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Analysis and Fractal behavior of Network Traffic Data Based on Topology

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Abstract: *Now a day's communication technology plays a vital role each and every one's life. People are hurry for fast and uninterrupted communication. In this paper it has been illustrated the fractal behavior of data in network. By creating three type of network it has been observed that topology plays vital role in data communication by using different devices it shows fractal behavior.*

Keyword: *Fractal, Switch, Protocol, DNS, TCP, UDP*

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I. INTRODUCTION

Network communication technology is growing rapidly day to day. In the late 19th century the network communication technology growing rapidly and is dominated by the use of telephone. In the 20th century, a new network communication generation was evolved: that of Internet. In the 21st century, the numbers of Internet users are growing exponentially. Every year the internet users increase by millions and thereby putting a lot of pressure on network traffic. Research has been done for well-developed tools from statistical mechanics and thermodynamics, spectral graph theory, and percolation theory among others to enhance the understandings of fields such as Internet topology and social network analysis previously only researched by the network engineering and sociology communities [1].

Internet traffic is dynamic and it is growing very rapidly. In last 15 year internet topology is also growing very fast. Different terms like, "self-similarity", "multifractal", and "critical phenomena" have been come in to mind to redesign the internet and study it behaviors. In the following Figure1[1] they tried to give a full diagram and function of world views operate. If someone is trying to see which view is completely "right" or "wrong" they are missing the point that the Internet is in some part everything that both sides describe. Physicists may be provided more exact information on the workings of packet switching systems in the Internet. Here it has been models and simulations and validates the model in order to allow us to better test our predictions against reality, build more realistic models and simulations on dynamic network.

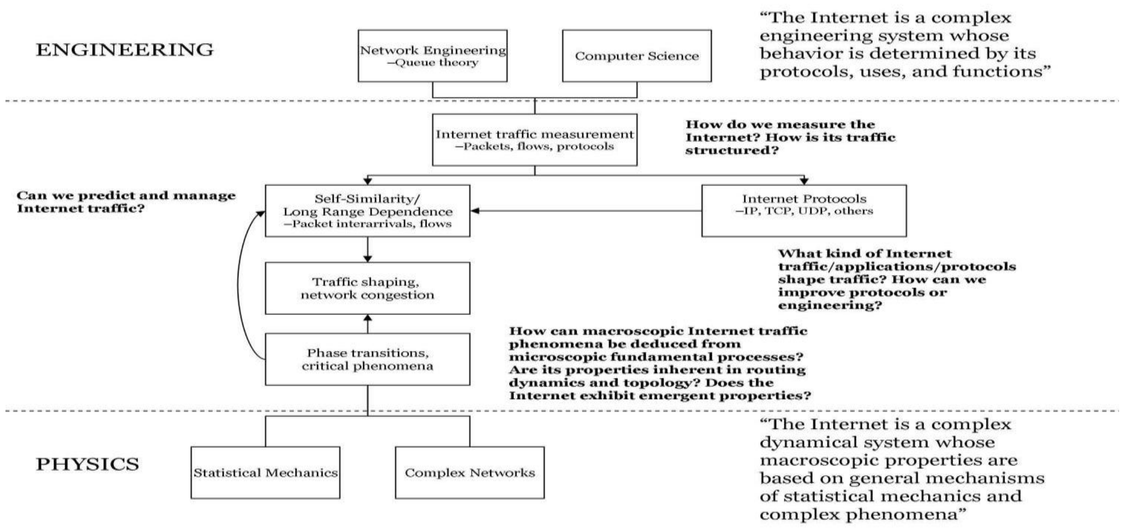

Figure1: Role of Network engineers and physicists in Dynamic Network[1].

Layer Name	Layer Number	Description	Protocols
Application	7	Network applications such as terminal emulation and file transfer	HTTP, DNS, SMTP
Presentation	6	Formatting of data and encryption	SSL
Session	5	Establishment and maintenance of sessions	TCP sessions
Transport	4	Provision of reliable and unreliable end-to-end delivery	TCP, UDP
Network	3	Packet delivery, including routing	IP
Data Link	2	Framing of units of information and error checking	Ethernet, ATM
Physical	1	Transmission of bits on the physical hardware	10BASE-T, SONET, DSL

Table 1: Breakdown of 7 layer OSI model. Descriptions taken from [2].

II. PACKETS AND OSI.

In 1969, the first packet switching network was developed it is known as ARPANET. Packet is the main unit of all Internets. A packet is a discrete bundle of data which is transmitted over the Internet containing a source and destination address, routing instructions, data description, a checksum, and data payload. Packet handling and traffic management are governed by a complex set of rules and algorithms collectively defined as a protocol. In network different protocol are available to handle different protocol, they are responsible for transferring and handling the data and controlling the traffic in the network. In network there are Open Systems Interconnection (OSI) model. It contents 7 layers the working and Protocol working upon are given in Table 1. Other some protocols are available such as SMTP, which starts a TCP connection and it take the help of IP packets to deliver data. In transport and network protocol combines TCP/IP. The higher layers (higher number) always initiate a lower level protocol. For example, for e-mail using the application protocol SMTP, SMTP starts a TCP connection which itself uses IP packets to deliver data. Even within the same layers though, protocols can function much differently. By far the most well-known and widely used suite is the transport/network protocol combination TCP/IP. Transmission Control Protocol(TCP), which manages sessions between two interconnected computers, is a connection based protocol which means it has various means of checking and guaranteeing delivery of all packets. This is why it is widely used to transmit web pages using Hypertext Transfer Protocol (HTTP), email with Simple Mail Transfer Protocol (SMTP), and other widely used applications. TCP's connectionless cousin is User Datagram Protocol (UDP). UDP sends packets without bothering to confirm a connection or receipt of packets. This can make it unreliable for delivery but much faster and more useful for real-time applications like voice over IP (VoIP)[1]. Packets are having two main parts: a data payload which contains specific data being transmitted and overhead which contains instructions about packet destination, in the following Table 2 it is mentioned the different protocol header size. Packet traffic owns different characteristics such as bandwidth, throughput, packet flow rate, flow, latency, packet loss and Round Trip Time (RTT).

It has been found that in the network different protocols having different dominating character such as TCP dominate all traffic with about 95% or more of total bytes, 85-95% of all packets and 75-85% of all flows using TCP as the transport protocol [3, 4, 5]. UDP comes second representing about 5% or less of traffic with its main function being sending DNS requests and communications. TCP and UDP both induce the presence of self-similarity. When load is low and loss is rare, the traffic looks Poisson. But, when load is high and network is overloaded, TCP congestion control can smooth out the burstiness. Now the total aggregate stream is bottleneck to Poisson. Time scale below which TCP gives rise to sustained correlation and long-lived TCP flow exhibit necessarily a correlation structure [6,7]. For communication in network TCP and UDP connect the application levels using sockets. A major part of traffic, around 95%, is dominated by TCP. The applications such as FTP, E-mail etc. work in transport level and TCP covers 90% of the bandwidth to transfer data in the transport level. Rest part of the load is taken by UDP, ICMP. At transport level, OSPF assumes a burden of around 1-2% of the total traffic. At the application level, HTTP and FTP are responsible for the transfer of data in the network.

Protocol Name	**Header Size**
IP	20 bytes for IPv4, 40 bytes for IPv6
TCP	Normally 20 bytes, can be up to 60 bytes
UDP	8 bytes
Ethernet	14 bytes for header and 4 bytes for checksum

Table 2: Packet header sizes for prominent protocols[1].

III. TOPOLOGY AND PACKET SIZE.

Now a day's internet is growing very fast so topology effect more on internet. When data moves in the internet it depends on topology. It is tackle by power law distribution. Packet sizes depend upon Distribution of packet sizes in internet traffic it deals with many type of protocols and traffic types which have various packet sizes. These packet sizes are determined at data link layer (DLL). In network there is an upper bound of packet size is known as Maximum Transmission Unit (MTU) at the link layer in Ethernet the maximum value is taken as 1500 bytes. In DLL packets are termed as frames. TCP systems have a protocol option for “MTU discovery” which tries to find the MTU of the network in order to make packets as large as possible. If MTU finding process isn’t implemented, TCP often defaults to an MTU of 552 or 576 bytes. Also, nearly half of the packets are 40-44 bytes in length. These packets are used by TCP in control communications such as SYN or ACK traffic to maintain the connection between the source and destination systems. At 576 bytes [8,9,10] the packet size increases linearly to 1500 bytes showing that packet sizes in the intermediate region are relatively equally distributed. In general, according to [3, 4, 5] about 50% of the packets are 40-44 bytes, 20% are 552 or 576 bytes, and 15% are 1500 bytes. In this paper we show the topological configuration and MTU role in network traffic. Internet flow is a continuous communication or link between a source and destination node. Flows are basically described by an clustering of packets arriving at a link or by identifying characteristics such as the source and destination addresses along with an identifying label such as a TCP session ID or an IPv4 or IPv6 flow label [1].

IV. EXPERIMENT RESULT AND ANALYSIS.

For the experiment of Ethernet we set up a network and conduct three experiments such as a) Traditional Ethernet b) Fast Ethernet c) Giga Ethernet. In all these three above network we put four numbers of nodes whose properties are same. In general these nodes are working on four layers such as Application layer, Transport layer, Network layer and Data link Layer. In Application layer two parameters has been set such as Transmission type and Traffic type. In the above three experiment we set Transmission type as broadcast the messages and Traffic type as Data type. In Transport layer we take protocol as UDP and Segment size 1472 because in data link layer we take MTU as 1500 so segment size is (MTU - Header) which came around 1472. In Network layer we take protocol as IPv4. In the fast experiments we put a Hub and in next two experiments we put switch like fast Ethernet and Giga Ethernet. In Hub or Switches set parameter like Data Rate, Error rate and Physical media etc. After performing the simulation in NetSim 6.2 we got following results on the following experiment that is Ether_tradition1, Ethernet_Fast1, and Ether_giga1. The experiment results are put in Table 3.

Name of the Experiments	Utilization	Effective utilization	overhead (%)	Loss(%)	Utilized	Delay(ms)	Queuing Delay	Medium Access time	Transmission time(ms)
Ethernet_tradition1	6.09	5.88	0.22	0	93.91	1.23	0.0	0.01	1.221
Ethernet_Fast1	0.609	0.588	0.022	0	99.391	0.139	0.017	0.00072	0.122
Ether_giga1	0.061	0.059	0.002	0	99.939	0.029	0.016	0.000072	0.012

Table 3: A Comparative study between data transfer in Hub, Switches.

Matrics	Ethernet_tradition1	Ethernet_Fast1	Ether_giga1
User Throughput	0.59	0.59	0.59
Simulation	10000	10000	10000
Payload Delivered	734528	734528	734528
Frame Generated	500	500	500
Probability of success	1	1	1
Average attempt	50	0.00005	0.00005

Table 4: Result after simulation.

From the above Table 3 and Table 4 it can be concluded that by transferring similar load in the three networks due to improved switch Average attempt became less in Ethernet_Fast1, Ether_giga1. Ether_giga1 is very fast due to topologically strong and utilized the network more than other network. In Ether_giga1 case Delay, Queuing Delay, Transmission time is very less than other two. So any device or topology having less delay and less time taking for transmission will perform better.

V. CONCLUSION AND FUTURE SCOPE

It can be concluded that any device or topology having less delay and less time taking for transmission will perform better. Due to Internet traffic topology plays vital role because data should move faster in the network. Further it can be studied how to arrange different topology so that it can reduce the complexity in the network. A new thing can be further study for dynamic data size it means data can be dynamically divided as per network requirement to avoid fractal in network.

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