Power Management for Raspberry Pi Clusters

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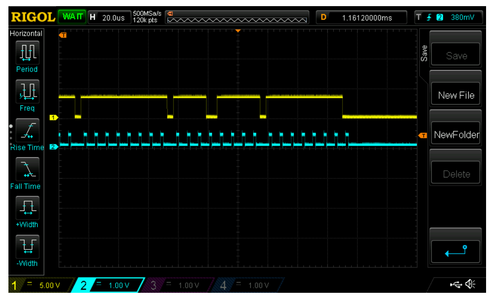
Motivation

Motivation: The Raspberry Pi cluster is a low cost, low power, and compact testbed for next generation high performance computing software. It will allow developers to investigate problems associated with the rapidly increasing scale of super computers, but existing software for the pi cluster made powering nodes tedious and slow.

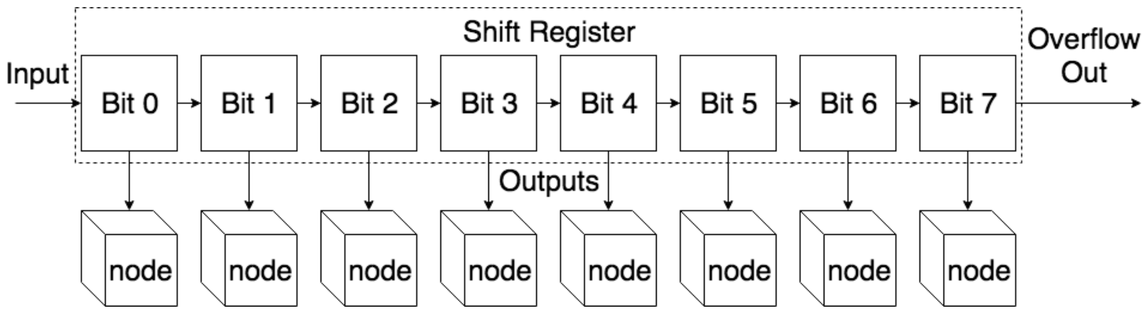
Goal: Replace the existing power control software to provide a more versatile control interface.

Looking at the Hardware

- Signals were retrieved by probing the power control pi with an oscilloscope.



- The power control pi sends these signals to shift registers that hold the state of each node.



- Each BitBar has two shift registers with one bit for each node on the bar.

- The BitBars are cascaded together and act as one 160 bit shift register.

New Software

- The new power control software was written in Golang. This makes it more compatible with some of the software that will be tested on the cluster.
- The first version used command line flags to control power to the nodes.

```
[pi@bitscope:~ $ piPower -a -on
[pi@bitscope:~ $ piPower -r="0-5, 15-20" -off
[pi@bitscope:~ $ piPower -r="0-25"
 Node 25 is on
 Node 24 is on
 Node 23 is on
 Node 22 is on
 Node 21 is on
 Node 20 is off
 Node 19 is off
 Node 18 is off
 Node 17 is off
 Node 16 is off
```

- The second version is a ReST API using http requests to control nodes.

/nodes/state
/nodes/{id}/state
/nodes/state/{on/off}
/nodes/{id}/state/{on/off}

- The ReST API allows for more customizable control.

Results

- Reverse engineered the existing software.
- Power for each node can be controlled individually or as groups with a ReST API.
- The API can power nodes over 70 times faster than the original software.

Future Work

When nodes are first powered on, it looks like there is a spike along the power rail causing other nodes to briefly lose power. This needs to be tested further to determine if nodes are being undervolted, or rebooted entirely, and if they will be damaged as a result.

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