# Real-Time Prototyping in Ptolemy

**Ptolemy Review**
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# *Objectives*

Provide a framework to:

- Specify systems using natural models of computation

- Use hardware within a simulation

- Use the user's computing environment

- Construct heterogeneous multiprocessor real-time prototypes

★ Shorten the design cycle

# *System Simulation*

- Interpreted — blocks compiled into Ptolemy system

- Multiple models of computation — process networks, communicating processes, discrete event, RTL
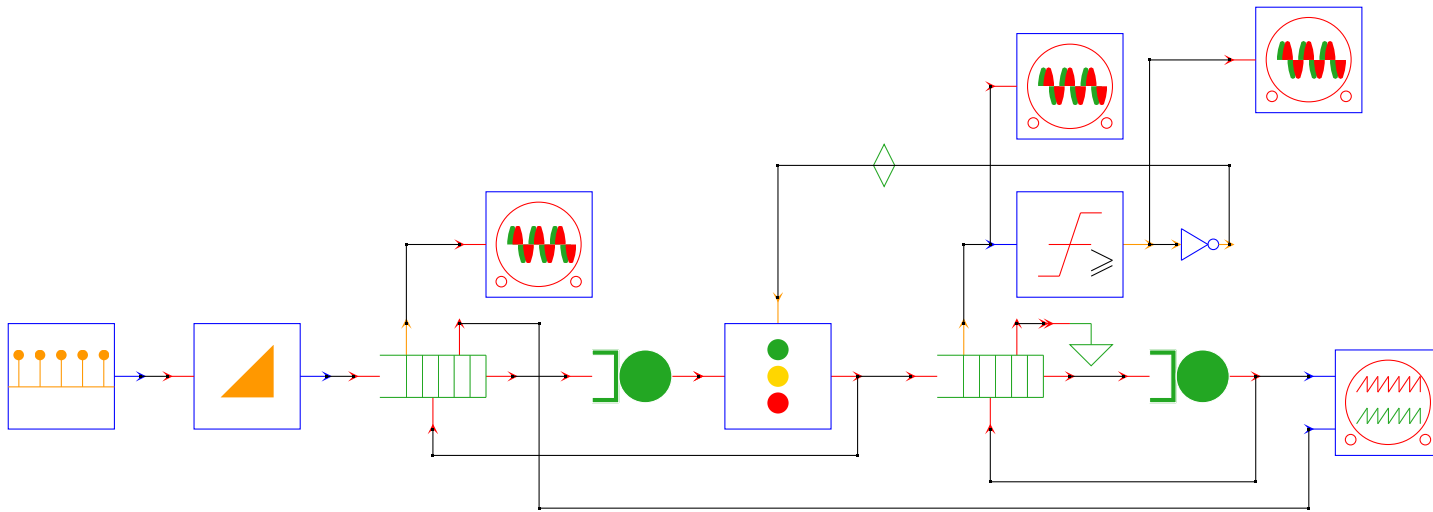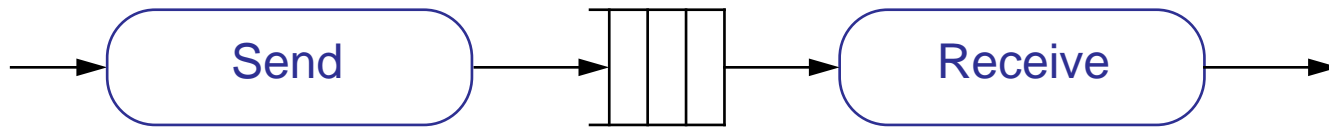
# *Code Synthesis*

- Compile-time scheduling

- SDF & BDF models supported with extensions that allow for nondeterminate communication

- Object-oriented target specification

CGC-S56X

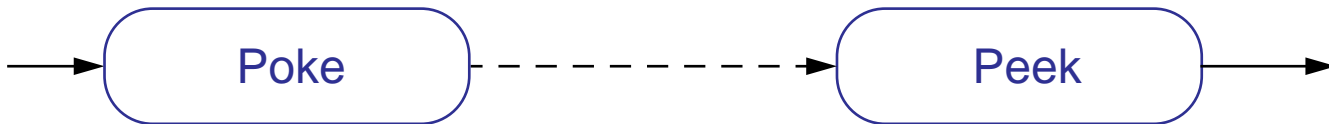| Sparc C & Tcl/Tk | M56K Assembly |

# *Communication Actors*

- Send/Receive
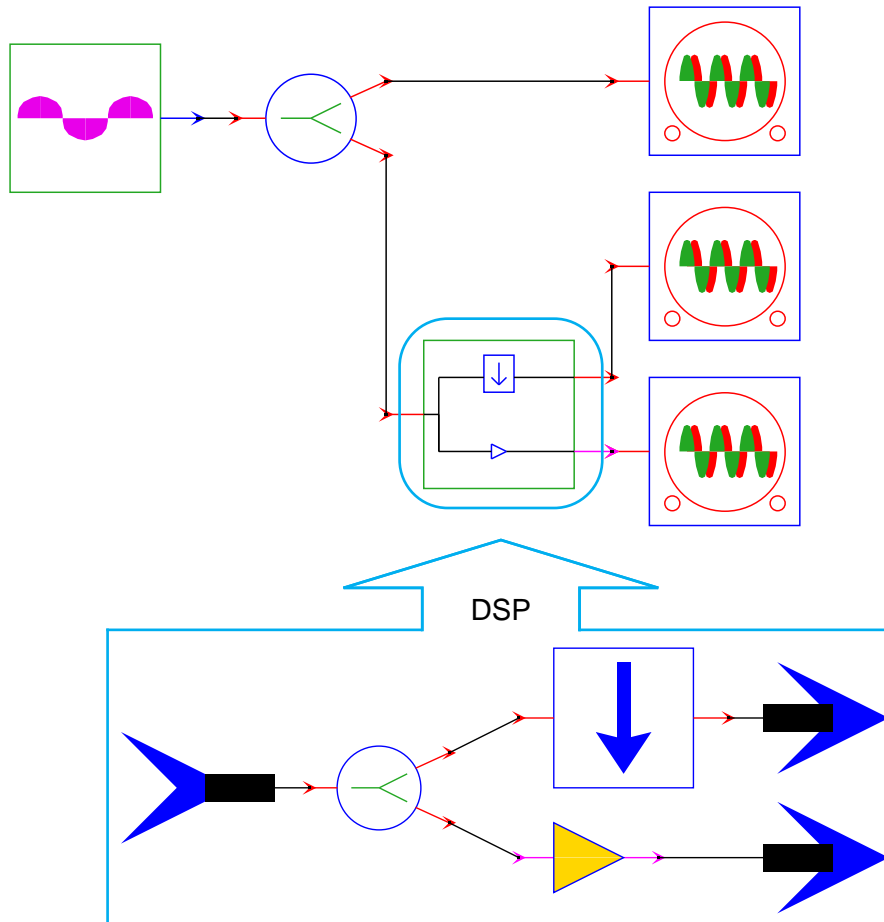  Multiprocessor self-timed SDF graphs



- Peek/Poke — Asynchronous & nondeterminate
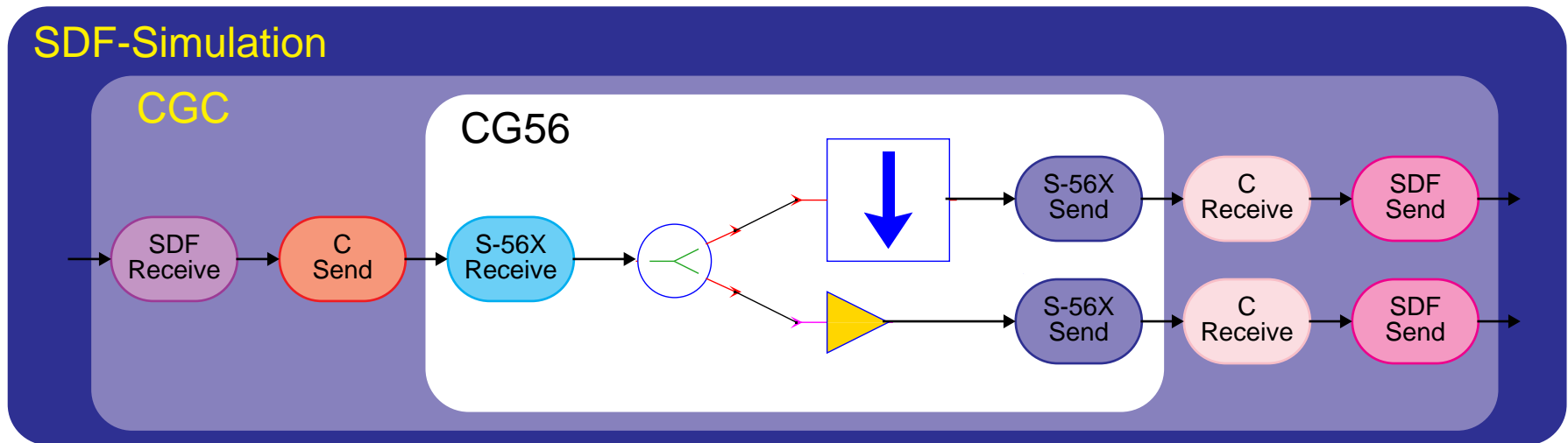  Multiple independent SDF graphs

# *Migration to Hardware*



- Top level — runs using a Ptolemy simulation domain (SDF)

- Subsystem compiled, downloaded and run on a S-56X DSP board installed in a host workstation

# *Simulation Interface Construction*



- Uses send/receive communication actors

- Incremental compilation

- Simulation block is constructed

# *Stand-alone Prototype Synthesis*

- Heterogenous multiprocessor support

- Hierarchical scheduling

- Peek/Poke — Extend SDF and BDF by allowing for nondeterminate communication

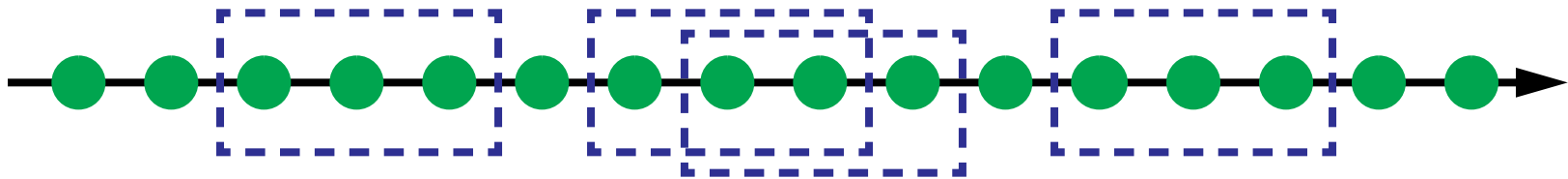- Example of useful nondeterminism — real-time prototype user interfaces
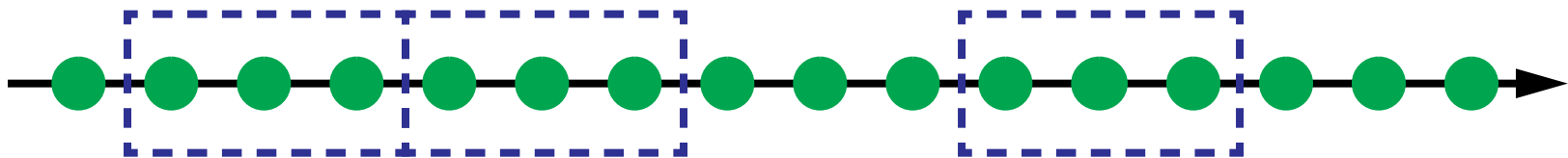
3(A)2(B)
CDE

10 Hz

44.1 kHz
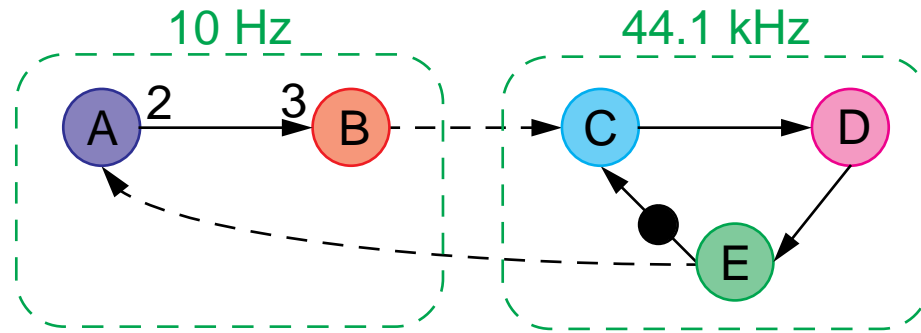
# *Peek/Poke Properties*
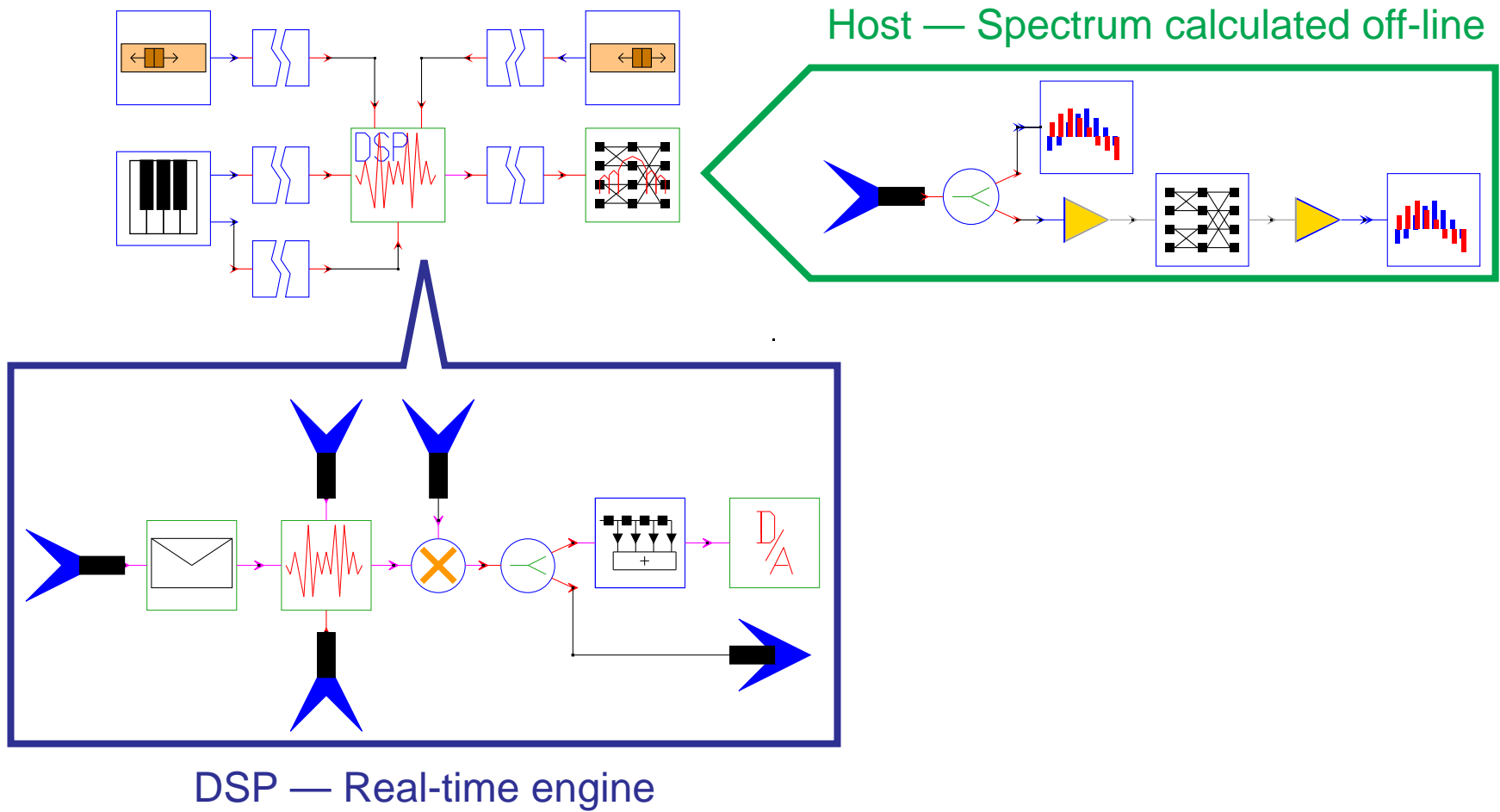
- Update rate is explicit, implicit or event driven (change of value)

- Single Sample

- Sliding Window



- Block aligned
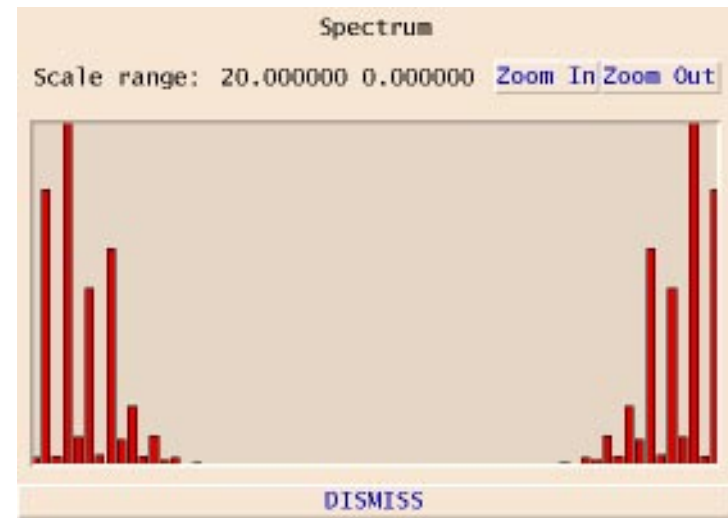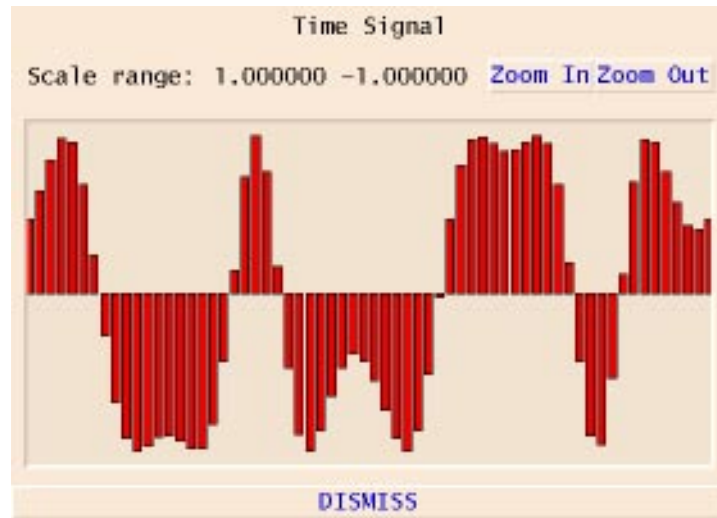
# *FM Synthesis Specification*



Host — Spectrum calculated off-line

DSP — Real-time engine

# *FM Synthesis: GUI*
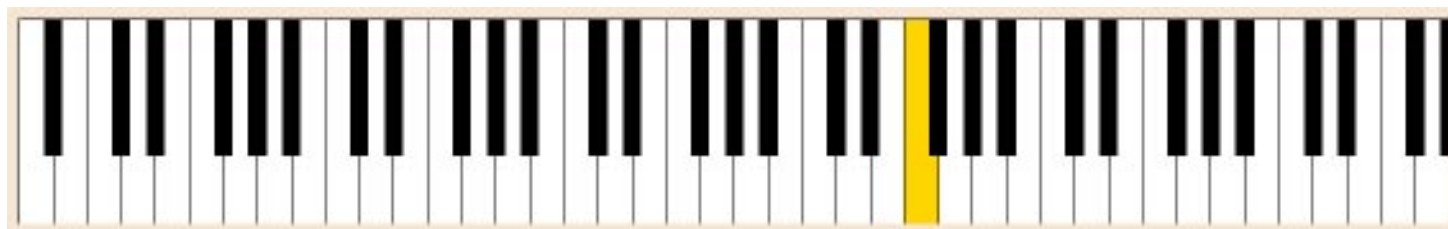
# *Conclusions*

- Describe system with simulation domains

- Migrate subsystems to prototype hardware, generating a composite block for simulation which can be added to block library

- Generate a real-time stand-alone system using nondeterminate peek/poke communication actors as necessary