Integration of Kepler with ROADNet: Visual Dataflow Design with Real-time Geophysical Data

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Abstract

The ROADNet project concentrates real-time data from a wide variety of signal domains, providing a reliable platform to store and transport these data. Protocols to a distribute data are designed to ensure that data packets are reassembled or consumed correctly. Kepler is a graphical, web-based dataflow design environment and library, the second generation of the Ptolemy II programming environment, that can be used to design dataflow architectures. Kepler can be used to combine many different data sources into a general purpose system. A crucial element of ROADNet is the use of orb servers, “object ring buffers” which concentrate and buffer real-time data. ORB servers and other elements of ROADNet are part of the Antelope real-time system by Boulder Real Time Technologies, Inc.

Examples of Current Applications

Remote Video. The JASON submersible, leathered to the R/V Reveille, explores the sea floor off the coast of the Aleutian Islands. Images and other data are transmitted in real time to the ROADNet system, based in San Diego.

Prototype signal processing applications. Laser strain gauges in the California desert transmit their signals to the ROADNet system.

“…if we’d like to display is series #2 minus #1 and #2, #3 and #9 being the two main ‘correction’ series. Once these series are subtracted (as you would in a spreadsheet, data sample by data sample) the result ought to be a convincing earth tide signal… For a feeling on this, we in San Diego are moving up and down about a foot, twice a day, from the center of the earth; the strainmeter measures the stretching of the surface as this happens.”

— Frank Wyatt suggesting an example application

We can quickly construct a Kepler model to encapsulate this task. The “OrbWaveformSink” connects to the Orb, and acquires the necessary data stream.

Build models that process real-time data using drag-and-drop components.

RoadNet/Antelope

The ROADNet system concentrates data from many different sources into a general purpose system. A crucial element of ROADNet is the use of orb servers, “object ring buffers” which concentrate and buffer data. The Antelope system is used to transport data from the JASON submersible in Alaska. The Kepler system consists entirely of free software.

Kepler/Ptolemy

Kepler is a system for graphically designing and automating data flow models that encapsulate “scientific workflows.” Kepler is based on UC Berkeley’s Ptolemy II system for heterogeneous, distributed, and concurrent design. Both Kepler and Ptolemy II are distributed as free software.

Our project is to integrate these two systems, providing access to ROADNet resources from Kepler.

Database connection

A full Kepler-ROADNet integration requires not just connectivity to Orbs (real-time data) but also to relational databases. Kepler already has support for many databases (via JDBC), but we are working on an interface to Datascape.

Packet Handling

The Kepler-Antelope interface makes it easy to manipulate real-time data in an intuitive manner, without writing code.

Kepler models that send their output back to the Orb may be a useful means of expressing a stream processing task.

Future work could implement more sophisticated signal processing (leading to applications such as coherent array processing), distributed processing, and modelling of higher level tasks such as event detection and packet routing.

Conclusions

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