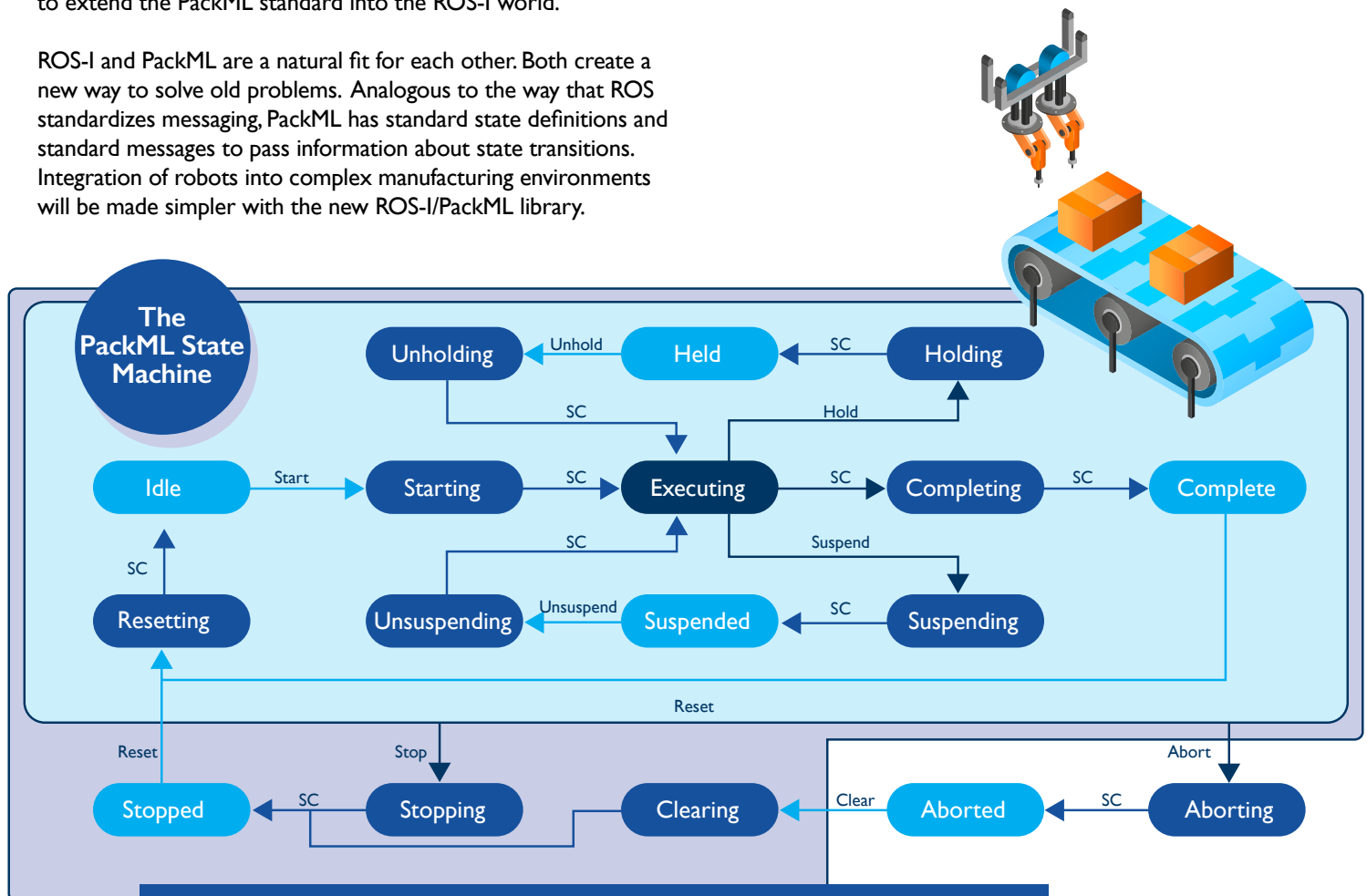
The PackML state machine standard provides a prescriptive set of states, which have predefined meanings that are useful for nearly all automation, despite its packaging automation heritage. To implement unique states for a process, as would be desired for ROS implementations, a subordinate state machine can run, for example, within the "Executing" state.

Image courtesy of SwRI