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Proposing the Secure Stream Control Transfer Protocol / Internet Protocol Stack (SSCTP/IP) for an Improved Internet Design

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Abstract:- Internet of the present day is robust and reliable with innovative breakthroughs in memory capacity and processor speeds both on internet routers and host devices. Connection speed and bandwidth capacity have greatly increased with host devices seen accessing internet at backbone connection speed. All resulting from improved internet communication infrastructure. However, with all the improvements in the communication infrastructure of the internet, the single system of rules that allow two entities to communicate i.e TCP/IP protocol, remains unchanged; hence this research work. There is need for an improved internet communication protocol to make this exotic service faster and more secure with speed and security been the most significant need of today's internet. This paper proposes the replacement of the four-layer TCP/IP protocol stack of the internet with a more efficient and secure five-layer SSCTP/IP protocol stack.

Keywords:- *TCP/IP, Internet, Protocols, SCTP.*

I. INTRODUCTION

A. Background of the Study

The concept of the internet started over 50 years ago when computers filled the entire room, today it is an ubiquitous information infrastructure, the initial prototype of what J. C. R. Licklider called the inter-galactic computer network (Wikipedia, 2018) has indeed becoming an inter-galactic network.

The history of the internet is multifaceted and encompasses many aspects – technological, organizational, community as its influence reaches not only the technical field of computing and communications but all through the entire society today. The initial design of the internet was conceived by ARPA, as a network that would be able to withstand a nuclear strike in event of nuclear attack.

Internet development began with ARPANET network of two nodes which were interconnected between the Network Measurement Center at the University of California, Los Angeles (UCLA) Henry Samueli School of Engineering and Applied Science directed by Leonard Kleinrock, and the NLS system at SRI International (SRI) by Douglas Engelbart in Menlo Park, California, on 29 October 1969 (Gregory Gromov, 1995).

According to B. Capenter, "Fortunately, nobody owns the Internet, there is no centralized control, and nobody can turn it off. Its developmenthinges on consensus about running codes and technical proposals. Feed-back from engineers' real implementations is more important than any architectural principles." (RFC 1958).

This paper will give us quick overview of the present-day internet design architecture, its problems and proposes a new SSCTP/IP protocol to solve the problem identified.

B. Statement of the Problem

Today's internet is robust and efficient but the problem of single point of failure, security and speed still poses a huge challenge; with the growing reliance on internet of things, network servers are not the only critical network equipment's but client equipment has become seemly critical too, thus there is need to review the internet architecture to improve on its design to take up new innovation and challenges hence this proposed SSCTP/IP protocol to replace the TCP/IP.

C. Aim and Objective of study

The aim and primary objective of this research is to identify problems with the existing internet design and to infer solutions; these teething troubles which predominately are found in the TCP/IP protocol stack, which include security, speed and redundant connections. Hence in this research we will

- Identify problems with the current internet design.
- Propose a new protocol stack that will enhance the way devices communicate via the internet.

D. Limitation

This work focuses mainly on communicating an idea and area of research to be worked on and focused on only end-to-end devices. Thus, we will not go into details regarding the TCP/IP protocol and SCTP protocol that are necessary to understand TCP and SCTP behavior in networking.

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More so, not a lot of work has been done previously toward a systematic analysis of the performance of commercial end-users SCTP use for internet resources. Thus, there are not a lot of information that are available to understand this complex.

Lastly, we do not have access to the hardware and software resources presently that would be required to perform measures.

II. LITERATURE REVIEW

A. Architecture of the Internet

Interconnection of diverse computer networks at global scale, processing and providing different services using a common standard protocol, "the Internet protocol suite (TCP/IP)"forms the internet. It is a network of different networks consisting of private and public (academic, business, This architecture is illustrated in Figure. 1

and government) networks from local to global span, interconnected by different arrays of wired, wireless and optical technologies. The Internet delivers a lot of services, including world wide web (www), on-demand video, TV, e-commerce, electronic library, electronic mail and is the life wire of the now revolutionizing internet of things.

Internet architecture is a meta-network, a repetitively varying assemblage of millions of individual networks inter-communicating with a common protocol, the TCP/IP.

The idea behind the internet is simple; all individual networks that want to participate, will carry a single packet type and a specific format of IP protocol. Additionally, this IP packet must carry an address defined with sufficient generality in order to efficiently identify each computer and terminals dispersed throughout the world.

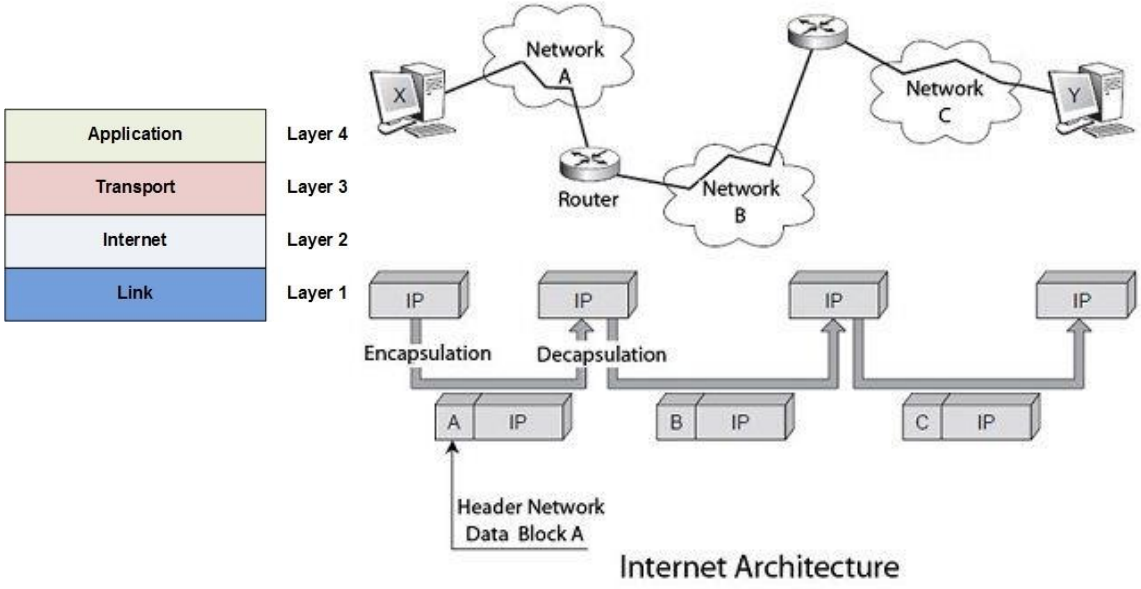

Fig 1

To explain the design of the internet it is important to understand what makes up the internet architecture. The internet architecture is made up of the following:

- Communication Infrastructure
- Protocols
- Services

B. Related Work

Researches to reinvent the internet and improve on its architecture is not a new topic, renowned academic institutions and vendor organizations unveiled a consortium in 2014 called "Named Data Networking" (NDN), an emerging internet architecture to satisfy the ever-increasing mobile world to accommodate more data and application access. the NDN, made up of universities such as UCLA and Tsinghua university, as well as network giant vendor Cisco and VeriSign. Their aim is to put forth an internet architecture that supports bigger bandwidth, secure and friendlier to developers (Networkworld, 2018).

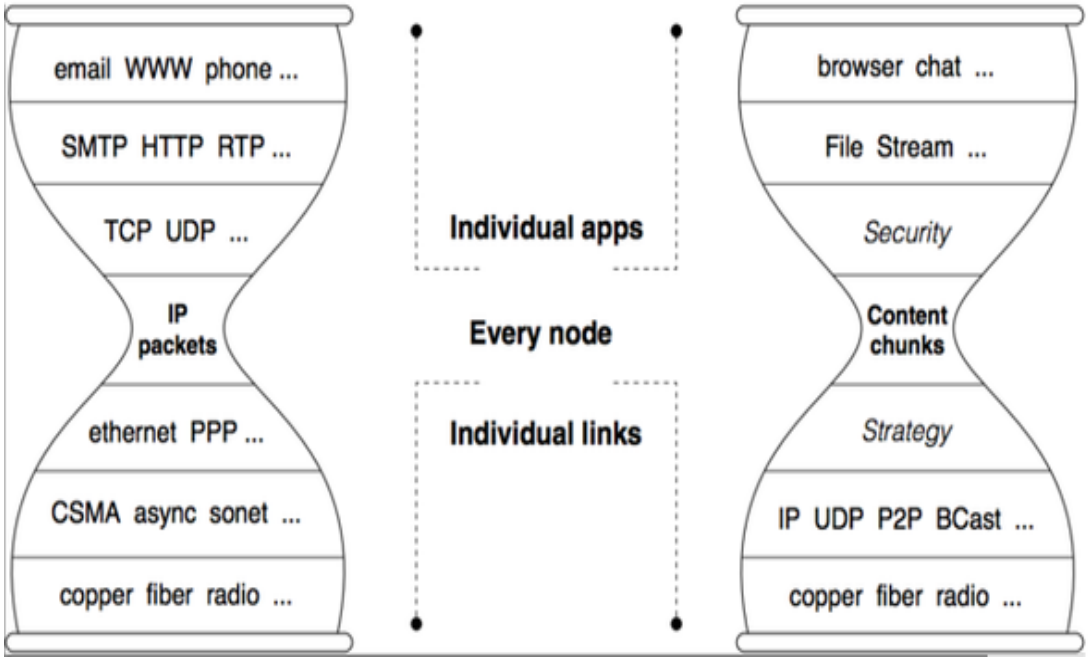

Fig 2:- TCP/IP versus NDN Architectures (NDN, 2018)

Furthermore, Akamai (a content delivery network CDN and cloud services company) released a proposal for replacement of TCP, designated as "Giga," which is capable of providing data transfers that are 30% faster on average (MIT Review, 2018).

Akamai's prototype tests indicated that in Bolivia, China and India indicated improvements of more than 150%—although those in some other places, like Germany, over its ISP Deutsche Telekom's network, yielded an improvement of only a few percentage points." (Tech Republic, 2018).

III. PROBLEMS WITH THE EXISTING INTERNET ARCHITECTURE

The problems of the present-day internet are many but this proposal will target the following

- Problems with the Transmission Control Protocol (TCP)
- Internet security

A.The problems of Transmission Control Protocol (TCP)

The transmission control protocol is one of the building blocks upon which the present-day internet was built, a lot has evolved and improved in the internet but the TCP remained fundamentally and functionally the same with little changes; so also, its problems which has limited addition of more services to the existing internet solutions. Some of these problems include:

- Does Not Support Multi homing: Multi homing is having two or more interfaces in a single host, allowing data to be sent automatically to alternate addresses should a failure occur, without the application layer even being aware of a lower level failure took place. This fault tolerance is not available for TCP, which binds endpoints only to a single interface, which still means a single point of failure should either endpoint interface or the link to the interface fail.
- TCP connections inbound to the interface would timeout and abort, thus coercing the application to reestablish the connection and packets lost in the process.
- Inextensible packets: TCP packets are not extensible, they are limited to only 40 bytes for options
- Sync flood attacks: SYN flood is a denial-of-service (DoS) attack used by hackers**,** one in which an attacker sends successions of SYN requests to the target's system in order to consume a lot of server resources making the system unresponsive and forestall legitimate traffic. This exploits the SYN-ACK requests of the TCP; hence TCP is less secure for critical servers.

Other problems of the TCP include Buffer bloat, Slow Handshake, slow start, head-of-the-line blocking (HOL) blocking etc.

B.Internet security:

Most connections to the internet is not or less secure, this give room for all forms of attacks and snooping. The SSL/TLS security is often expensive and sometimes difficult to implement on connected devices mostly IoT devices and not easily available to many users of the internet.

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IV. PROPOSING THE SSCTP/IP PROTOCOL STACK FOR AN IMPROVED INTERNET DESIGN

The proposed Secure stream control transfer protocol/internet protocol (SSCTP/IP) protocol stack is a five (5) layer protocol stack proposed to replace the existing TCP/IP and solve the above listed issues and shorting comings of the TCP/IP protocol stack.

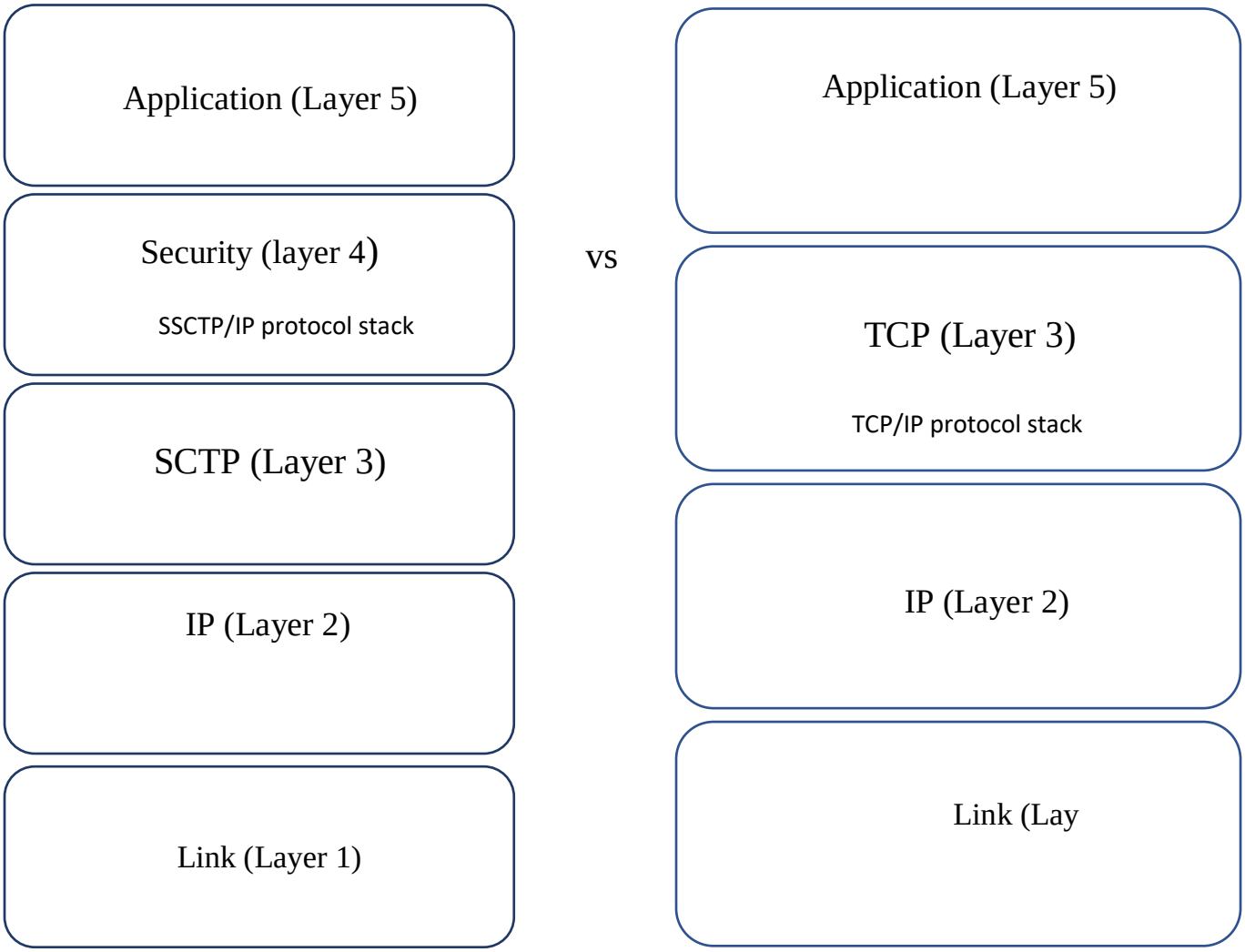

Fig 6:- SSCTP/IP vs TCP/IP Protocol Stack

The stack replaces the TCP layer 3 of the TCP/IP protocol with the SCTP and adds an extra security layer at layer 4, which will implement the asymmetric (private – public key) encryption key infrastructure to secure the link between the server – client connections.

This proposed SSCTP/IP will use the many enhanced features of the SCTP, predominately used in SIGTRAN (signal translation) of telecommunication industry to improve the architecture of the internet.

Signal control transmission protocol SCTP is an OSI layer 4 protocol (RFC4960) in the likes of TCP or UDP used in telephony signaling massage transport, originally designed to adapt the predominantly circuit switched TDM (time division multiplex) telephony network over packet switched IP network. Its generic and has more features than the TCP.

One of the many features of the SCTP is the support for multihoming, multithreading, unordered transmission and not vulnerable to the TCP syn attack.

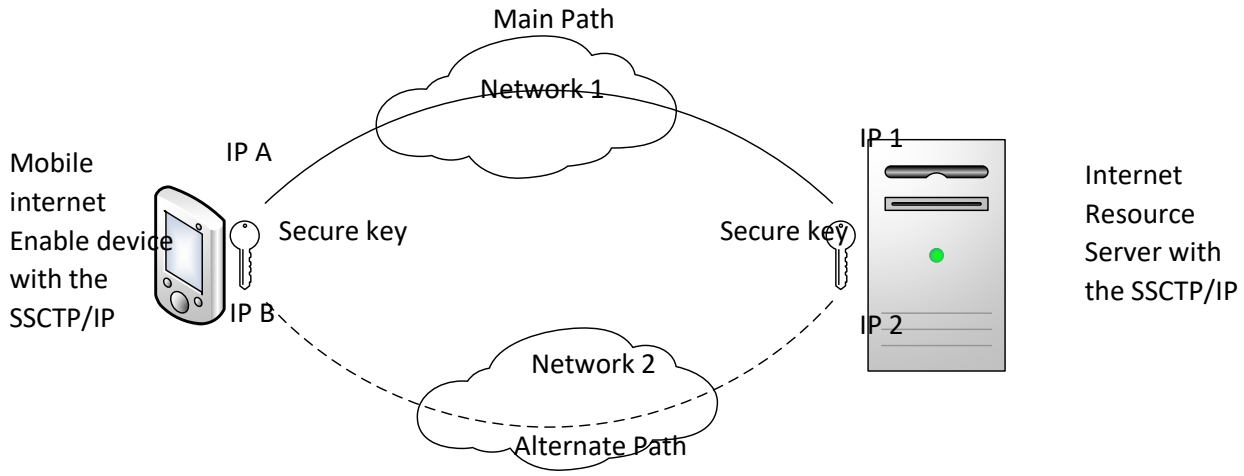

Fig 7:- Improved simple schema of the new internet architecture using the SSCTP/IP protocol stack

Features	SCTP	TCP
Reliability	Reliable	Reliable
Connection Management	Connection-oriented	Connection-oriented
Transmission	Message-oriented	Byte-oriented (capped at 40 bytes)
Flow Control	Yes	Yes
Congestion Control	Yes	Yes
Fault Tolerance	Yes	No
Data Delivery	Partially ordered or Unordered	Strictly Ordered
Security	Improved	Yes
Multihoming	Supported	Not Supported
Multi-streaming	Supported	Not Supported

Table 1: SCTP vs TCP

A.Benefits of this Improved Design:

- Removal of single point of failure:
- With support of the multihoming feature of the SCTP, each connected device will have two or more points of connection, with a primary and alternate path. The SCTP allows mainstreaming and unordered data transfer, which will facilitate seamless handover active connection to an alternate connection with the application layer been aware in event of a path failure. This means that connected devices will be more available and reachable over the internet.
- SCTP is not vulnerable to SYN flooding of the TCP, so it's more secure and reliable, this will eliminate the most used attack vector hackers.
- With the SCTP, many known issues with the TCP, such as slow start, slow handshake etc. will be eliminated, making data transmission faster.
- The Security layer 4 adds an extra layer security, targeted to eliminate all forms attacks including denial of service (DoS), snooping, Man-in-the-middle (MITM), Code injection attacks and session hijacking. Hence making all connected devices more secure.

V. CONCLUSION AND FURTHER WORK

The internet is still evolving to support more services, it has become an integral part of our lives; with more devices connected to the internet via the internet of things IoT, there is a need for a more reliable and secure internet architecture that will support many more services. In this paper we have proposed a secure stream control transmission protocol / Internet protocol (SSCTP/IP), if implemented will change the internet architecture and will provide redundancy and security needed by now booming internet of things and for all

connected devices supporting more services. In further work, we will simulate and compare the efficiency of carrying HTTP over SCTP and TCP.

REFERENCES

[1]. Gregory Gromov (1995) "Roads and Crossroads of Internet History" Archived 27 January 2016 at the Way back Machine.
[2]. Ecomputer Notes (March, 2018). Internet Architecture Retrieved from
[3]. http://ecomputernotes.com/computernetworkingnotes/services-and-applications/internet-architecture.
[4]. MIT Review (July, 2018) Upgrade to Core Internet Protocol Can Boost Speeds 30 Percent Retrieved from https://www.technologyreview.com/s/546001/upgrade-to-core-internet-protocol-can-boost-speeds-30-percent.
[5]. NDN (July, 2018) Named Data Network: Motivation & Details, Retrieved from http://named-data.net/project/arch overview.
[6]. Network world (July, 2018) UCLA, Cisco & more join forces to replace TCP/IP, Retrieved from https://www.networkworld.com/article/2602109/lan-wan/ucla-cisco-more-join-forces-to-replace-tcpip.html.
[7]. RFC 1958; B. Carpenter; *Architectural Principles of the Internet*; June, 1996.
[8]. Tech Republic (July, 2018) For the internet to keep growing, we need a next-gen TCP, Retrieved fromhttps://www.techrepublic.com/article/for-the-internet-to-keep-growing-we-need-a-next-gen-tcp.
[9]. Wikipedia (2018, February 14). Internet; Retrieved from https://en.wikipedia.org/wiki/internet.