

Write your own monitoring software with RRDtool

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ISG.EE - ETH Zürich

OSCON 2005

Portland, Oregon, August 3, 2005

Netflow Data presented with Fluxscope

Write your own
monitoring
software with
RRDtool

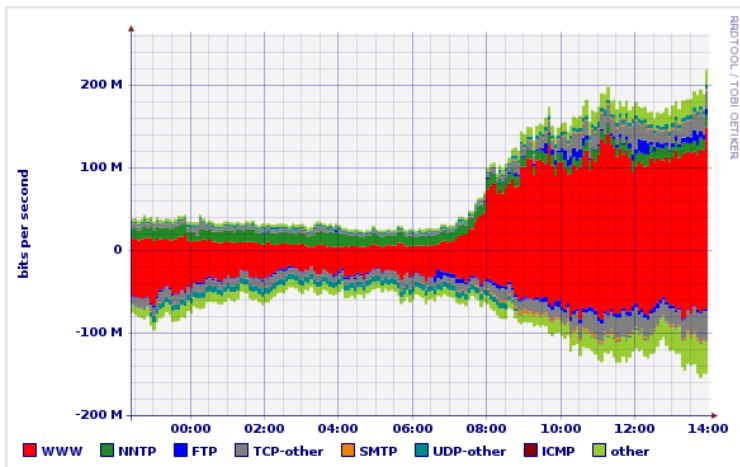
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The world today
About data collection
A graph says more than
1'000 words

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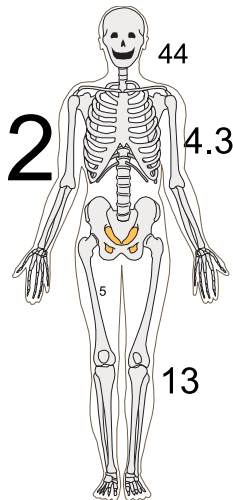
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Numbers everywhere

- ▶ 15 users online
- ▶ 1.34 PB free tape space
- ▶ 31'223 iflnOctets
- ▶ 100 degrees in the server room
- ▶ 87 Mb/s transfer rate



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All these questions

- ▶ Are we running out of disk space?
- ▶ Is there a pattern in the high server load?
- ▶ Is there really global warming?
- ▶ Can we do something about it?
- ▶ Collect that data!



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How to collect data

- ▶ collect everything, analyze later (aka never)
- ▶ data with known properties makes life simpler
- ▶ from research to production



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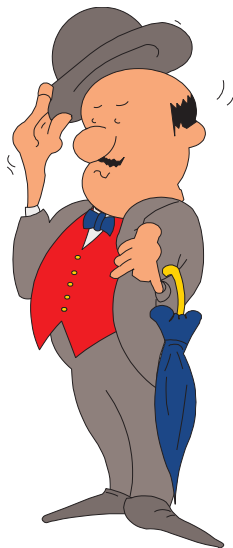
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Requirements for a solution

- ▶ handle counters and gauges
- ▶ be nice to the server
- ▶ setup for specific task
- ▶ data-pre processing
- ▶ and forget about it ...



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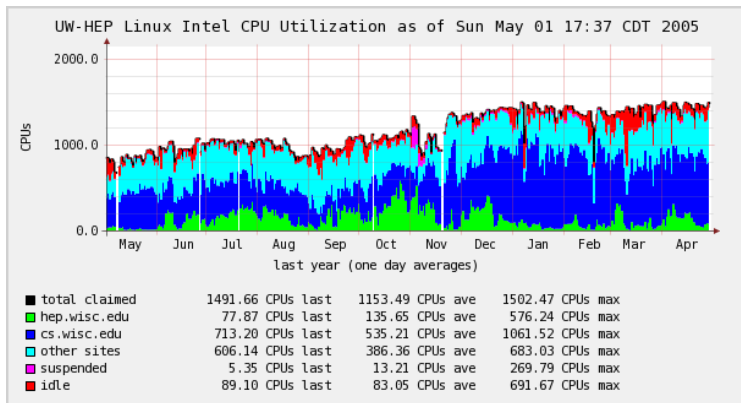
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Condor use at UW

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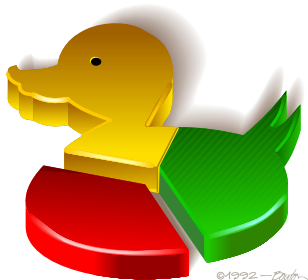
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Making data accessible

- ▶ graphical representation
- ▶ eye candy for the people
- ▶ analysis at a glance
- ▶ make my boss look good to his boss



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Data post-processing

- ▶ highlight interesting properties
- ▶ combine data from several sources
- ▶ add extra Information



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1995: MRTG was only a start

- ▶ logfiles in text format
- ▶ gnuplot for graphs
- ▶ 1996 - MRTG is used for amazing tasks
- ▶ more performance
- ▶ more flexibility



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The rrd *TOOL*

- ▶ a building block
- ▶ basis for a better MRTG (2nd system)
- ▶ basis for hundreds of other tools
- ▶ Google says: “industry standard”



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The Round Robin Database

- ▶ lossy storage, fixed file size
- ▶ current data is the most interesting
- ▶ consolidation functions for feature extraction
- ▶ artificial data-sources
- ▶ holt-winters aberrant behavior detection
- ▶ constant step size
- ▶ fixed disk space



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Feeding Data

- ▶ combat jitter by taking acquisition time into account.
- ▶ preserve data-volume
- ▶ on-the-fly data validation
- ▶ deal with *unknown data*
- ▶ time is a one way street



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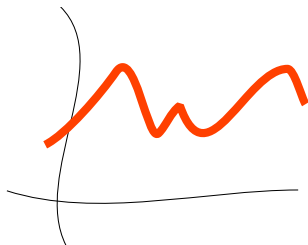
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Basic Graphing

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- ▶ auto scaling
- ▶ auto labeling
- ▶ sensible defaults
- ▶ quick results
- ▶ anti-aliased output
- ▶ multiple formats
(png/eps/pdf/svg)



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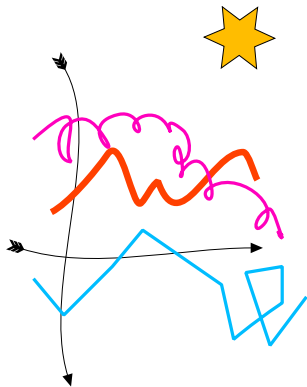
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Advanced Graphing

- ▶ change colors, fonts, sizes
- ▶ data from several databases
- ▶ data processing with RPN math
- ▶ alpha transparency (rrggbbaa)
- ▶ support of locale based character encoding
- ▶ truetype fonts



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On the command line

Just another Unix command.

code

```
rrdtool cmd arg
```

example

```
rrdtool info demo.rrd
```

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Via STDIN

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Save startup time by feeding several commands.

code

```
echo cmd arg | rrdtool -
```

example

```
echo info demo.rrd | rrdtool -
```

- ▶ several commands
- ▶ fast operation
- ▶ simple interface

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perl module

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I love coding in perl ...

code

```
use RRDs;  
my $return = RRDs::cmd arg;
```

example

```
use RRDs;  
use Data::Dumper  
my $ret = RRDs::info "demo.rrd";  
print Dumper $ret;
```

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Other Bindings

- ▶ RRDcgi
- ▶ Perl Pipes - RRDp
- ▶ Python
- ▶ Tcl
- ▶ and more externally

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Creating Round Robin Databases

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- ▶ what data do I want to look at?
- ▶ how long do I want to keep it?
- ▶ what are the interesting properties of my data?
- ▶ what to keep in one rrd file?

Command

```
rrdtool create filename [-start start time] [-step step]  
[DS:ds-name:DST:heartbeat:min:max]  
[RRA:CF:xff:steps:rows]
```

DST: COUNTER, GAUGE, DERIVE, ABSOLUTE,

New in 1.2: *COMPUTE*

CF: AVERAGE, MIN, MAX, LAST,

New in 1.2: *Aberrant Behavior Detection*.

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Create Example

example

```
rrdtool create example.rrd --step=60\  
DS:in:COUNTER:600:0:1000 \  
RRA:AVERAGE:0.5:1:100 \  
RRA:AVERAGE:0.5:10:100 \  
RRA:MAX:0.5:10:100
```

- ▶ resolution **60** seconds
- ▶ **COUNTER** data source
- ▶ updates at least every **600** seconds
- ▶ accept rates between **0** and **1000**
- ▶ three archive with **100** entries
- ▶ store *unknown* unless half are known.

Adding Data into a Round Robin Database

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Command

```
rrdtool update filename [-template ds:ds:...]  
time:value:value...[...]
```

- ▶ data value **and** acquisition time
- ▶ timestamps have to increase with every update
- ▶ instead of *time* use **N** for now
- ▶ templates are for redundancy only

Update Example

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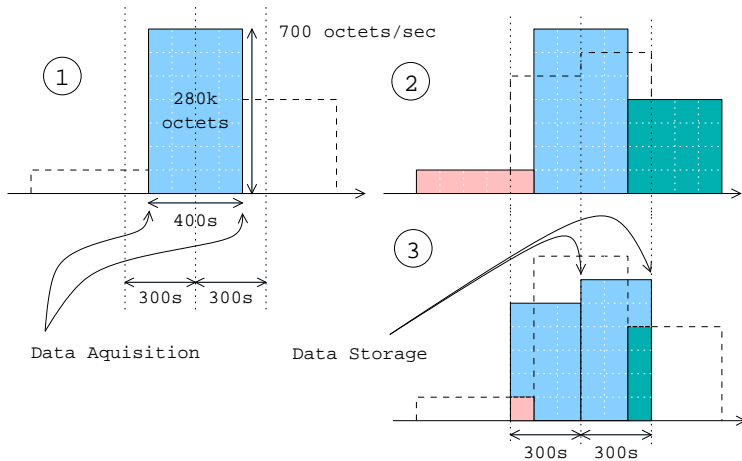
example

```
rrdtool update example.rrd \  
--template in N:39344
```

Data re-bin-ning

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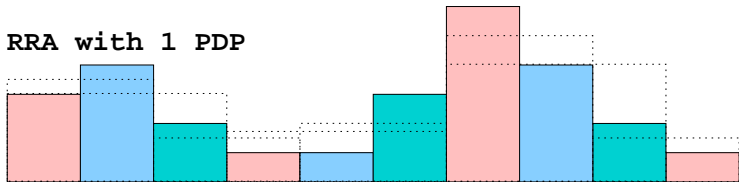
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Data Consolidation

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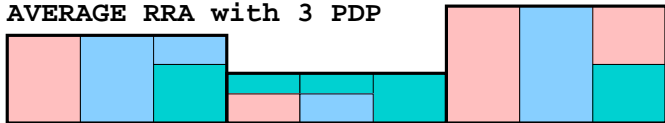
RRA with 1 PDP



AVERAGE RRA with 2 PDP



AVERAGE RRA with 3 PDP



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The first graph

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Command

```
rrdtool graph graph.png DEF:var=rrdfile:DS-name:CF  
LINE1:var#rrggb:label
```

1. prepare data (DEF)
2. draw graph (LINE1)

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Data processing with RPN (remember the HP days)

What if you have collected octets
but want to present bits?

Calculated time series and variables

CDEF:*var=RPN expression*

Examples

<code>a,8,*</code>	$a * 8$ (bit to byte conversion)
<code>a,b,+</code>	$a + b$
<code>a,b,c,IF</code>	if ($a \neq 0$) then b else c
<code>a,1800,TREND</code>	half-hour sliding window average
<code>a,b,c,LIMIT</code>	if ($a > b$ AND $a < c$) then a else 'UNKN'

Data processing with RPN

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Calculated single value variable

VDEF:*var=RPN expression*

var is associated with a time and a data value.

Examples

a, TOTAL	rate multiplied with interval
a, AVERAGE	average value of a
a,95, PERCENT	find 95-percentile

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MRTG like Graph

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Example

```
rrdtool graph graph.png \  
  DEF:in=data.rrd:input:AVERAGE \  
  DEF:out=data.rrd:output:AVERAGE \  
  AREA:in#ff0000:incoming \  
  LINE2:out#00ff00:outgoing
```

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Graph with marked maximum

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Example

```
rrdtool graph graph.png \  
  DEF:a=data.rrd:a:AVERAGE \  
  VDEF:max=a,MAXIMUM \  
  LINE2:a#00ff00:outgoing \  
  LINE1:max#ff0000:maximum\\g \  
  VRULE:max#ff0000 \  
  GPRINT:max:"at %.2lf"
```

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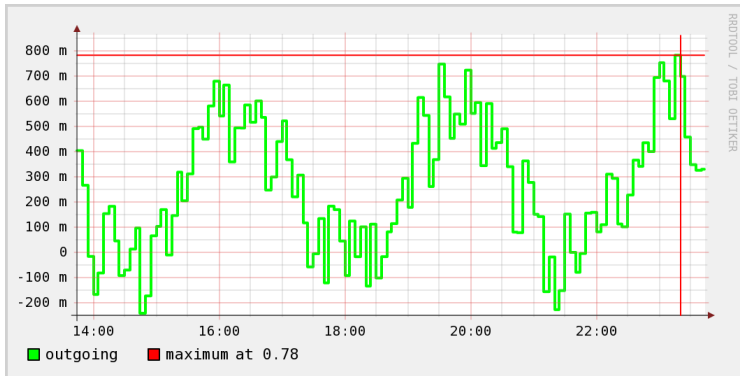
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Graph with 95 percentile

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Example

```
rrdtool graph.png \  
  DEF:in=data.rrd:input \  
  DEF:out=data.rrd:output \  
  CDEF:base=in,out,MAX \  
  VDEF:n95=base,95,PERCENT \  
  AREA:in#0000b0:incoming \  
  AREA:out#00ff0080:outgoing \  
  LINE1:base#000000:maximum \  
  LINE1:n95#ff0000:"95%-tile" \  
  GRPINT:n95:"at %.2lf %s"
```

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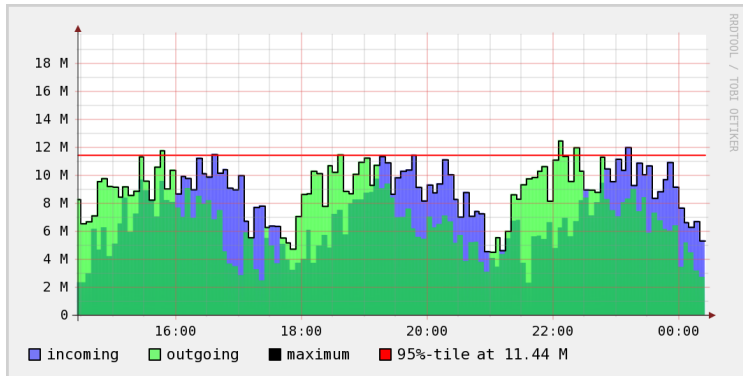
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Mailserver Statistics

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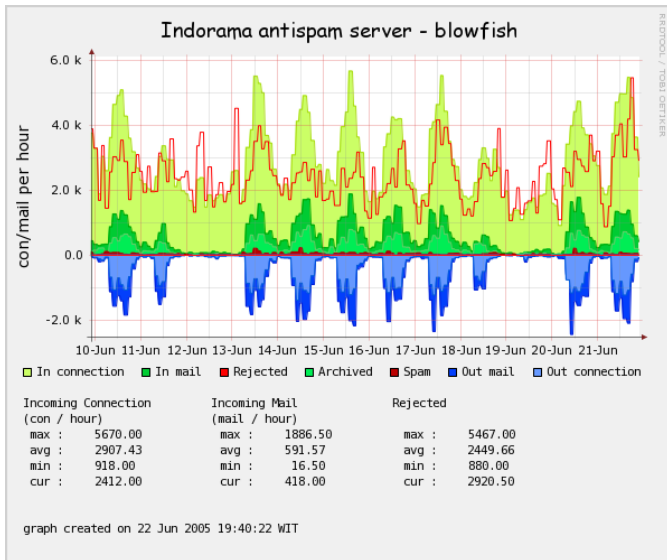
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- ▶ carefully design your RRD structure
- ▶ use RPN math to beat your data into form
- ▶ write your own monitors, RRDtool does the boring stuff
- ▶ look good

More information on ...

<http://www.rrdtool.org>

