

EEC 687/787 Mobile Computing (Spring, 2007)

Ns-2 Laboratory #3 (January 29)

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Summarize Trace File using awk

```
r 100.381997477 _1_ AGT --- 82 cbr 1060 [13a 1 0 800] ---  
---- [0:0 1:0 32 1] [32 0] 1 0
```

r :receive event,	100.381997477 :time stamps,
1 :node 1,	AGT :trace generated by agent,
82 :event(pkt) id,	cbr : cbr packet,
1060 :packet size,	
13a(hex) :expected duration of pkt transmission (not working),	
1 :sender mac id,	0 :transmitter mac id,
800 :pkt type IP (806 for ARP),	0:0 : sender address:port#
1:0 : receiver address:port#,	32 : TTL
1 : next hop address,	[32 0] : TCP sequence #, ack #

awk

□ Script structure

➤ Initialization

```
BEGIN { ... }
```

➤ Body

```
{ ... }
```

Important: Every row in the trace file is scanned by the commands in the body part one time, just ONE time.

➤ Summarization

```
END { ... }
```

3

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An Example Of awk Script (fil2.awk)

```
BEGIN{ sim_end = 200;
  i=0;
  while (i<=sim_end) { sec[i]=0; i+=1;};
}

{ if ($1=="r" && $7=="cbr" && $3=="_1_") {
  sec[int($2)] += $8;
};
}

END{ i=0;
  while (i<=sim_end) {
  print i " " sec[i]*8;
  i+=1;
};
}
```

*Every line in the trace file
will be processed using the
awk commands in the body.*

***What're changes for
fil4.awk & fil6.awk?***

What does it show?

4

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Working with awk Scripts

```
awk -f fil2.awk out.tr > out2.xgr
```

```
awk -f fil4.awk out.tr > out4.xgr
```

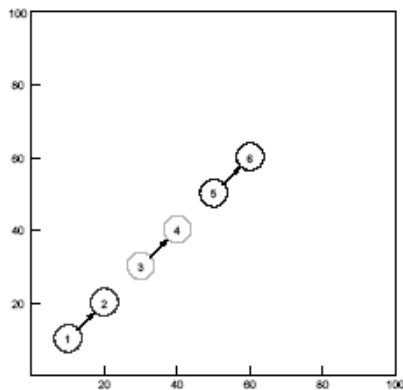
```
awk -f fil5.awk out.tr > out6.xgr
```

```
xgraph out2.xgr out4.xgr out6.xgr &
```

5

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Mobile Network Simulation with ns-2



- Adding finish procedure

```
$ns_ at $opt(stop).1 "finish"  
$ns_ at $opt(stop).2 "$ns_halt"
```

```
proc finish {} {  
  for {set i 2} {$i <= 6 } {incr i 2} {  
    exec rm -f out$i.xgr  
    exec awk -f fil$i.awk out.tr > out$i.xgr  
  }  
  exec xgraph out2.xgr out4.xgr out6.xgr &  
  puts "Finishing ns.."  
  exit 0  
}
```

6

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Another awk Script: How to get Delay?

```
BEGIN {
    idHighestPacket = 0 ;           idLowestPacket = 10000 ;
    rStartTime = 1000.0 ;          rEndTime = 0.0 ;
    nSentPackets = 0 ;             nReceivedPackets = 0 ;
    nReceivedBytes = 0 ;          rTotalDelay = 0.0 ;
}

{
    strEvent = $1 ;                rTime = $2 ;
    strAgt = $4 ;                  idPacket = $6 ;
    strType = $7 ;                 nBytes = $8 ;
}
```

7

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Another awk Script: How to get Delay?

```
if ( strAgt == "AGT" && strType == "cbr" ) {
    if ( idPacket > idHighestPacket ) idHighestPacket = idPacket ;
    if ( idPacket < idLowestPacket ) idLowestPacket = idPacket ;
    if ( rTime > rEndTime ) rEndTime = rTime ;
    if ( rTime < rStartTime ) rStartTime = rTime ;

    if ( strEvent == "s" ) {
        nSentPackets += 1 ; rSentTime[ idPacket ] = rTime ;
    }
    if ( strEvent == "r" && idPacket >= idLowestPacket ) {
        nReceivedPackets += 1 ;      nReceivedBytes += nBytes ;
        rReceivedTime[ idPacket ] = rTime ;
        rDelay[ idPacket ] = rReceivedTime[ idPacket ] - rSentTime[ idPacket ] ;
    }
}
}
```

8

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Another awk Script: How to get Delay?

```
END {
  rTime = rEndTime - rStartTime ;
  rThroughput = nReceivedBytes*8 / ( rEndTime - rStartTime ) ;
  rPacketDeliveryRatio = nReceivedPackets / nSentPackets * 100 ;
  for ( i=idLowestPacket; ( i<idHighestPacket ); i+=1 )
    rTotalDelay += rDelay[ i ] ;
  if ( nReceivedPackets != 0 )
    rAverageDelay = rTotalDelay / nReceivedPackets ;

  printf( "AverageDelay: %15.5f Throughput: %15.2f PacketDeliveryRatio: %10.2f\n",
    rAverageDelay, rThroughput, rPacketDeliveryRatio ) ;
  printf( "AverageDelay: %15.5f Throughput: %15.2f PacketDeliveryRatio: %10.2f\n",
    rAverageDelay, rThroughput, rPacketDeliveryRatio ) > "result-file" ;
}
```

9

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Mobile Network Simulation

- Number of nodes
- Moving range
- Initial positions
- Moving pattern
 - Direction
 - Velocity
 - Acceleration

- Node WT1 moves towards (90, 50) with speed 20m/s at time 15
\$ns_ at 15.0 "WT1 setdest 90.0 50.0 20.0"

10

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Mobility Model in ns-2

□ RWP (Random Waypoint) mobility model

- The most popular in simulation studies

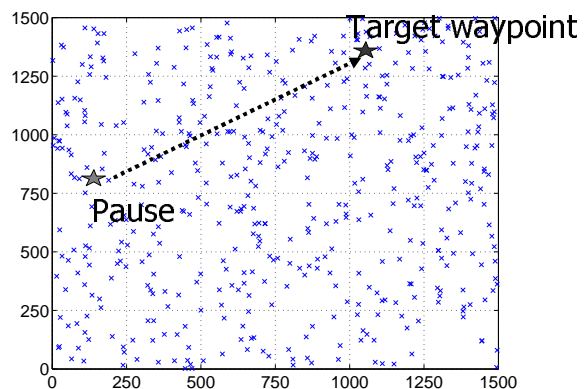
- Two parameters: Pause time and speed $[0, v_{\max}]$

- Pause ▶
- Select a waypoint randomly ▶
- Move toward it with a randomly chosen speed between $[0, v_{\max}]$ ▶
- Repeat

11

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RWP Mobility Model



12

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setdest

A Node-Movement Generator

- ❑ **Generating idea**
Node moves randomly. (distribution of nodes: uniform)
- ❑ **Location**
~ns/indep-utils/cmu-scen-gen/setdest/setdest{.cc; .h}
- ❑ **Command format (version 1)**
setdest -v 1 [-n ##] [-p ##] [-s ##] [-t ##] [-x ##] [-y ##]
- ❑ **Option explanation**
n: number of nodes; p: pause time; s: maximum speed;
t: simulation time; x: maximum x; y: maximum y
- ❑ `setdest -v 1 -n 50 -p 20 -s 5 -t 150 -x 300 -y 1500 > mob`

In run script

```
set opt(sc) "./mob"  
source $opt(cp)
```

13

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Simulation Study

- ❑ **Simulation study usually based on random numbers (seed)**
 - Results vary depending on the selection of seed number
 - One single simulation run does not tell us the true performance metrics
- ❑ **Methodology**
 - Run multiple simulation runs with different seed numbers
 - Take the average
- ❑ **Is it enough?**
 - Observed packet delays are 2.9, 3.0 and 4.1 seconds
 - Observed packet delays are 0.0, 3.0 and 6.0 seconds
 - Averages are 3.0 seconds in both cases but we are more "confident" about this value in the first case.

14

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Homework #1: Physical layer (due Monday, February 12)

- ❑ Goal
 - Ns-2 supports three different radio propagation models.
 - What is the effect of radio propagation model on network performance with the standard ad hoc network scenario in ns-2?
 - Shadowing model includes parameter(s) to determine the level of randomness.
 - Investigate the performance changes with different values of the parameter(s).
- ❑ Output
 - Simulation report including excel (or xgraph) charts with explanation and discussion.
 - Measure the PDR and delay versus node mobility in terms of pause time (0-900 seconds).
 - Consider also to measure different metrics such as signal strength or point-to-point delivery ratio versus distance.

15

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Scenario Files

- ❑ Standard scenario
 - 50 nodes, 300x1500m network area, simulation time of 900 seconds
 - 802.11, AODV
 - 20 CBR sources, two 256-byte packets/second
 - Maximum node speed 5m/s, pause time of 100 seconds
 - Locate the source files for Radio propagation model, 802.11 MAC, AODV network software

 - How to modify the “wireless-test.tcl”?
- ❑ Mobility generator: setdest
- ❑ Traffic generator: cbrgen

16

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cbrgen.tcl A CBR Traffic Generator

- What is CBR?
Constant Bit Rate.
- Generating idea
Randomly pick up node pairs as sources and destinations.
- Traffic generator
~ns/indep-utils/cmu-scen-gen/cbrgen.tcl
- Command format
ns cbrgen.tcl [-type ##] [-nn ##] [-seed ##] [-mc ##][-rate ##]

17

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cbrgen.tcl (cont.)

- Option explanation
 - type: traffic/connection type. Must be tcp or cbr.
 - nn: number of nodes.
 - seed: seed for generating random number. It is used to generate the random starting time of the traffic.
 - mc: maximum number of connections.
 - rate: packet rate = 1 / packet interval
- Generate real random traffic
cbrgen.tcl does not generate the real random traffic.

18

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cbrgen.tcl

A CBR Traffic Generator

- ❑ For 50 nodes, 20 connections and packet rate of 2.0
 ns cbrgen.tcl -type cbr -nn 50 -seed 1 -mc 20 -rate 2.0 > traffic.seed1
- ❑ Read “traffic.seed1” file
- ❑ Read “cbrgen.tcl”
 - How to determine packet size?
 - How to correctly make 20 connections?
 - When does each source start transmitting?
 - Who are the destinations?

19

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Specifying and Parameterizing the Propagation Model

- ❑ Goal is to compare three different radio propagation models.
 - Free space and two-way ground reflection models in fact comprise one model
 - Shadowing model is another
 - Compare Two-Ray with Shadowing, but Shadowing model can be parameterized (beta and stdev values)

```
# first set values of shadowing model
Propagation/Shadowing set pathlossExp_ 2.0 ;# path loss exponent
Propagation/Shadowing set std_db_ 4.0 ;# shadowing deviation (dB)
Propagation/Shadowing set dist0_ 1.0 ;# reference distance (m)
Propagation/Shadowing set seed_ 0 ;# seed for RNG
```

20

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Output (PDR and Delay) Versus Mobility

□ Output is PDR and Delay

- What is PDR (Packet delivery ratio)?
- How many packet are transmitted at the application layer?
- And, how many packets are actually received at the application layer?

- What is PDR in case of TCP traffic?

□ Versus mobility

- Pause time of 0s = constant movement (high mobility)
- Pause time of 900s = no mobility (low mobility)