Visualization of Flight Software Components and Connections

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Project Objective

Component-based frameworks can lower the cost and improve the quality of flight software.

Visualization and graphical editing of components and connections is important for constructing, understanding, and communicating designs.

The objective of this project is to develop a graphical tool for visualizing and editing a model of spacecraft flight software, specified as a set of interconnected reusable components.

FY19 Results

We have developed a graphical tool called the **FPP Visual Editor**. It provides visualization and editing of FPP (F Prime Prime) models. FPP is a text-based domain-specific modeling language for the open-source F Prime flight software framework (https://github.com/nasa/fprime).

Using the FPP Visual Editor, developers can

1. Specify ports, components, and connections both graphically and textually.
2. Use several different views to edit and visualize component connection graphs.
3. Edit the views and save layout information separately from the model information.
4. Run correctness analyses on the model, e.g., to ensure that connected ports have matching types.
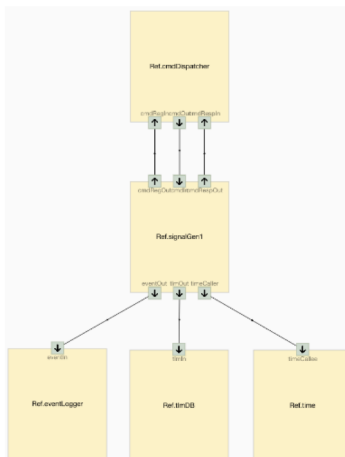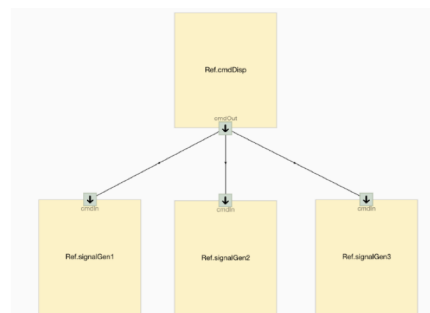5. Generate C++ code.

FPP Tool Chain
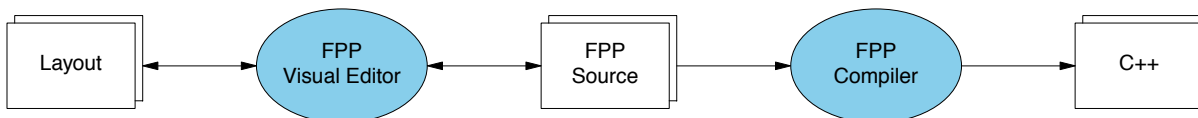
Component View (Command Dispatcher)
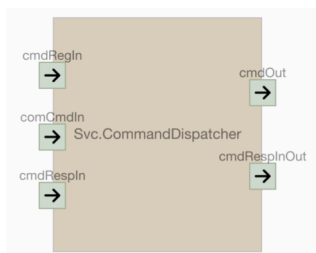
Instance View (signalGen1)

Function View (Commands)

Component Model

```
component CmdDispatcher {

  constant numCmdPorts = 10

  @ Dispatches commands
  output port cmdOut : [numCmdPorts] Fw.Cmd
  …

}
```

Connection Model

```
connections Commands {
  cmdDispatcher.cmdOut -> signalGen1.cmdIn
  …
}
```

Significance of Results

F Prime is an enabling technology for flight software, especially for small, cost-constrained missions where reuse of existing components and tools is critical for success. Several flight missions and research projects have successfully used F Prime.

FPP enhances F Prime by providing modeling and visualization in a way that is intuitive and easy to use.

Next Steps

The current tool chain is a prototype. It demonstrates the potential of FPP, but it lacks several features necessary for production use.

We intend to mature FPP. We will use the lessons learned from this research to revise and enhance the modeling language and the graphical front end.

We intend to release FPP as part of the open-source F Prime framework, so that flight software developers both inside and outside JPL can use it.

Acknowledgements

CMU Student Team (Visualizer): Miaojiang Deng, Qingqing Tong, Changjian Zhang

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