PLuSH: A Tool for Remote Deployment, Management, and Debugging

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University of California, San Diego
**SWORD on PlanetLab: Scalable Wide-Area Resource Discovery**

SWORD is a scalable resource discovery tool for wide-area distributed systems. The particular type of resource SWORD is intended to discover is **nodes on which to deploy a service**. SWORD instances run on infrastructure machines (such as PlanetLab nodes). SWORD collects reports about available resources on nodes, and answers queries from users requesting nodes matching user-defined criteria. These criteria may be per-node (e.g., load, free memory, or free disk space) or inter-node (e.g., inter-node latency). The nodes about which SWORD collects reports do not have to be the same nodes as those that are running SWORD, but for SWORD on PlanetLab, they are the same set of nodes.

The SWORD project aims to explore techniques for specifying and scalably evaluating resource discovery queries in wide-area distributed systems. Compared to other Internet-scale distributed query processors, SWORD’s primary features are:

- an **XML encoding of user queries expressed as utility functions**;
- **scalable multi-attribute distributed range queries** over node measurements, including network coordinates and inter-node measurements; and
- an **optimizer** that finds the set of nodes that maximizes the user's utility

The details of SWORD's implementation, and more background on the SWORD project, are described in a forthcoming technical report. This document is intended as a user guide for SWORD on PlanetLab, describing only the user-visible aspects of its operation, particularly its query language.

**Quick start**

SWORD currently runs on approximately all production PlanetLab nodes. To see which nodes SWORD is running on right now, click [here](#). This list is updated every five minutes based on application-level heartbeats.

You can use the following text box to issue a pre-canned query to SWORD, or to enter your own query. If you use the default text, you will be issuing a query for all of the nodes running SWORD that currently have a load less than 5.0, with a maximum of 20 nodes returned per PlanetLab site. Once you click "submit," the output returned will contain one line per PlanetLab node that satisfies the query; each line contains
<request>
  <group>
    <name>Group1</name>
    <numhosts>2</numhosts>
    <num_machines>10</num_machines>
    <load_one>0.0,0.0,0.0,2.0,0.01</load_one>
    <disk_free>0.1,0.2,max,max,0.005</disk_free>
    <latency>0.0,0.0,20.0,30.0,0.5</latency>
    <os_name>
      <value>Linux, 0.0</value>
    </os_name>
    <gnp>
      <value>0.0/0.0/0.0;50.0, 0.0</value>
    </gnp>
  </group>
  <group>
    <name>Group2</name>
    <numhosts>2</numhosts>
    <num_machines>10</num_machines>
    <load_one>0.0,0.0,0.0,2.0,0.01</load_one>
    <disk_free>0.1,0.2,max,max,0.005</disk_free>
    <latency>0.0,0.0,20.0,30.0,0.5</latency>
    <os_name>
      <value>Linux, 0.0</value>
    </os_name>
    <gnp>
      <value>100.0/-100.0/100.0;50.0, 0.0</value>
    </gnp>
  </group>
  <constraint>
    <group_names>Group1 Group2</group_names>
    <latency>0.0,10.0,90.0,100.0,0.5</latency>
  </constraint>
</request>
Manage Node Assignments

Show: University of California, Davis

- planetlab1.cee.ucdavis.edu
- planetlab2.cee.ucdavis.edu

Add Selected

All nodes currently assigned:
- planetlab-1.cmcl.cs.cmu.edu
- planetlab-1.cs.princeton.edu
- planetlab-2.cmcl.cs.cmu.edu
- planetlab-2.cs.princeton.edu
- planetlab-3.cmcl.cs.cmu.edu
- planetlab-3.cs.princeton.edu
- planetlab-4.cs.princeton.edu
- planetlab-5.cs.princeton.edu
- planetlab-6.cs.princeton.edu
- planetlab-7.cs.princeton.edu
- planetlab1.cs.duke.edu
- planetlab1.cs.umd.edu
- planetlab1.millennium.berkeley.edu
- planetlab1.ucsd.edu
- planetlab10.millennium.berkeley.edu
- planetlab11.millennium.berkeley.edu
- planetlab12.millennium.berkeley.edu
- planetlab13.millennium.berkeley.edu
#!/usr/bin/perl -w

open (FILE, "<sword-output.txt");
$test = "";

while ($line = <FILE>) {
   $test .= $line;
}

foreach $host (split /'\n'/, $test) {
   if (!fork()) {
      `scp -n packages.tar -ucsd_3@$host: >& /dev/null`;
      if ($? != 0) {
         print "Error: could not connect to $host\n";
      }
      `ssh -n -l ucsd_3 $host tar -xvf packages.tar > /dev/null`;
      exit(0);
   }
}

[clt@koyaanisqatsi] ~/% ./send_files.pl

Error: could not connect to planetlab1.ucsd.edu
Error: could not connect to planetlab-1.cs.uvw.edu
...

CoMon PlanetLab Status (sort key: Name)

Part of the CoDeNi project
Updated Tue Dec 7 00:45:01 2004

legend
slice max, slice avg, slice tot

<table>
<thead>
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<th>#</th>
<th>Name</th>
<th>Address</th>
<th>Resp Time</th>
<th>Uptime</th>
<th>Busy CPU %</th>
<th>Last CoTop</th>
<th>Mem Used</th>
<th>Mem Act %</th>
<th>Swap Used %</th>
<th>Swap</th>
<th>Disk In</th>
<th>Disk Out</th>
<th>Timer max</th>
<th>Conn max</th>
<th>Conn avg</th>
<th>DNS1 udp %</th>
<th>DNS2 tcp %</th>
<th>DNS2 udp %</th>
<th>Num Slices</th>
<th>CPU Hog</th>
<th>Mem Hog</th>
<th>Proc Hog</th>
<th>Tx Hog</th>
<th>Rx Hog</th>
<th>Rs Hog</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>planetlab1.it.pitt.edu.au</td>
<td>138.25.15.194</td>
<td>0.48 S</td>
<td>32.1 D</td>
<td>5.0 M</td>
<td>51</td>
<td>24</td>
<td>197</td>
<td>20.3 %</td>
<td>2.02</td>
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<td>0</td>
<td>243.1</td>
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<td>3.8</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>planetlab2.it.pitt.edu.au</td>
<td>138.25.15.195</td>
<td></td>
<td>No route to host node down</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>plnode01.cs.uu.nl</td>
<td>220.245.140.100</td>
<td>22.5 D</td>
<td>no response node down</td>
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</tr>
<tr>
<td>4</td>
<td>plnode02.cs.uu.nl</td>
<td>220.245.140.101</td>
<td>22.5 D</td>
<td>no response node down</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>planetlab1.info.ucalgobe.ca</td>
<td>130.104.229.228</td>
<td>0.61 S</td>
<td>5.5 D</td>
<td>5.0 M</td>
<td>100</td>
<td>0</td>
<td>0.99</td>
<td>1.2 %</td>
<td>0.4</td>
<td>0</td>
<td>1</td>
<td>198</td>
<td>1195</td>
<td>452.1</td>
<td>11.2</td>
<td>0.69</td>
<td>0.69</td>
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<td>105</td>
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</tr>
<tr>
<td>6</td>
<td>planetlab2.info.ucalgobe.ca</td>
<td>130.104.229.229</td>
<td>17.5 D</td>
<td></td>
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</tr>
</tbody>
</table>

200.102.209
SWORD on PlanetLab: Scalable Wide-Area Resource Discovery

Quick navigate to: [Introduction | Quick start | Query language | Examples | Supported attributes | How to use | Publications | Support and future plans | People | System status]

SWORD is a scalable resource discovery tool for wide-area distributed systems. The particular type of resource SWORD is intended to discover is nodes on which to deploy a service. SWORD instances run on infrastructure machines (such as PlanetLab nodes). SWORD collects reports about available resources on nodes, and answers queries from users requesting nodes matching user-defined criteria. These criteria may be per-node (e.g., load, free memory, or free disk space) or inter-node (e.g., inter-node latency). The nodes about which SWORD collects reports do not have to be the same nodes as those that are running SWORD, but for SWORD on PlanetLab, they are the same set of nodes.

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Query in progress...

Group LowLoad

plab2.ee.ucla.edu [164.67.194.226] amrep=1.0 gnp=6798.159590805327 nonkey=164.67.194.226:4973 load_one=0.99
site=16729.0 gnp=9524.92681462820 gnp=5987.63231557558
planetlab1.cs.uoregon.edu [128.223.6.113] amrep=1.0 gnp=6744.582088512453 nonkey=128.223.6.113:4973
load_one=0.57 site=13597.0 gnp=9585.634131193847 gnp=5982.680219031864
planetlab01.cs.washington.edu [128.208.4.197] amrep=1.0 gnp=6728.191239810425 nonkey=128.208.4.197:4973
load_one=3.59 site=11588.0 gnp=9637.912114411305 gnp=5982.6762429333
load_one=0.38 site=10931.0 gnp=9532.127313666284 gnp=5990.340100419439
planetlab01.ethz.ch [129.132.57.2] amrep=1.0 gnp=6697.951289695401 nonkey=129.132.57.2:4973 load_one=0.52
load_one=17266.0 gnp=9647.294620363266 gnp=5979.64059301744
planetlab1.cs.purdue.edu [128.10.19.52] amrep=1.0 gnp=6729.73573622207 nonkey=128.10.19.52:4973
load_one=1.64 site=691.0 gnp=9553.31036649137 gnp=6026.320974199748
198.32.154.194 [198.32.154.194] amrep=1.0 gnp=6680.975622736025 nonkey=198.32.154.194:4973 load_one=0.66
15532.0 gnp=9566.316998412712 gnp=5960.0192200015209
p11.cs.uit.no [160.36.57.172] amrep=1.0 gnp=6727.839984527569 nonkey=160.36.57.172:4973 load_one=0.4
site=11510.0 gnp=9578.24200618792 gnp=5994.339911762783
load_one=2.16 site=11787.0 gnp=9591.851182202046 gnp=5964.3851390743
p11-br-3.hpl.hp.com [192.6.31.0] amrep=1.0 gnp=6675.666512670949 nonkey=192.6.61.0:4973 load_one=0.57
load_one=13211.0 gnp=9564.489934917603 gnp=6020.51266003497
planetlab2.tau.ac.il [192.114.4.3] amrep=1.0 gnp=6709.465402106331 nonkey=192.114.4.3:4973 load_one=1.55
3927.0 gnp=9718.822853857686 gnp=5947.26234289012
planetlab1.cs.vu.nl [130.36.198.243] amrep=1.0 gnp=6713.082423913325 nonkey=130.36.198.243:4973
load_one=2.06 site=23473.0 gnp=9575.815876790024 gnp=6033.881306874744
planetlab1.win.tr robotics.ca [192.6.61.0] amrep=1.0 gnp=6736.4631949927 nonkey=192.6.61.0:4973 load_one=0.4
load_one=2.24 site=22262.0 gnp=9590.29326660348 gnp=5975.065163269856
planet2.winnipeg.canet4.nodes.planet-lab.org [205.119.32.137] amrep=1.0 gnp=6731.44625138262
nonkey=205.119.32.137:4973 load_one=0.21 site=22255.0 gnp=9585.592420276902 gnp=5983.999507372215
planetlab2.iis.sinica.edu.tw [140.109.17.181] amrep=1.0 gnp=6776.983684363099 nonkey=140.109.17.181:4973
load_one=0.44 site=7295.0 gnp=9662.213751303641 gnp=5907.59163516149
planetlab3.flux.utah.edu [155.98.35.4] amrep=1.0 gnp=6765.674366667623 nonkey=155.98.35.4:4973 load_one=3.26
site=29491.0 gnp=9525.1876792399678 gnp=5934.353346103131
planet1.ics.forth.gr [139.91.70.61] amrep=1.0 gnp=6801.15335592233 nonkey=139.91.70.61:4973 load_one=2.58
load_one=26417.0 gnp=9591.97209275402 gnp=6002.40969336677
203.177.76.242 [203.177.76.242] amrep=1.0 gnp=6844.995791205465 nonkey=203.177.76.242:4973 load_one=2.34
planet2.ics.forth.gr [145.68.24429733
69.110.237.116 [69.110.237.116] amrep=1.0 gnp=7092.4425852738905 nonkey=69.110.237.116:4973 load_one=1.37
site=14251.0 gnp=9767.38443687774 gnp=5578.755529408
p11-br-3.hpl.hp.com [204.123.28.53] amrep=1.0 gnp=6770.839058171448 nonkey=204.123.28.53:4973 load_one=1.01
load_one=13211.0 gnp=9563.93957316228 nonkey=5981.631875713002
Manage Node Assignments

Show: University of California, Davis

- planlab1.ooe.ucdavis.edu
- planlab2.ooe.ucdavis.edu

Add Selected

All nodes currently assigned:
- planlab-1.cmcl.cs.cmu.edu
- planlab-1.cs.princeton.edu
- planlab-2.cmcl.cs.cmu.edu
- planlab-2.cs.princeton.edu
- planlab-3.cmcl.cs.cmu.edu
- planlab-3.cs.princeton.edu
- planlab-4.cs.princeton.edu
- planlab-5.cs.princeton.edu
- planlab-6.cs.princeton.edu
- planlab-7.cs.princeton.edu
- planlab1.cs.duke.edu
- planlab1.cs.berkeley.edu
- planlab1.cs.mit.edu
- planlab1.millennium.berkeley.edu
- planlab1.ucsd.edu
- planlab10.millennium.berkeley.edu
- planlab11.millennium.berkeley.edu
- planlab12.millennium.berkeley.edu
- planlab13.millennium.berkeley.edu
#!/usr/bin/perl -w

open (FILE, "<sword-output.txt");
$test = "";

while ($line = <FILE>) {
    $test .= $line;
}

foreach $host (split /\n/, $test) {
    if (!fork()) {
        `scp -n packages.tar -ucsd_3@$host: >& /dev/null`;
        if ($? != 0) {
            print "Error: could not connect to $host.\n"
        }
        `ssh -n -l ucsd_3 $host tar -xvf packages.tar > /dev/null`;
        exit(0);
    }
}

[clt@koyaanisqatsi] ~/% ./send_files.pl
[clt@koyaanisqatsi] ~/% ./run.pl
...
The processes were started successfully.
<table>
<thead>
<tr>
<th>Node Name</th>
<th>Status</th>
<th>Requested</th>
<th>Last Command</th>
<th>Time Since Contact</th>
<th>Build</th>
<th>Time Since Install</th>
<th>Install Message</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-102-209-151.pacnet0001.brasiltelecom.net.br</td>
<td>Online</td>
<td>Online</td>
<td>Online</td>
<td>00:04:20</td>
<td>143</td>
<td>00:35:32</td>
<td>SUCCESS</td>
<td>Detail</td>
</tr>
<tr>
<td>alsdin.planetlab.extranet.uni-passau.de</td>
<td>Error</td>
<td>Offline</td>
<td>New</td>
<td>168 days 05:57:23</td>
<td>18</td>
<td>07:46:00</td>
<td>any connect to address 195.37.16.97 por</td>
<td>Detail</td>
</tr>
<tr>
<td>alice.cs.princeton.edu</td>
<td>New</td>
<td>Offline</td>
<td>New</td>
<td>09:08:57</td>
<td>143</td>
<td>06:52:00</td>
<td>Success</td>
<td>Detail</td>
</tr>
<tr>
<td>aruri.sys.ac.kr</td>
<td>Online</td>
<td>Online</td>
<td>Online</td>
<td>00:00:52</td>
<td>143</td>
<td>06:52:00</td>
<td>SUCCESS</td>
<td></td>
</tr>
<tr>
<td>blou.uwaterloo.ca</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>12 days 06:31:01</td>
<td>142</td>
<td>06:31:00</td>
<td>any connect to address 129.97.76.238 por</td>
<td></td>
</tr>
<tr>
<td>cloudburst.uwaterloo.ca</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>8 days 06:31:01</td>
<td>142</td>
<td>06:31:00</td>
<td>any connect to address 129.97.76.238 por</td>
<td></td>
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<tr>
<td>c.planetlab1.kaist.ac.kr</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>20 days 05:15:14</td>
<td>139</td>
<td>14:35:59</td>
<td>any connect to address 142.187.139.168</td>
<td></td>
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<tr>
<td>c.planetlab2.kaist.ac.kr</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>8 days 12:31:18</td>
<td>138</td>
<td>08:06:31</td>
<td>any connect to address 163.208.138.169</td>
<td></td>
</tr>
<tr>
<td>c.planetlab3.kaist.ac.kr</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>36 days 13:50:22</td>
<td>130</td>
<td>07:35:50</td>
<td>any connect to address 163.208.138.171</td>
<td></td>
</tr>
<tr>
<td>dchinni.planetlab.extranet.uni-passau.de</td>
<td>Online</td>
<td>Online</td>
<td>Online</td>
<td>00:05:12</td>
<td>143</td>
<td>06:32:26</td>
<td>SUCCESS</td>
<td>Detail</td>
</tr>
<tr>
<td>d-p11.technion.ac.il</td>
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<td>Offline</td>
<td>New</td>
<td>121 days 06:46:41</td>
<td>101</td>
<td>07:46:41</td>
<td>any connect to address 132.68.237.34 por</td>
<td></td>
</tr>
<tr>
<td>d-p12.technion.ac.il</td>
<td>Error</td>
<td>Offline</td>
<td>New</td>
<td>109 days 22:38:58</td>
<td>109</td>
<td>07:31:28</td>
<td>any connect to address 132.68.237.35 por</td>
<td></td>
</tr>
<tr>
<td>d-p13.technion.ac.il</td>
<td>Error</td>
<td>Offline</td>
<td>New</td>
<td>108 days 22:38:58</td>
<td>109</td>
<td>08:12:50</td>
<td>any connect to address 132.68.237.38 por</td>
<td></td>
</tr>
<tr>
<td>freedom.nl.uni-tuebingen.de</td>
<td>Error</td>
<td>Offline</td>
<td>New</td>
<td>09:08:59</td>
<td>143</td>
<td>06:58:59</td>
<td>Permission denied (public key) bad</td>
<td></td>
</tr>
<tr>
<td>groove.hpl.hp.com</td>
<td>Online</td>
<td>Online</td>
<td>Online</td>
<td>00:01:05</td>
<td>143</td>
<td>06:58:59</td>
<td>SUCCESS</td>
<td></td>
</tr>
<tr>
<td>ichy.co.uga.edu</td>
<td>Error</td>
<td>Offline</td>
<td>Online</td>
<td>20 days 05:18:17</td>
<td>141</td>
<td>08:25:15</td>
<td>SUCCESS</td>
<td>Detail</td>
</tr>
<tr>
<td>keep1.itc.ku.edu</td>
<td>Online</td>
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<td>143</td>
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<td>any connect to address 198.183.209.4 por</td>
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Announcements

Version 3.0 Rollout
A rollout of Version 3.0 of PlanetLab's core software is now underway, with a target of completing the upgrade during the week of November 15th. Users are encouraged to test their services on v3 nodes as soon as possible. For more information, see the message posted to announce.
Research Questions Abound

- What are the fundamental abstractions?
- How do we represent distributed executions?
- How do we best deploy and manage distributed services and experiments?

- We investigate these questions through PLuSH.
Approach

- Fundamental Abstractions
  - Abstract Description Language
  - Resource Discovery
  - Resource Allocation
  - Host and Environment Monitoring
  - Experiment Deployment
  - Execution Management

- PLuSH is a framework of components that integrates these abstractions
PLuSH Lives.

- PLuSH is built and running on laptops in the back of the room.

- We want user feedback!

- http://ramp.ucsd.edu/projects/plush/