PERCOBAAN 3

SIMULASI WIFI (Wireless AP-Client)

4.1 Tujuan :

Setelah melaksanakan praktikum ini mahasiswa diharapkan mampu :

- Mendesain dan memprogram jaringan WIFI menggunakan NS-3.
- Memahami dan membandingkan hasil trace output jaringan WIFI pada NS-3 menggunakan Tracemetrics.

4.2 Peralatan :

- 1 PC dilengkapi dengan OS Ubuntu 22.04
- Software NS-3 versi 3.36
- Software Tracemetrics

4.3 Teori :

Dalam simulasi Wireless Fidelity atau Wifi kita perlu melihat terlebih dahulu parameter yang digunakan untuk standar Wifi itu sendiri. Salah satu yang paling krusial adalah penggunaan Standar 802.11. Kemudian pada simulasi Wifi ini terdapat dua jenis node yaitu Station (Sta) dan Access Point (AP).

Selain itu, pada simulasi Wifi ini objek helper yang digunakan adalah WifiHelper dan WifiMacHelper yang dibuat untuk mengatur beberapa atribut lain.

Sama halnya seperti pada simulasi sebelumnya, pada simulasi Wifi ini output visualnya dapat dilihat pada Netanim. Skrip konfigurasi Netanim untuk simulasi ini adalah seperti yang ditunjukkan di bawah ini.

> // Animation configuration lines AnimationInterface anim ("mythird.xml"); anim.EnablePacketMetadata(true); // End of animation configuration

Sedangkan, untuk melihat trace outputnya, masih sama yaitu dengan menggunakan Tracemetrics, dimana skrip konfigurasi ascii tracing yang perlu ditambahkan sebelumnya adalah seperti berikut.

```
//Ascii Format Tracing
AsciiTraceHelper ascii;
phy.EnableAsciiAll(ascii.CreateFileStream("mythird.tr"));
```

4.4 Prosedur Percobaan :

1. Buka direktori *ns-allinone-3.36.1/ns-3.36.1/scratch* melalui terminal. Copykan dari examples/tutorial/third.cc

Namun gabungan antara wireless dan wireline. Edit program agar sesuai dengan dibawah agar full wireless.

2. Tuliskan perintah gedit dengan nama file *third.cc* seperti berikut.

gedit third.cc

 Tuliskan script di bawah ini, dimana script ini merupakan simulasi sederhana Wifi empat node.

```
#include "ns3/core-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/network-module.h"
#include "ns3/applications-module.h"
#include "ns3/mobility-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/yans-wifi-helper.h"
#include "ns3/ssid.h"
// Default Network Topology
11
11
    Wifi 10.1.3.0
11
                  AP
    *
         *
              *
                  *
11
    11
                       10.1.1.0
// n5
                 n0 ----- n1
                                                  n4
                                        n2
                                             n3
       n6
            n7
//
                    point-to-point |
                                        //
                                     _____
11
                                      LAN 10.1.2.0
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("ThirdScriptExample");
int
main (int argc, char *argv[])
{
```

```
bool verbose = true;
  uint32_t nCsma = 3;
  uint32_t nWifi = 3;
  bool tracing = false;
  CommandLine cmd (__FILE__);
  cmd.AddValue ("nCsma", "Number of \"extra\" CSMA
nodes/devices", nCsma);
  cmd.AddValue ("nWifi", "Number of wifi STA devices", nWifi);
  cmd.AddValue ("verbose", "Tell echo applications to log if
true", verbose);
  cmd.AddValue ("tracing", "Enable pcap tracing", tracing);
  cmd.Parse (argc,argv);
  // The underlying restriction of 18 is due to the grid position
  // allocator's configuration; the grid layout will exceed the
  // bounding box if more than 18 nodes are provided.
  if (nWifi > 18)
    {
      std::cout << "nWifi should be 18 or less; otherwise grid</pre>
layout exceeds the bounding box" << std::endl;</pre>
      return 1;
    }
  if (verbose)
    {
      LogComponentEnable ("UdpEchoClientApplication",
LOG_LEVEL_INFO);
      LogComponentEnable ("UdpEchoServerApplication",
LOG_LEVEL_INFO);
    }
  NodeContainer p2pNodes;
  p2pNodes.Create (2);
  PointToPointHelper pointToPoint;
  pointToPoint.SetDeviceAttribute ("DataRate", StringValue
("5Mbps"));
  pointToPoint.SetChannelAttribute ("Delay", StringValue
("2ms"));
  NetDeviceContainer p2pDevices;
  p2pDevices = pointToPoint.Install (p2pNodes);
  NodeContainer csmaNodes;
  csmaNodes.Add (p2pNodes.Get (1));
  csmaNodes.Create (nCsma);
  CsmaHelper csma;
  csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
  csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds
(6560)));
  NetDeviceContainer csmaDevices;
  csmaDevices = csma.Install (csmaNodes);
```

```
NodeContainer wifiStaNodes;
 wifiStaNodes.Create (nWifi);
 NodeContainer wifiApNode = p2pNodes.Get (0);
 YansWifiChannelHelper channel = YansWifiChannelHelper::Default
();
 YansWifiPhyHelper phy;
 phy.SetChannel (channel.Create ());
 WifiMacHelper mac;
 Ssid ssid = Ssid ("ns-3-ssid");
 WifiHelper wifi;
 NetDeviceContainer staDevices;
 mac.SetType ("ns3::StaWifiMac",
               "Ssid", SsidValue (ssid),
               "ActiveProbing", BooleanValue (false));
 staDevices = wifi.Install (phy, mac, wifiStaNodes);
 NetDeviceContainer apDevices;
 mac.SetType ("ns3::ApWifiMac",
               "Ssid", SsidValue (ssid));
  apDevices = wifi.Install (phy, mac, wifiApNode);
 MobilityHelper mobility;
 mobility.SetPositionAllocator ("ns3::GridPositionAllocator",
                                 "MinX", DoubleValue (0.0),
                                 "MinY", DoubleValue (0.0),
                                 "DeltaX", DoubleValue (5.0),
                                 "DeltaY", DoubleValue (10.0),
                                 "GridWidth", UintegerValue (3),
                                 "LayoutType", StringValue
("RowFirst"));
 mobility.SetMobilityModel ("ns3::RandomWalk2dMobilityModel",
                             "Bounds", RectangleValue (Rectangle
(-50, 50, -50, 50));
 mobility.Install (wifiStaNodes);
 mobility.SetMobilityModel
("ns3::ConstantPositionMobilityModel");
 mobility.Install (wifiApNode);
 InternetStackHelper stack;
 stack.Install (csmaNodes);
 stack.Install (wifiApNode);
 stack.Install (wifiStaNodes);
 Ipv4AddressHelper address;
 address.SetBase ("10.1.1.0", "255.255.255.0");
 Ipv4InterfaceContainer p2pInterfaces;
 p2pInterfaces = address.Assign (p2pDevices);
 address.SetBase ("10.1.2.0", "255.255.255.0");
```

```
Ipv4InterfaceContainer csmaInterfaces;
  csmaInterfaces = address.Assign (csmaDevices);
  address.SetBase ("10.1.3.0", "255.255.255.0");
  address.Assign (staDevices);
  address.Assign (apDevices);
  UdpEchoServerHelper echoServer (9);
  ApplicationContainer serverApps = echoServer.Install
(csmaNodes.Get (nCsma));
  serverApps.Start (Seconds (1.0));
  serverApps.Stop (Seconds (10.0));
  UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress
(nCsma), 9);
  echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
  echoClient.SetAttribute ("Interval", TimeValue (Seconds
(1.0)));
  echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
  ApplicationContainer clientApps =
    echoClient.Install (wifiStaNodes.Get (nWifi - 1));
  clientApps.Start (Seconds (2.0));
  clientApps.Stop (Seconds (10.0));
  Ipv4GlobalRoutingHelper::PopulateRoutingTables ();
  Simulator::Stop (Seconds (10.0));
  if (tracing)
    {
      phy.SetPcapDataLinkType
(WifiPhyHelper::DLT_IEEE802_11_RADIO);
      pointToPoint.EnablePcapAll ("third");
      phy.EnablePcap ("third", apDevices.Get (0));
      csma.EnablePcap ("third", csmaDevices.Get (0), true);
    }
  Simulator::Run ();
 Simulator::Destroy ();
  return 0;
}
```

4. Buka direktori ns-allinone-3.36.1/ns-3.36.1 dan jalankan program tersebut

menggunakan ns3 dengan menuliskan perintah seperti di bawah ini.

```
zenhadi@zenhadi-vm:~/Downloads/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/third.cc
[ 0%] Building CXX object scratch/CMakeFiles/scratch_third.dir/third.cc.o
[ 0%] Linking CXX executable ../../build/scratch/ns3.36.1-third-default
At time +2s client sent 1024 bytes to 10.1.2.4 port 9
At time +2.01624s server received 1024 bytes from 10.1.3.3 port 49153
At time +2.01624s server sent 1024 bytes to 10.1.3.3 port 49153
At time +2.02849s client received 1024 bytes from 10.1.2.4 port 9
```

5. Tambahkan kode berikut agar bisa ditampilkan animasinya:

Bagian header:

#include "ns3/netanim-module.h"

Bagian Tengah:

```
mobility.SetMobilityModel ("ns3::ConstantPositionMobilityModel");
mobility.Install (wifiApNode);
mobility.Install (csmaNodes); //
```

Bagian bawah:

// Animation configuration lines

AnimationInterface anim ("mythird0.xml");

anim.EnablePacketMetadata(true);

// End of animation configuration

```
// Animation configuration lines
AnimationInterface anim ("mythird0.xml");
anim.EnablePacketMetadata(true);
// End of animation configuration
//Ascii Format Tracing
AsciiTraceHelper ascii;
phy.EnableAsciiAll(ascii.CreateFileStream("mythird0.tr"));
```

6. Kemudian, buka direktori *ns-allinone-3.36.1/netanim-3.108* buka Netanim dengan menuliskan command berikut.

zenhadi@zenhadi-vm:~/Downloads/ns-allinone-3.36.1/netanim-3.108\$./NetAnim

7. Buka file *mythird.xml* dengan cara klik icon Open File di pojok kiri atas dan akan muncul tampilan berikut.

		///////////////////////////////////////	-3.23			Lø 🕒	- (
💄 Com	Name	*	Size	Туре	Date Mod	lified	
root	CHANGES.html		124 KB	html File	24/03/16	11.36	-
	different.pcap		216tes	pcap File	17/04/19	19.14	
	DIMacStats.txt		56 KB	txt File	17/04/19	19.16	
	DIPdcpStats.txt		190tes	txt File	17/04/19	19.16	
	DIRIcStats.txt		728tes	txt File	17/04/19	19.17	
	LICENSE		17 KB	File	24/03/16	11.36	
	Makefile		256tes	File	24/03/16	11.36	
	myfourth.xml		35 KB	xml File	03/05/19	17.05	
	mysecond.tr		7 KB	tr File	16/05/19	08.35	
	mysecond.xml		4 KB	xml File	16/05/19	08.35	
	mythird.tr		200 KB	tr File	16/05/19	14.43	
	mythird.xml		73 KB	xml File	16/05/19	14.43	
	ptop.tr		1 KB	tr File	13/05/19	14.48	
	ptop.xml		794tes	xml File	13/05/19	14.48	
	README		3 KB	File	24/03/16	11.36	
	RELEASE_NOTES		123 KB	File	24/03/16	11.36	
	second-0-0.pcap		2 KB	pcap File	16/05/19	08.35	
	Character & Barren		-	man Pila	17/04/100	20.02	

8. Jalankan simulasi tersebut dengan klik icon Play berwarna hijau di pojok kiri atas.



9. Ketika dijalankan, node – node yang ditampilkan seperti yang ditunjukkan pada gambar di bawah ini.



10. Tambahkan kode berikut untuk tracing file pada sistem komunikasi yang sudah dibangun.

//Ascii Format Tracing
AsciiTraceHelper ascii;
phy.EnableAsciiAll(ascii.CreateFileStream("mythird0.tr"));

```
//Ascii Format Tracing
AsciiTraceHelper ascii;
phy.EnableAsciiAll(ascii.CreateFileStream("mythird0.tr"));
Simulator::Run ();
Simulator::Destroy ();
return 0;
```

11. Untuk mengetahui trace outputnya, buka direktori tracemetrics-1.4.0.

Gunakan *tracemetrics-1.3.0* jika masih gagal dengan versi 1.4.0. https://stackoverflow.com/questions/65045027/exception-when-trying-torun-tracemetrics-with-ns3

Kemudian, buka file *tracemetrics.jar* melalui terminal dengan menuliskan perintah berikut.

```
root@dina-Inspiron-5458:/home/Softwares/tracemetrics-1.4.0# java -jar "tracemetrics.jar"
```

Maka, akan muncul tampilan seperti di bawah ini.



12. Buka file *mythird.tr* dengan cara klik File \rightarrow Choose File.



13. Setelah itu, akan muncul tampilan seperti di bawah ini. Kemudian, klik Execute analysis.

😣 🖨 🛛 TraceMetrics - a tr	ace analyzer f	or Network Simulator 3
File Tools Help		
	Name:	mythird.tr
	Size:	205241 bytes. (200.43 KB)
	Modified:	Thu May 16 14:43:05 WB 2019
File's attributes:	Path:	/home/Softwares/ns-allinone-3.25/ns-3.25
Read 🖌 🌱		
Write 🖌 🖌		
Execute 😣		
		C Execute analysis

14. Hasil trace output untuk simulasi Wifi ini adalah seperti berikut.

	s - a trace analyzer fo	or Network Simulator 3		8	Trac	eMetrics - a trace an	alyzer for Ne	twork Simulator 3
File Tools Help				File	Tools He	elp		
Simulation Nodes	Throughput / Goodput L	ittle's Result Streams		Sin	nulation	Nodes Throughput / G	aoodput Little's	Result Streams
Details				Details				
cite :	h		of the shind to	NOG				
File:	/nome/So	ittwares/hs-allinone-3.25/hs-3.	25/mythird.tr	1		Sent packets: 2		
Total enqueued pa	ackets: 0			2	_	Received packets:	:	108
Total sent packets	: 110			3	_	Dropped packets:	()
Total received pac	kets: 330					Data sent:	(0.0 B
Total dropped pac	kets: 0					Data received: 0.0	08	
Total simulation ti	me: 9.93291 s	seconds				Throughput:	08	0.B
Time of analisys:	Os					Goodput:		0.0 B
						Lambda:	(0.2013508629394608
						EN:	(0.0
						EW:	(0.0
						Little's result:		
						-> EN:	(0.0
						-> EW*lambda:	(0.0
						Average length of:		
						-> Sent packets:	ate (0.0 B
🗖 🦱	ee a teaco analyzar	For Notwork Cimulator 2			Mahalar	-> Received pack	fee blobused	Simulates 3
- Hacemeth	cs - a crace analyzer	TOT NELWORK SIIIdtacor S	U	acer	Mecric	s - a trace analyzer	FOF NELWORK	Simulator 5
ile Tools Help			File Tools	Help)			
Simulation Nodes	Throughput / Goodput	Little's Result Streams	Simulatio	on N	Nodes	Throughput / Goodput	Little's Result	Streams
Node Detail	s		Nada		Details	1		
0			Node	- 1	-			
1 Sen	t packets: 2		1		Sent	packets: 2		
2 Rec	eived packets:	108	2		Recei	ived packets:	108	
3 Dro	pped packets:	0	3		Drop	ped packets:	0	
Data	a sent:	0.0 B			Data	sent:	0.0 B	
Dat	a received: 0.0 B				Data	received: 0.0 B		
Data	a dropped: 0.0 B				Data	dropped: 0.0 B		
Thro	sughput:	0.0 B			Throu	ughput:	0.0 B	
Goo	aput:	0.0 B			Good	iput:	0.0 B	
Lan	ioda:	0.2013508629394608	6		Lamb	oda:	0.2013	5086293946086
EN:		0.0			EN:		0.0	
EW:	ale regult:	0.0			EW:		0.0	
Litti	e s result:	0.0			Little	's result:		
	EW#lambda:	0.0			-> E	IN:	0.0	

😕 🖨 🛛 Tra	ceMetri	cs - a trace	analyzer	for Network	Simulator	3 😣 🖨	TraceMetr	ics - a trace ana	lyzer for Network	Simulator 3	
File Tools H	Help					File To	ols Help				
Simulation	Nodes	Throughput	/ Goodput	Little's Result	Streams	Simul	ation Nodes	Throughput / Go	odput Little's Result	Streams	
Node	Detail	s									
0						Node	Throughput			Goodput	
1	Sen	t packets:	104			0	0.0			0.0	
2	Rec	eived packet	S:	6		1	0.0			0.0	
3	Dro	pped packet	S:	0 0.0 B		2	2 0.0				
	Data	a sent:				3	0.0			0.0	
	Data	a received:	0.0 B								
	Data	a dropped:	0.0 B								
	Thre	ughput:		0.0 B							
	Goo	dput:		0.0 B							
	Lam	nbda:		10.4702	448728519	64					
	EN:			0.0							
	EW:			0.0							
	Little	e's result:									
	->	EN:		0.0							
	->	EW*lambda		0.0							
	Ave	rage length (of:								
	->	Sent packet	S:	0.0 B							
	->	Received pa	ckets:	0.0 B							
😕 😑 🛛 Tra	ceMetri	cs - a trace	analyzer	for Network	Simulator	13					
File Tools H	Help										
Simulation	Nodes	Throughput	/ Goodput	Little's Result	Streams						
Node Lan	nbda		E[W]		E[N]		E[W]	* Lambda			
0 0.2	01350862	93946086	0.0		0.0		0.0				
1 0.2	01350862	93946086	0.0		0.0		0.0				
2 0.2	01350862	93946086	0.0		0.0		0.0				
3 10.4	10.470244872851964 0.0 0.0						0.0				

Buat grafik excel untuk throughput, goodput dan lambda.

4.5 Analisa

- Pada percobaan ini, coba ubahlah nilai *Rectangle Value* menjadi (-100, 100, -100, 100).
- Amatilah perubahan yang terjadi.