Network Visualization with Nodemap

Agenda

- What is *Internode Nodemap?*
- Why would I use it?
- How do I configure it?
- How do I run it?
- Where can I find out more?

What do I need first?

- Basic knowledge of SNMP, network monitoring.
- Basic Cisco knowledge -- don't need a CCNA, but you should know what an interface is.
- A UNIX box (FreeBSD, Linux, Solaris, Mac OS X, ...)
- A network. *Duh.*

Network visualization with Internode Nodemap

- *Internode Nodemap* is a network monitoring, diagnostic, mapping and visualization application
- Displays in your web browser – no client software needed
- Near real-time visual feedback
- Expressive configuration language
- Scalability: monitors 100's of routers, 1000's of links, from one host

Why Nodemap?

- Status monitoring on large networks is “hard”
- Tools like MRTG are good at the “micro” view, but don’t work holistically
- Tools like Nagios and mon work holistically, but are bad at managing relationships

Why Nodemap?

- Tracking DoS attacks with thousands of MRTG graphs is Not Fun™
- Getting dozens of Nagios SMS messages about latency and reachability without knowing there's a DoS in progress is also Not Fun™

Why Nodemap?

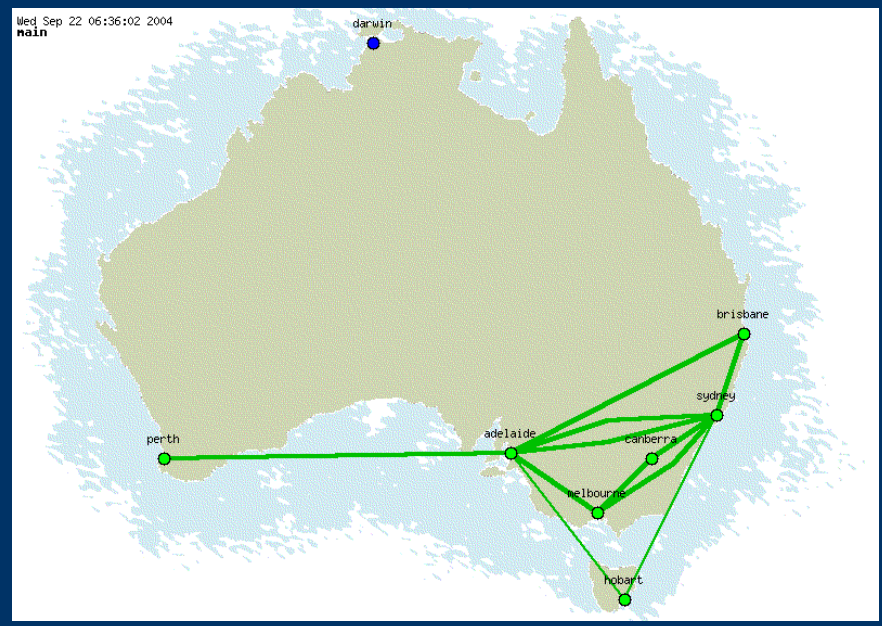
- Nodemap fills the gap.
- Provides a holistic visualization of an entire network
- More detailed views available on-demand
- Supplements, doesn't replace: Other monitoring tools are still needed, but Nodemap makes interpreting their results easier.

Why Nodemap?

- Additional uses:
  - Network mapping
    Nodemap config file gives you automatically-maintained network diagrams for free!
  - Fault-finding
    Operations staff can use visual feedback to assist with performance and reachability fault resolution

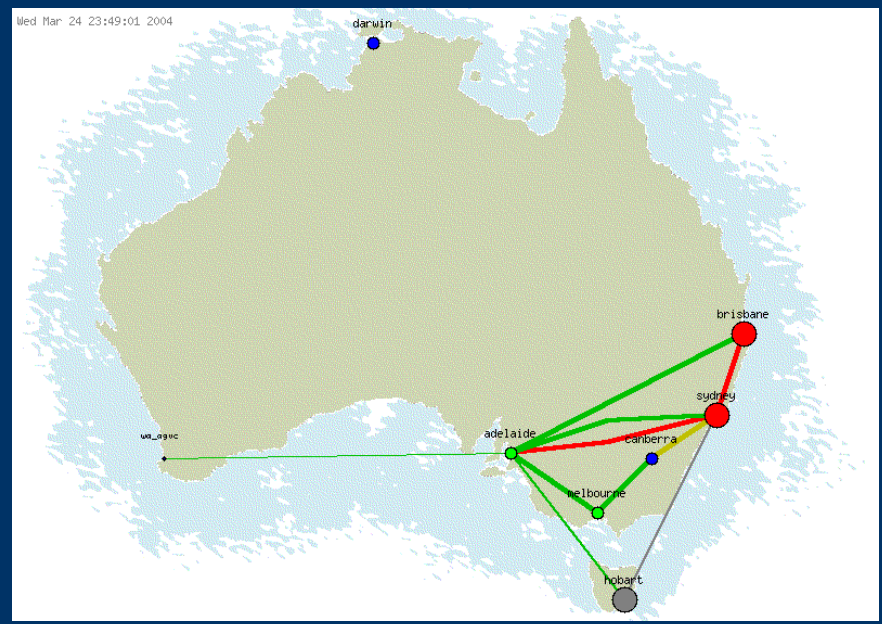
Nodemap display

- Network administrators define *maps*
- A map consists of an image, a set of nodes, and a set of links between the nodes



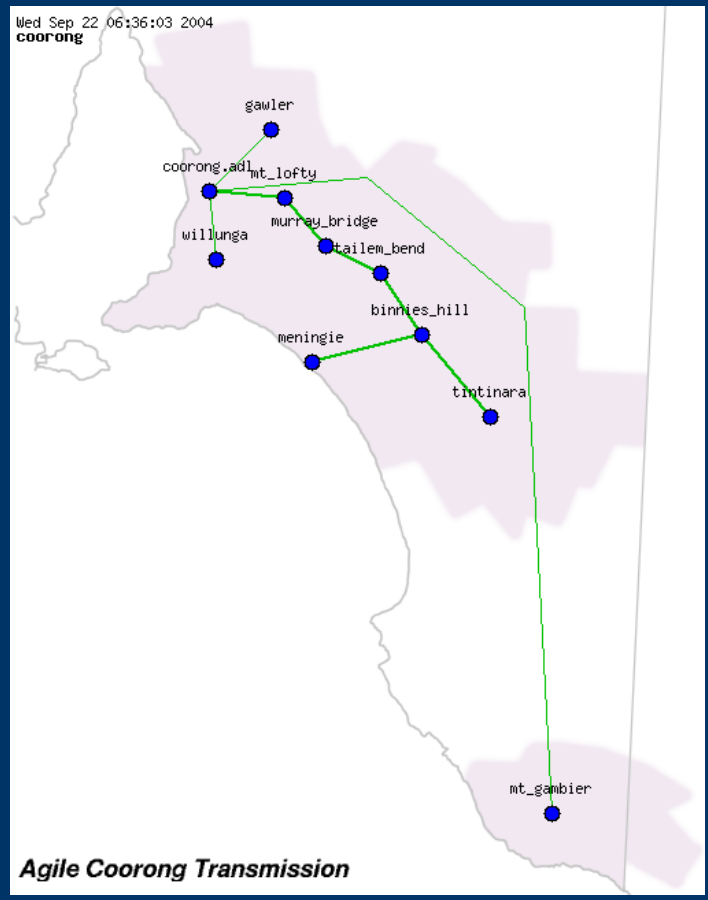
Nodemap display

- Links change color depending on status
- Color changes occur with load increases, congestion and packet loss



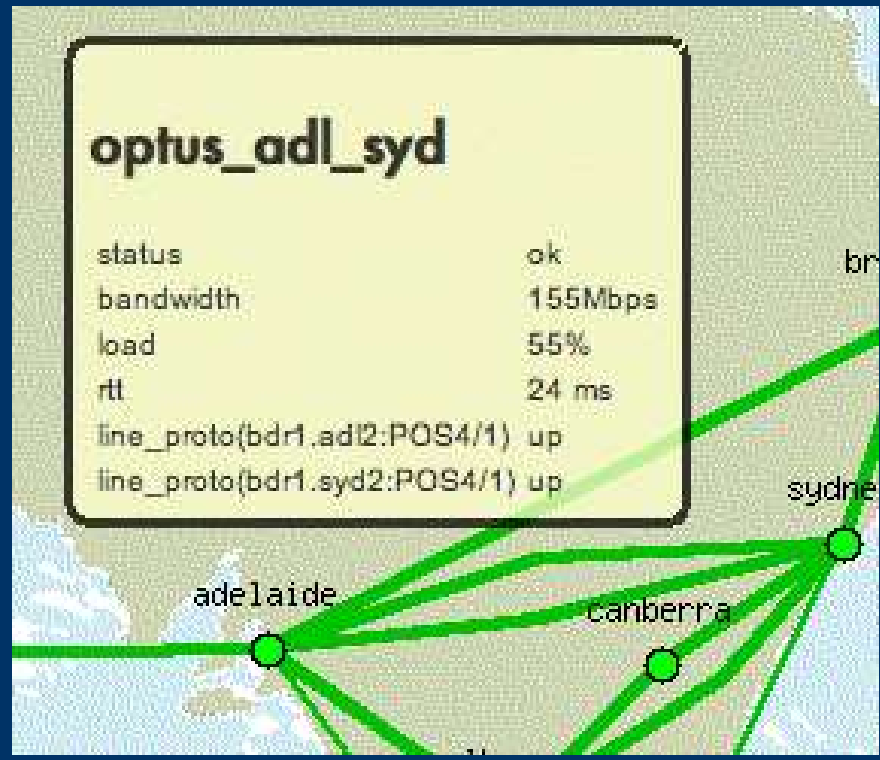
Nodemap display

- Nodes can have additional maps “nested” within.
- Nodes change color depending on the state of links within nested maps.



Nodemap display

- Hovering the mouse over a link provides link statistics
- Stats are updated every few minutes



Nodemap display

- Hovering over a node lists all the maps nested inside
- If any nested links are non-green, it tells you about that too

How?

Nodemap Configuration

Nodemap Configuration

- Nodemap reads a config file
- Heirarchical tree of named objects

```
/* Comment text */
objecttype OBJECTNAME {
  attribute VALUE;
  ...
};
```

Nodemap Configuration

- Top level of the tree is a “map” object
- A map contains a source (background) image and the node and link objects to be painted on that map
- Image format is GIF (Now patent-free!)

Nodemap Configuration

```
map adelaide {
   /* Background image definition */
   image images/adl_ubd_mapscan.gif;

   /* nodes and links go here */
};
```

Nodemap Configuration

- Node objects minimally contain “x” and “y” coordinates.
- Coordinates count in pixels from the top left of the source image (i.e., each map has an independent coordinate system)
- Nodes optionally have other attributes

Nodemap Configuration

```
map adelaide {
   image images/adl_ubd_dirscan.gif;

   node richmond {
      x 240;
      y 320;
   };
   node kensington {
      x 490;
      y 310;
   };
};
```

Nodemap Configuration

- “Link” objects connect the nodes
- Link definitions describe the nodes the link connects, other nodes it passes through on the way, and either one or two “endpoint” object definitions
- If two endpoints are provided, their usage stats are averaged

Nodemap Configuration

- “Endpoint” objects describe a router/switch interface which Nodemap can query for performance stats.
- Nodemap uses SNMP – The router or switch must be able to respond to SNMP queries (RFC-1213 INTERFACES-MIB and Cisco gunk).

Nodemap Configuration

```
link r_to_k {
   between richmond kensington;
   endpoint richmond_outside {
      host richmond-router.company.com;
      interface Serial0;
      location richmond;
   };
   endpoint kensington_outside {
      host kensington-router.company.com;
      interface Serial4;
      location kensington;
   };
};
```

Nodemap Configuration

- Maps can be nested inside nodes:

```
map adelaide {
    image images/adelaide.gif;
    node richmond {
        x 150; y 320;
        map south_road {
            ...
        };
        map railway_terrace {
            ...
        };
    };
};
```

Nodemap Configuration

- Extra node attributes:
  - `terminal`
  - `hide`
  - `url`
- Extra link attributes:
  - `thickness <thin|medium|thick|obese|XX>`
  - `shaded`
  - `bandwidth XX <kbps|mbps|k|m>`
  - `url`

Nodemap Configuration

- Latency measurement:
  ```
  ping X.X.X.X from ENDPOINTNAME;
  ping Y.Y.Y.Y from @host:interface;
  ```

- Feature is Cisco-centric. If you don't have a Cisco and you need this to work, *send patches*. Thanks.

- `@host:interface` syntax permits ping tests from a nearby router when the endpoint is a switch

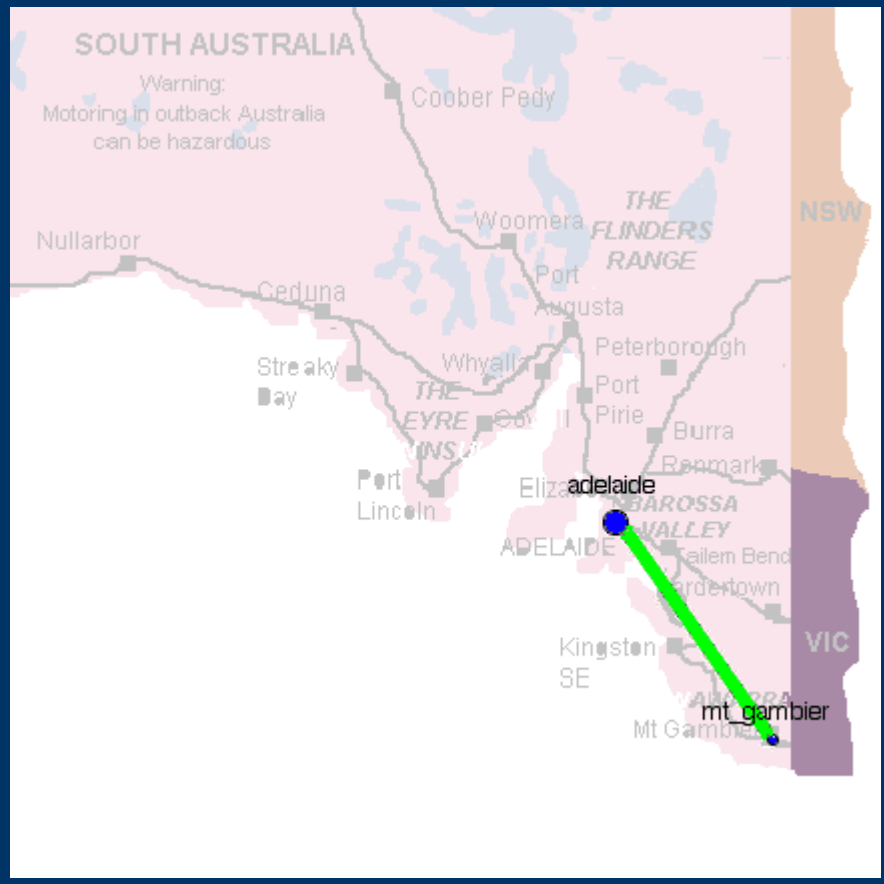
Configuration Example

```
map sa {
     image images/sa.gif;

     node adelaide { x 160; y 240; };
     node mt_gambier { x 235; y 360; terminal; };

     link adl_mtg {
          bandwidth 48M;
          url http://mrtg.company.com.au/links/adl_mtg.html;
          between adelaide mt_gambier;
          ping 192.168.2.41 from adlborder;
          endpoint mtgborder {
              host 192.168.2.41;
              interface Serial2;
              location mt_gambier;
          };
          endpoint adlborder {
              host 192.168.2.40;
              interface Serial0;
              location adelaide;
          };
     };
};
```

Configuration Example



Nodemap Runtime

- Once you have a config file, you need to get Nodemap to render it.
- The software has an installation directory (e.g., `/usr/local/nodemap`)
- Default config file is *etc/nodemap.cf* inside the installation directory:
  `/usr/local/nodemap/etc/nodemap.cf`

Nodemap Runtime

- You also need an output directory
  `/usr/local/www/data/nodemap/`
- Output directory needs to be populated with *.css* and *.js* files which come in Nodemap's *webroot/* distribution directory
- Default is your current directory

Nodemap Runtime

- Command to invoke is *scheduler* in the installation directory:

```
# ./scheduler    [-p] [-d]
                 [-c config-file]
                 [-o output-directory]
                 mapname
```

- The scheduler will render the map called *mapname* and any other maps nested within.

- `-p` disables packetloss/latency checks

Nodemap Runtime

- *scheduler* forks other processes to perform SNMP queries and rsh/ssh checks for packetloss and latency
- Resource limits are enforced to make sure it doesn't fork enough processes to kill your system (even with large configs)
- Use `-d` to debug

Nodemap Runtime

- Three types of scheduled jobs:
  - *update_stats*
    Collects SNMP stats from routers
  - *update_pktloss*
    Uses rsh/ssh to ping across links
  - *update_nodemap*
    Redraws the map

Nodemap Runtime

- Jobs are scheduled “intelligently”
- *update_pktloss* and *update_stats* scheduled at random intervals (less than 5 minutes) to avoid load surges
- *update_nodemap* every 2 minutes
- Jobs rescheduled if system is too busy

Nodemap Runtime

- Status reflected in “ps” output:

```
newton@nodemap> ps ax | grep nodemap
41331  ??  Ss    12:51.90 nodemap sleeping for 1 seconds with 4 slots (perl)
98103  p5  R+     0:00.00 grep nodemap
newton@nodemap> ps ax | grep pinger
 1106  ??  S      0:00.05 pinger: 192.168.21.4 from bdr1.adl:Ethernet0/2
 1121  ??  S      0:00.05 pinger: 192.168.126.118 from bdr1.bne:Serial6
 1148  p5  RV     0:00.00 grep pinger (tcsh)
newton@nodemap> ps ax | grep snmp
 2858  ??  R      0:00.37 /usr/bin/perl ./snmp_show_int -v 2c -h lns1.adl Gig
 2875  ??  R      0:00.08 /usr/bin/perl ./snmp_show_int -v 2c -h lns1.syd Gig
newton@nodemap>
```

Nodemap Resources

- Website:
  http://nodemap.internode.on.net/
- Manual
  http://nodemap.internode.on.net/docs.html
- Mailing list
  nodemap-users@lists.internode.on.net

We're done!

Any questions?