5.1 Explain how different tools are used in network maintenance and performance monitoring.

Network Maintenance Tools

Help the network to run smoothly, identify potential issues, and perform regular maintenance.

Ping: Ping tool is used to check network connectivity and trace the path packets take to reach a destination, identifying latency issues or routing problems.

```
root@ip-10-10-172-234:~# ping -c 5 5.134.9.101
PING 5.134.9.101 (5.134.9.101) 56(84) bytes of data.
64 bytes from 5.134.9.101: icmp_seq=1 ttl=52 time=12.6 ms
64 bytes from 5.134.9.101: icmp_seq=2 ttl=52 time=12.6 ms
64 bytes from 5.134.9.101: icmp_seq=3 ttl=52 time=12.6 ms
64 bytes from 5.134.9.101: icmp_seq=4 ttl=52 time=12.5 ms
64 bytes from 5.134.9.101: icmp_seq=5 ttl=52 time=12.6 ms

--- 5.134.9.101 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 12.599/12.648/12.698/0.129 ms
```

Fig (5.1/1) shows the ping output of WAES IP address is online and reachable. It has transmitted five packets, and we received five replies. Also we can see it took 12.648 ms for the reply to reach to my system, with the maximum being 12.698 ms.

Traceroute: Traceroute tool is used to find the IP addresses of the routers or hops that a packet traverses between a system and host. This commands also reveals the number of routers between the two systems.

```
root@ip-10-10-172-234:~# traceroute waes.ac.uk
traceroute to waes.ac.uk (5.134.9.101), 30 hops max, 60 byte packets
 1  100.91.211.47 (100.91.211.47)  10.113 ms 100.91.211.1 (100.91.211.1)  9.431
ms 100.91.211.51 (100.91.211.51)  9.334 ms
 2  100.100.6.9 (100.100.6.9)  36.037 ms 100.100.6.41 (100.100.6.41)  36.132 ms
100.100.6.65 (100.100.6.65)  56.263 ms
 3  100.100.92.6 (100.100.92.6)  9.940 ms * 100.100.64.6 (100.100.64.6)  9.899 m

 4  * 100.100.84.143 (100.100.84.143)  25.558 ms 100.100.89.143 (100.100.89.143)
  9.811 ms
 5  100.100.14.82 (100.100.14.82)  9.401 ms 100.100.14.84 (100.100.14.84)  9.401
 ms 100.100.14.86 (100.100.14.86)  9.395 ms
 6  ld5-linx.as29550.net (195.66.236.223)  9.774 ms  9.604 ms  9.552 ms
 7  ae0-cr0.the.as29550.net (91.186.5.254)  11.450 ms  11.398 ms  11.406 ms
 8  ae1-cr0.rdg.as29550.net (91.186.5.250)  11.563 ms  11.575 ms  11.560 ms
 9  213-229-127-74.static.as29550.net (213.229.127.74)  14.234 ms  14.249 ms  18
.981 ms
10  85.92.93.66 (85.92.93.66)  15.442 ms  13.309 ms  13.345 ms
11  . (81.19.189.1)  19.430 ms  21.514 ms  20.076 ms
12  gsp13.guru.net.uk (5.134.9.101)  11.622 ms !X  11.617 ms !X  11.544 ms !X
```

Fig (5.1/2) Using traceroute to find the Ip addresses of the routers. In this traceroute output shows replies from 12 different routers/hops.

Network Performance monitoring tools

Wireshark – is a packet analysis tool used to capture and analyzes network traffic at the packet level. It creates and analyzes PCAPs (network packet capture files) and helps diagnose network issues and identify security threats.

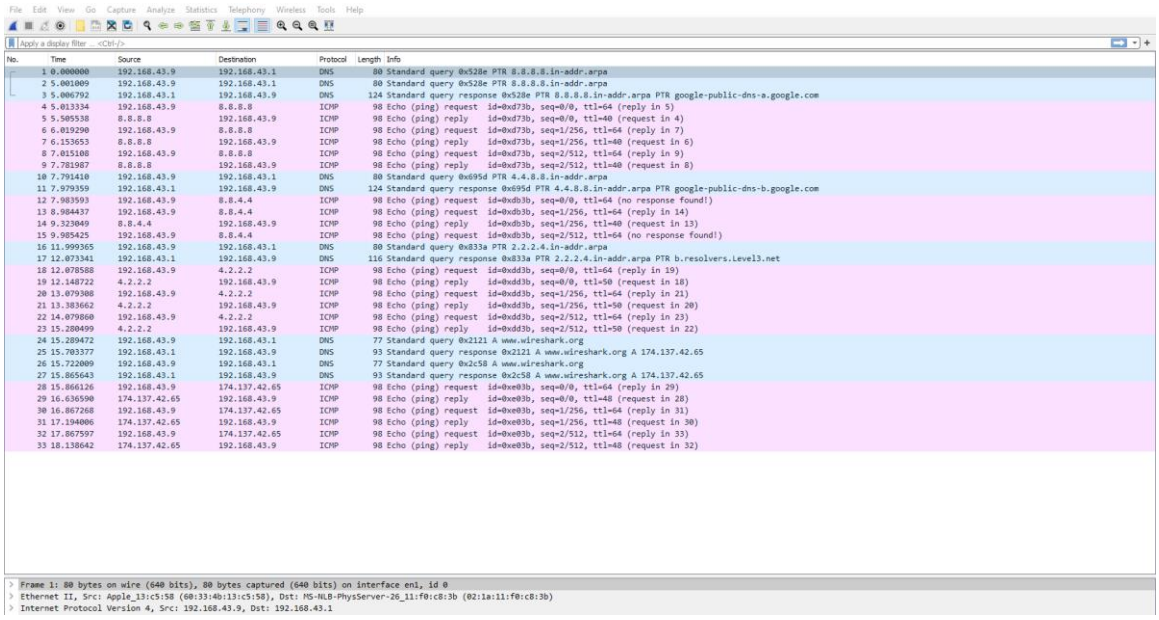

Fig (5.1/3)In this screen, Wireshark gives important information about each packet including packet number, time, source, destination, protocol, length, and packet info.

Nagios – Monitor network devices, services, and applications for performance and availability. It sends alerts on breaches. Also provides detailed reports and includes a wide range of extended functionality.

SolarWinds Network Performance Monitor (NPM) - a tool to monitor network performance including real-time visibility into bandwidth usage, device status, and network health. Its features include intuitive dashboards, automated network discovery, and advanced alerting.

ManageEngine OpManager – monitor network performance, servers, and virtual enivronments by providing real-time status and alerts. It can perform network mapping, root cause analysis, and performance reports.