

# NS-2

Introduction to the network  
simulator 2

# What NS-2 is not

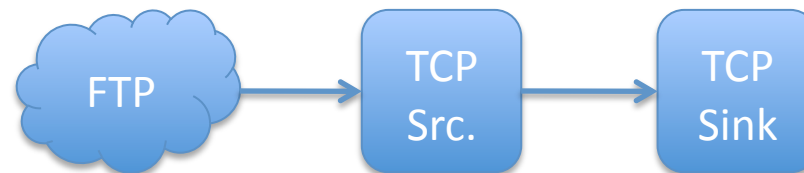
- A replacement for lab experiments
- Fast – runtime
- Bug free
- Well written software
- Without opponents
- Alone
  - [NS-3](#) – Written with Python bindings, fewer bugs, fewer features as of now...
  - [OPNET](#) – A commercial product
  - [GTNetS](#) – Open Source

# What NS-2 is

- A discrete-event network simulator
- Fast – development time
- Well accepted in the academic community
- Tested
- Different...

# Highest Level

- Nodes (Routers and end Systems)
- Links
  - Most of the configuration is done here
- Traffic generators
  - FTP
- Protocols
  - CBR, UDP, TCP



# Pragmatic usage

- Highly recommend usage on Linux
- Multi-core will not help, but lots of memory will
- Need working knowledge of Tcl (similar to bash)
- Zip your output, because there will be a lot...
  - `set tracefile [open "| gzip > file_name.gz" w]`
- Avoid using NAM
- Run a small test case before long runs

# Tcl To get Started

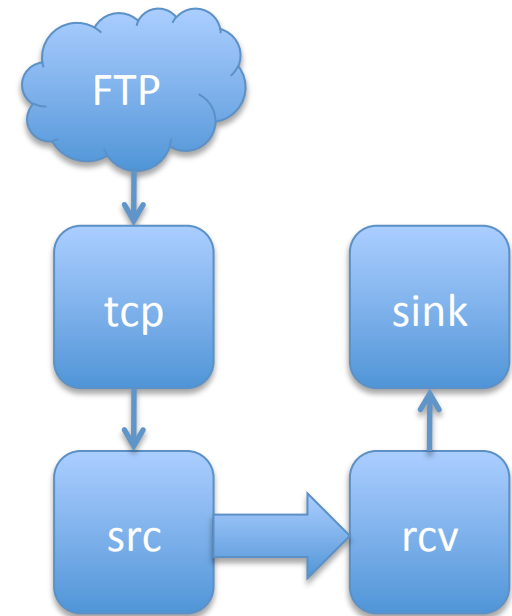
- Comments
  - `#` beginning of line comment
  - `...; #` end of line comment
- Assign to variable
  - `set stop 1000`
- Read from variable
  - `set end $stop`
- Output to stdout
  - `puts "Stopping at $stop"`

# Tcl Things to Know

- Learn these before your first NS-2 attempt.
  - Arrays – they save memory and speed things up
  - Basic file I/O
  - Flow control (if, else, for)
  - Expressions are very strange/verbose
  - Functions and Procedures

# Pragmatic Usage

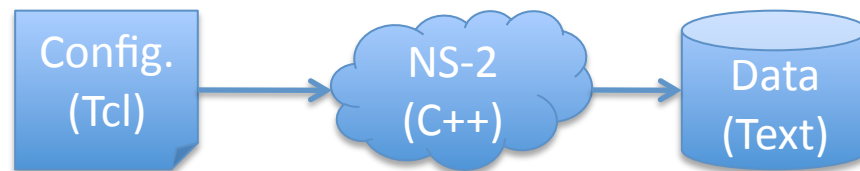
```
set ns [new Simulator]
set src [$ns node]
set rcv [$ns node]
$ns duplex-link $src $rcv 100Mb 10ms DropTail
set tcp [new Agent/TCP/Newreno]
$ns attach-agent $src $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $rcv $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
```





# Under the Hood

- Could be completely coded in an interpreted language, but what would be the problem?
- C++ is used for speed
- Tcl is used for flexibility
- The interaction between them can be confusing...



# Under the Hood Continued...

- Things I have hacked...
  - TCP Congestion Control Algorithm
  - Timer resolution
  - Event Trace format
- With the exception of the timer resolution all of my modifications have been in a handful of files.

# Your First Exp.

- We will create a framework and then fill in the details...
- Start simple (just the basics) then gradually add complexity. Skills like unit testing will come in handy here.
- I can't beat this...please look at this for the basics...

<http://nile.wpi.edu/NS/>

# Output

- Tracing – see chapter 26 in the NS-2 documentation
- Packet based tracing
  - +, -, r, d
  - headers
  - flags (see my decoding file)
- Periodic tracing
  - `$ns monitor-queue $n1 $n2 file_name interval`
- Event tracing – undocumented but very useful
  - See code example

# Learn GNU Plot

- Department machines have old versions of gnuplot, and things don't always port 100%
- Different “terminals” will have different options.
- There is a lot of style and preferences, but this is what works for me.
- There is some separation between commands and terminal types.
  - One style for working data so I can view the details
  - Another style for placing in papers or presentations

# Basic Plot File

```
set terminal jpeg giant transparent size 400,300
set output "file_name.jpg"
set title "A nice description"
set xlabel "Value (unit)"
set ylabel "Value (unit)"
set yrange [0:100]
set xrange [0:1000]
set logy
set grid
plot "< zcat file_name1.gz" using 1:2 with lines t "1", \
"< zcat file_name2.gz" using 1:2 with lines t "2", \
"< zcat file_name3.gz" using 1:2 with lines t "3"
quit
```

# Resources

- NS by Example – <http://nile.wpi.edu/NS/>
- NS Doc – [http://www.isi.edu/nsnam/ns/doc/ns\\_doc.pdf](http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf)
- Scripts and Files –
  - Data processing
  - Basic experiments
  - Flag keys
- NS-2 source
  - Use allinone – it is huge but it is worth the time savings
  - There is source available on the [NS-2 Site](#) but we will be using our local git repository
- gnuplot – <http://www.gnuplot.info/>