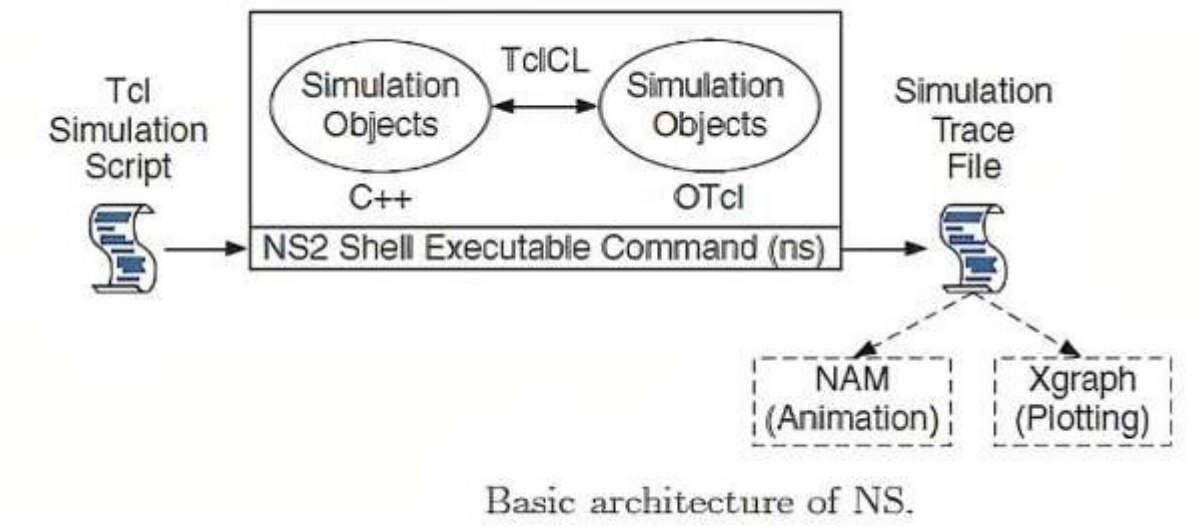
EX.NO:7	STUDY OF NETWORK SIMULATOR(NS)

Aim:

To study about NS2 Simulator in detail.

Theory:

Network Simulator (Version 2), widely known as NS2, is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors. Due to its flexibility and modular nature, NS2 has gained constant popularity in the networking research community since its birth in 1989



Basic architecture of NS.

The above figure shows the basic architecture of NS2. NS2 provides users with an executable command ns which takes on input argument, the name of a Tcl simulation scripting file. Users are feeding the name of a Tcl simulation script (which sets up a simulation) as an input argument of an NS2 executable command ns.

In most cases, a simulation trace file is created, and is used to plot graph and/or to create animation. NS2 consists of two key languages: C++ and Object-oriented Tool Command Language (OTcl). While the C++ defines the internal mechanism (i.e., a backend) of the simulation objects, the OTcl sets up simulation by assembling and configuring the objects as well as scheduling discrete events (i.e., a frontend).

The C++ and the OTcl are linked together using TCICL. Mapped to a C++ object, variables in the OTcl domains are sometimes referred to as handles. Conceptually, a handle (e.g., n as a Node handle) is just a string (e.g.,_010) in the OTcl domain, and does not contain any functionality.

instead, the functionality (e.g., receiving a packet) is defined in the mapped C++ object (e.g., of class Connector). In the OTcl domain, a handle acts as a frontend which interacts with users and other OTcl objects. It may defines its own procedures and variables to facilitate the interaction. Note that the member procedures and variables in the OTcl domain are called instance procedures (instprocs) and instance variables (instvars), respectively

Tcl scripting:

*Tcl is a general purpose scripting language. [Interpreter]
*Tcl runs on most of the platforms such as Unix, Windows, and Mac.
*The strength of Tcl is its simplicity.
*It is not necessary to declare a data type for variable prior to the usage

Basics of TCL:

Syntax: command arg1 arg2 arg3 Hello World! puts stdout(Hello, World!} Hello, World!

Variables:

Command Substitution
set a 5 set len [string length foobar] set b $a set len [expr [string length foobar] + 9]

Simple Arithmetic

expr 7.2/4

Procedures:

proc Diag {ab}{ set c [expr sqrt(aa+ $b● $b)] return $c) puts -Diagonal of a 3, 4 right triangle is [Diag 3 4]
Output:Diagonal of a 3,4 right triangle is 5.0.

Loops:

while {$i < $n} {
....
}
	for { set i 0 } { $i < $n } { incr i }
	{
	...
	}

NS Simulator Preliminaries.

1. Initialization and termination aspects of the ns simulator.
2. Definition of network nodes, links, queues and topology.
3. Definition of agents and of applications.

4. The nam visualization tool.
5. Tracing and random variables.

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Initialization and Techniques of TCL Script in NS-2

An ns simulation starts with the command

set ns [new Simulator]

Which is thus the first line in the tcl script? This line declares a new variable as using the set command, you can call this variable as you wish, In general people declares it as ns because it is an instance of the Simulator class, so an object the code[new Simulator] is indeed the installation of the class Simulator using the reserved word new.

In order to have output files with data on the simulation (trace files) or files used for visualization (nam files), we need to create the files using "open" command:

#Open the Trace file set tracefile1

[open out.tr w]

$ns trace-all $tracefile1

#Open the NAM trace file set

namfile [open out.nam w]

$ns namtrace-all $namfile

The above creates a dta trace file called-out.tr and a nam visualization trace file called || out.nam.Within the tcl script,these files are not called explicitly by their names, but || instead by pointers that are declared above and called -tracefile1 and -nam file respectively. Remark that they begins with a # symbol. The second line open the file -out.tr to be used for writing, declared with the letter -w. The third line uses a simulator || || method called trace-all that have as parameter the name of the file where the traces will go.

The last line tells the simulator to record all simulation traces in NAM input format. It also gives the file name that the trace will be written to later by the command $ns flush-trace. In our case, this will be the file pointed at by the pointer-$namfile,i.e the file-out.tr. The || termination of the program is done using a -finish procedure.

#Define a 'finish' procedure

Proc finish {} {
global ns tracefile1 namfile
$ns flush-trace
Close $tracefile1
Close $namfile

Exec nam out.nam &
Exit 0

The word proc declares a procedure in this case called finish and without arguments. The word global is used to tell that we are using variables declared outside the procedure. The simulator method-flush-trace" will dump the traces on the respective files. The tcl command-close" closes the trace files defined before and exec executes the nam program for visualization.

The command exit will ends the application and return the number 0 as status to the system. Zero is the default for a clean exit. Other values can be used to say that is a exit because something fails.

At the end of ns program we should call the procedure-finish and specify at what time the || termination should occur. For example,

$ns at 125.0 "finish"

will be used to call-finish || at time 125sec.Indeed, the at method of the simulator allows us to schedule events explicitly.

The simulation can then begin using the command

$ns run

Definition of a network of links and nodes

The way to define a node is

set no [$ns node]

The node is created which is printed by the variable no. When we shall refer to that node in the script we shall thus write $no. Once we define several nodes, we can define the links that connect them. An example of a definition of a link is:

$ns duplex-link $n0 $n2 10Mb 10ms DropTail

Which means that $no and $n2 are connected using a bi-directional link that has 10ms of propagation delay and a capacity of 10Mb per sec for each direction. To define a directional link instead of a bi-directional one, we should replace "duplexlink" by "simplexlink".

In NS, an output queue of a node is implemented as a part of each link whose input is that node. The definition of the link then includes the way to handle overflow at that queue. In our case, if the buffer capacity of the output queue is exceeded then the last packet to arrive is dropped. Many alternative options exist, such as the RED (Random Early Discard) mechanism, the FQ (Fair Queuing), the DRR (Deficit Round Robin), the stochastic Fair Queuing (SFQ) and the CBQ (which including a priority and a round-robin scheduler). In ns, an output queue of a node is implemented as a part of each link whose input is that node. We should also define the buffer capacity of the queue related to each link.

An example would be:

#set Queue Size of link (n0-n2) to 20

$ns queue-limit $n0 $n2 20

Agents and Applications.

We need to define routing (sources, destinations) the agents (protocols) the application that use them

FTP over TCP

TCP is a dynamic reliable congestion control protocol. It uses Acknowledgements created by the destination to know whether packets are well received. There are number variants of the TCP protocol, such as Tahoe, Reno, NewReno, Vegas. The type of agent appears in the first line:

set tcp [new Agent/TCP]

The command $ns attach-agent $n0 $tcp defines the source node of the tcp connection. The command

set sink [new Agent /TCPSink]

Defines the behavior of the destination node of TCP and assigns to it a pointer called sink

#Setup a UDP connection

```
set udp [new Agent/UDP]
$ns attach-agent $n1 $udp set null [new Agent/Null]
$ns attach-agent $n5 $null
$ns connect $udp $null
$udp set fid_2
```

#setup a CBR over UDP connection

```
set cbr [new
Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set packetsize_100
$cbr set rate 0.01Mb
$cbr set random_false
```

Above shows the definition of a CBR application using a UDP agent. The command $ns attachagent $n4 $sink defines the destination node. The command $ns connect $tcp $sink finally makes the TCP connection between the source and destination nodes.

TCP has many parameters with initial fixed defaults values that can be changed if mentioned explicitly. For example, the default TCP packet size has a size of 1000bytes. This can be changed to another value, say 552bytes, using the command $tcp set packetSize_552.

When we have several flows, we may wish to distinguish them so that we can identify

them with different colors in the visualization part. This is done by the command $tcp set fid 1 that assigns to the TCP connection a flow identification of "1".We shall later give the flow identification of "2" to the UDP connection.

CBR over UDP

A UDP source and destination is defined in a similar way as in the case of TCP. Instead of defining the rate in the command $cbr set rate_ 0.01Mb, one can define the time interval between transmission of packets using the command.

Scbr set interval 0.005

The packet size can be set to some value using

$cbr set packetSize_<packet

size> Scheduling Events

NS is a discrete event based simulation. The tcp script defines when event should. occur. The initializing command set ns [new Simulator] creates an event scheduler, and events are then scheduled using the format: $ns at <time><event>

The scheduler is started when running ns that is through the command $ns run. The beginning and end of the FTP and CBR application can be done through the following command

$ns at 0.1 "$cbr start"
$ns at 1.0" $ftp start"
$ns at 124.0 "$ftp stop"
$ns at 124.5 "$cbr stop"

Result:

To study about NS2 Simulator in detail is successful.