3.3.2 "Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years

List of Research Papers Published by Faculty in the Calendar year 2019

Sl. No.	Name of the teacher	Title of the book/chapters published	Title of the paper	Title of the proceedings of the conference	Name of the conference	National / International	Calendar Year of publication	ISBN number of the proceeding	Affiliating Institute at the time of publication	Name of the publisher	Link to website of the Journal	Link to article / paper / abstract of the article
6	Dr. Rasik Patel	**NA**	On Common Fixed Point Theorems in Intuitionistic Fuzzy Metric Spaces	International Journal of Mathematics Trends and Technology (IJMTT)	-	**International**	2019	2231-5373	**Saffrony Institute of Technology**	Seventh Sense Research Group®	https://ijmttjournal.org	https://ijmttjournal.org/archive/ijmtt-v65i12p501
7	Prof. Upasna Leela	**NA**	A survey on mitigation techniques of economical denial of sustainability attack in cloud computing	International research jounal of engineering and technology	-	**International**	2019	ISSN: 2395-0056	**Saffrony Institute of Technology**	Fast Track Publications	https://www.irjet.net	https://www.irjet.net/archives/V6/i12/IRJET-V6I1292.pdf

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1. **A survey on mitigation techniques of economical denial of Sustainability attack in cloud computing-**

Prof. Upasna Leela

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SURVEY ON MITIGATION TECHNIQUES OF ECONOMICAL DENIAL OF SUSTAINABILITY ATTACK IN CLOUD COMPUTING

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Abstract - *The promise of pay-as-you-go and scalable model of cloud computing has attracted a large number of medium and small enterprise to adopt E-commerce model of conducting on-line businesses. While E-commerce applications on cloud expand businesses by making them more widely acceptable, they also make these application susceptible to economic denial of sustainability attacks a form of application layer Distributed Denial of Service attack that drive up the cost of cloud computing by using up application resources. Economical Denial of Service attack intention is to consume all the resources (like memory, bandwidth and CPU etc.) of the web server thus making it unavailable to its legitimate users.*

***Key Words*:** Cloud computing, DDoS, EDoS, EDoS-Shield, EDoS-ADS, EDoS-Eye

1. INTRODUCTION

Cloud computing is a strong contender to traditional IT implementations as it offers low-cost and "pay-as-you-go" based access to computing capabilities and services on demand providing ease users[1]. The cloud resources can be provisioned and frees with minimal cloud provider interaction by using an auto scaling feature. The auto scaling feature is activated by monitoring parameters such as CPU utilization, memory usage, response time and bandwidth.

1.1 INTRODUCTION TO DOS ATTACK

1. DoS and DDoSAttack

DoS attackers target the server, which is providing a service to its users, behaving like legitimate user, DoS attackers try to find

2. On Common Fixed Point Theorems in Intuitionistic Fuzzy Metric Spaces

-Dr. Shailesh Patel

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On Common Fixed Point Theorems in Intuitionistic Fuzzy Metric Spaces

Rasik M.Patel, Ramakant Bhardwaj

PDF
Abstract
Keywords
References
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Abstract

In this paper, we prove some common fixed point theorems for weakly compatible maps in Intuitionistic Fuzzy metric.

Keywords

Intuitionistic fuzzy metric space, weakly Compatible Mappings, Common fixed point.

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On Common Fixed Point Theorems in Intuitionistic Fuzzy Metric Spaces

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Abstract: *In this paper, we prove some common fixed point theorems for weakly compatible maps in Intuitionistic Fuzzy metric.*

2010 Mathematics Subject Classification: *47H10, 54H25.*

Key words and phrases: *Intuitionistic fuzzy metric space, weakly Compatible Mappings, Common fixed point.*

1. Introduction

It proved a turning point in the development of fuzzy mathematics when the notion of fuzzy set was introduced by L.A.Zadeh [15]. K.Atanassov [14] introduced and studied the concept of intuitionistic fuzzy sets. D.Coker [4] introduced the concept of intuitionistic fuzzy topological spaces. Jungck [13] common fixed point theorem in the setting of intuitionistic fuzzy metric space. Turkoglu et al. [5] further formulated the notions of weakly commuting and R weakly commuting mappings in intuitionistic fuzzy metric spaces and proved the intuitionistic fuzzy version of Pant's theorem [16]. Gregori et al. [19], Saadati and Park [21] studied the concept of intuitionistic fuzzy metric space and its applications. No wonder that intuitionistic fuzzy fixed point theory has become an area of interest for specialists in fixed point theory as intuitionistic fuzzy mathematics has covered new possibilities for fixed point theorists. Recently, many authors have also studied the fixed point theory in fuzzy and intuitionistic fuzzy metric spaces Dimri et.al.[6], Grabiec [9], Imdad et. al.[11], J.S. Park, Y.C. Kwan, and J.H. Park[12]. H.Dubey and R.Jain [9] studied the concept on common fixed point theorems in intuitionistic fuzzy metric spaces.

2. Preliminaries

Definition 2.1[3]. *A binary operation* $*: [0, 1] \times [0, 1] \to [0, 1]$ *is a continuous t-norm if it satisfies the following conditions:*

(1) $*$ *is associative and commutative,*

(2) $*$ *is continuous,*

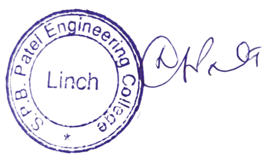
(3) $a * 1 = a$ *for all* $a \in [0, 1]$*,*

(4) $a * b \leq c * d$ *whenever* $a \leq c$ *and* $b \leq d$ *for all* $a, b, c, d \in [0, 1]$*,*

Two typical examples of continuous t-norm are $a * b = ab$ *and* $a * b = \min(a, b)$*.*

Definition 2.2[3]. *A binary operation* $\diamond: [0, 1] \times [0, 1] \to [0, 1]$ *is a continuous t-co-norm if it satisfies the following conditions:*

(1) $\diamond$ *is associative and commutative,*



(2) $\diamondsuit$ is continuous,

(3) $a \diamondsuit 1 = a$ for all $a \in [0, 1]$,

(4) $a \diamondsuit b \leq c \diamondsuit d$ whenever $a \leq c$ and $b \leq d$ for all a, b, c, $d \in [0, 1]$,

Two typical examples of continuous t-co norm are $a \diamondsuit b = ab$ and $a \diamondsuit b = \min(a, b)$.

Definition 2.3[4]. *A 5-tuple $(X, M, N, *, \diamondsuit)$ is said to be an intuitionistic fuzzy metric space if X is an arbitrary set, $*$ is a continuous t-norm, $\diamondsuit$ is a continuous t-co-norm and M,N are fuzzy sets on $X^2 \times [0,\infty)$ satisfying the following conditions:*

(i) $M(x,y,t) + N(x,y,t) \leq 1 \, for \, all \, x,y \in X \, and \, t > 0;$

(ii) $M(x,y,0) = 0 \, for \, all \, x,y \in X;$

(iii) $M(x,y,t) = 1 \, for \, all \, x,y \in X \, and \, t > 0 \, if \, and \, only \, if \, x = y;$

(iv) $M(x,y,t) = M(y,x,t) \, for \, all \, x,y \in X \, and \, t > 0;$

(v) $M(x,y,t) * M(y,z,s) \leq M(x,z,t+s) for \, all \, x,y \in X \, and \, s,t > 0;$

(vi) $for \, all \, x,y \in X, M(x,y,\ .): [0,\infty) \to [0,1] \text{ is left continuous};$

(vii) $\lim_{t\to\infty} M(x,y,t) = 1 \, for \, all \, x,y \in X \, and \, t > 0;$

(viii) $N(x,y,0) = 1 \, for \, all \, x,y \in X;$

(ix) $M(x,y,t) = 1 \, for \, all \, x,y \in X \, and \, t > 0 \, if \, and \, only \, if \, x = y;$

(x) $N(x,y,t) = N(y,x,t) \, for \, all \, x,y \in X \, and \, t > 0;$

(xi) $N(x,y,t) \diamondsuit N(y,z,s) \geq N(x,z,t+s) for \, all \, x,y \in X \, and \, s,t > 0;$

(xii) $for \, all \, x,y \in X, N(x,y,\ .): [0,\infty) \to [0,1] \text{ is right continuous};$

(xiii) $\lim_{t\to\infty} N(x,y,t) = 0 \, for \, all \, x,y \in X \, and \, t > 0.$

Then (M, N) is called an intuitionistic fuzzy metric space on X. The functions M(x, y, t) and N(x, y, t) denote the degree of nearness and the degree of non-nearness between x and y w.r.t. t respectively.

Remark 2.1[4]. *Every fuzzy metric space $(X, M, *)$ is an intuitionistic fuzzy metric space of the form $(X, M, 1-M, *, \diamondsuit)$ such that t-norm $*$ and t-co norm $\diamondsuit$ defined by $a * a \geq a, a \in [0,1]$ & $(1-a) \diamondsuit (1-a) \leq (1-a) \, for \, all \, x,y \in X$, In intuitionistic fuzzy metric space $(X, M, N, *, \diamondsuit)$, $M(x,y,*)$ is non-decreasing and $N(x,y,\diamondsuit)$ is non-increasing.*

Remark 2.2[17]. *Let (X, d) be a metric space. Define t-norm $a * b = \min(a, b)$ and t-co norm $a \diamondsuit b = \max(a, b)$, $for \, all \, x,y \in X \, \& \, t > 0$.*

$M_d(x,y,t) = \frac{t}{t+d(x,y)}$, $N_d(x,y,t) = \frac{d(x,y)}{t+d(x,y)}$ *Then* $(X, M, N, *, \diamond)$ *is an intuitionistic fuzzy metric space induced by the metric. It is obvious that* $N(x,y,t) = 1 - M(x,y,t)$

Alaca, Turkoglu and Yildiz [4] introduced the following notions:

Definition 2.4. *Let (X, M, N, * , ♢) be an intuitionistic fuzzy metric space. Then*

(a) a sequence $\{x_n\}$ *in X is called Cauchy-sequence if, for all t > 0 and P > 0,*

$$\lim_{n\to\infty} M(x_{n+p}, x_n, t) = 1 \quad \text{and} \quad \lim_{n\to\infty} N(x_{n+p}, x_n, t) = 0,$$

(b) a sequence $\{x_n\}$ *in X is said to be convergent to a point* $x \in X$ *if, for all* $t > 0,$

$$\lim_{n\to\infty} M(x_n, x, t) = 1 \quad \text{and} \quad \lim_{n\to\infty} N(x_n, x, t) = 0.$$

Definition 2.5. *Let (X, M, N, * , ♢) be an intuitionistic fuzzy metric space and* $\{y_n\}$ *be a sequence in X if there exists a number* $k \in (0,1)$ *such that:*

1. $M(y_{n+2}, y_{n+1}, kt) \geq M(y_{n+1}, y_n, t),$

2. $N(y_{n+2}, y_{n+1}, kt) \leq N(y_{n+1}, y_n, t)$

for all t > 0 and n = 1 ,2 ,3……then $\{y_n\}$ *is a Cauchy sequence in X*

Definition 2.6. *A pair of self-mappings (f, g) of an intuitionistic fuzzy metric space (X, M, N, * , ♢) is said to be compatible if* $\lim_{n\to\infty} M(fgx_n, gfx_n, t) = 1$ & $\lim_{n\to\infty} N(fgx_n, gfx_n, t) = 0$ *for every t > 0, whenever* $\{x_n\}$ *is a sequence in X such that* $\lim_{n\to\infty} fx_n = \lim_{n\to\infty} gx_n = z,$ *for some.* $z \in X.$

Definition 2.7. *A pair of self-mappings (f, g) of an intuitionistic fuzzy metric space (X, M, N, * , ♢) is said to be non-compatible if* $\lim_{n\to\infty} M(fgx_n, gfx_n, t) \neq 1$ & $\lim_{n\to\infty} N(fgx_n, gfx_n, t) \neq 0$ *for every t > 0, whenever* $\{x_n\}$ *is a sequence in X such that* $\lim_{n\to\infty} fx_n = \lim_{n\to\infty} gx_n = z,$ *for some.* $z \in X.$

Definition 2.8. *An intuitionistic fuzzy metric space (X, M, N, * , ♢) is said to be complete if and only if every Cauchy sequence in X is convergent.*

Definition 2.9[7]. *A pair of self mappings* (f, g) *of a metric space is said to be weakly compatible if they commute at the coincidence points i.e.* $fu = gu$ *for some* $u \in X,$ *then* $fgu = gfu.$

Definition 2.10[7]. *A pair of self mappings* (f, g) *intuitionistic fuzzy metric space is said to be weakly compatible if they commute at the coincidence points i.e.* $fu = gu$ *for some* $u \in X,$ *then* $fgu = gfu.$

Definition 2.11[8]. *A pair of self mappings (f, g) intuitionistic fuzzy metric space is said to be occasionally weakly compatible iff there is a point x in X which is coincidence point of they commute at the coincidence points f and g at which f and g commute.*

Lemma 2.1[7]. *Let (X, M, N, ∗, ◇) be an intuitionistic fuzzy metric space. f and g be self maps on X and f and g have a unique point of coincidence, $w = fx = gx$, then w is the unique common fixed point of f and g.*

Lemma 2.2[2]. *Let (X, M, N, ∗, ◇) be an intuitionistic fuzzy metric space and $for\ all\ x, y \in X, t > 0$ and if for a number $k \in (0,1)$ such that $M(x, y, kt) \geq M(y, x, t)$ and $N(x, y, kt) \leq N(y, x, t)$ then $x = y$.*

3. Main results

Theorem 3.1. *Let A, B, S and T be self maps of intuitionistic fuzzy metric spaces (X, M, N, ∗, ◇) with continuous t-norm ∗ and continuous t-co norm ◇ defined by $t * t \geq t$ and $(1-t) \diamond (1-t) \leq (1-t)$ for all $t \in [0,1]$ satisfying the following condition:*

(3.1.1) A(X) ⊆ S(X) and B(X) ⊆ T(X),

(3.1.2) If one of the A, B, S and T is a complete subspace of X then {A, T} and {B, S} have a coincidence point,

(3.1.3) The pairs (A, T) and (B, S) are weakly compatible,

(3.1.4)

$$M(Ax, By, t) \geq \emptyset\left\{min\begin{pmatrix} M(Tx, Sy, t) * M(Tx, Ax, t) * M(Ax, Sy, t) * \\ M(Sy, Tx, t) * M(Bx, Ty, t) * M(Bx, Sx, t) * \\ M(Tx, Bx, t) * M(Tx, By, t) \end{pmatrix}\right\}$$

and

$$N(Ax, By, t) \leq \varphi\left\{max\begin{pmatrix} N(Tx, Sy, t) \diamond N(Tx, Ax, t) \diamond N(Ax, Sy, t) \diamond \\ N(Sy, Tx, t) \diamond N(Bx, Ty, t) \diamond N(Bx, Sx, t) \diamond \\ N(Tx, Bx, t) \diamond N(Tx, By, t) \end{pmatrix}\right\}$$

$\forall x, y \in X$ & > 0, *where* $\emptyset, \varphi: [0,1] \to [0,1]$ *is a continuous function such that* $\emptyset(t) > t$ & $\varphi(t) < t$ *for each 0 < t < 1 and* $\emptyset(1) = 1$ *and* $\varphi(0) = 0$ *with* $M(x, y, t) > 0$. *Then A, B, S and T have a unique common fixed point in X.*

Proof : *Since A(X) ⊆ S(X), therefore for any $x_0 \in X$, there exists a point $x_1 \in X$ such that $Ax_0 = Sx_1$ and for the point x_1, we can choose a point $x_2 \in X$ such that $Bx_1 = Tx_2$ as B(X) ⊆ S(X). Inductively, we get Sequence $\{y_n\}$ in x as follows $y_{2n+1} = Bx_{2n+1} = Tx_{2n+2}$ and $y_{2n} = Ax_{2n} = Sx_{2n+1}$ for n = 0,1,2.....Putting $x = x_{2n}$, $y = x_{2n+1}$ in (3.1.4) we have,*

$$M(Ax_{2n}, Bx_{2n+1}, t) \geq \emptyset\left\{min\begin{pmatrix} M(Tx_{2n}, Sx_{2n+1}, t) * M(Tx_{2n}, Ax_{2n}, t) * \\ M(Ax_{2n}, Sx_{2n+1}, t) * M(Sx_{2n+1}, Tx_{2n}, t) * \\ M(Bx_{2n}, Tx_{2n+1}, t) * M(Bx_{2n}, Sx_{2n}, t) * \\ M(Tx_{2n}, Bx_{2n}, t) * M(Tx_{2n}, Bx_{2n+1}, t) \end{pmatrix}\right\}$$

$$M(y_{2n}, y_{2n+1}, t) \geq \emptyset\left\{min\begin{pmatrix} M(y_{2n-1}, y_{2n}, t) * M(y_{2n-1}, y_{2n}, t) * \\ M(y_{2n}, y_{2n}, t) * M(y_{2n}, y_{2n-1}, t) * \\ M(y_{2n-1}, y_{2n}, t) * M(y_{2n-1}, y_{2n}, t) * \\ M(y_{2n-1}, y_{2n-1}, t) * M(y_{2n-1}, y_{2n}, t) \end{pmatrix}\right\}$$

$$M(y_{2n}, y_{2n+1}, t) \geq \emptyset\left\{min\begin{pmatrix} M(y_{2n-1}, y_{2n}, t) * M(y_{2n-1}, y_{2n}, t) * \\ 1 * M(y_{2n}, y_{2n-1}, t) * \\ M(y_{2n-1}, y_{2n}, t) * M(y_{2n-1}, y_{2n}, t) * \\ 1 * M(y_{2n-1}, y_{2n}, t) \end{pmatrix}\right\}$$

i.e $M(y_{2n}, y_{2n+1}, t) \geq \emptyset\{M(y_{2n-1}, y_{2n}, t)\} > M(y_{2n-1}, y_{2n}, t)$ as $\emptyset(t) > t$ for each $0 < t < 1$ and

$$N(Ax_{2n}, Bx_{2n+1}, t) \leq \varphi\left\{max\begin{pmatrix} N(Tx_{2n}, Sx_{2n+1}, t) \diamond N(Tx_{2n}, Ax_{2n}, t) \diamond \\ N(Ax_{2n}, Sx_{2n+1}, t) \diamond N(Sx_{2n+1}, Tx_{2n}, t) \diamond \\ N(Bx_{2n}, Tx_{2n+1}, t) \diamond N(Bx_{2n}, Sx_{2n}, t) \diamond \\ N(Tx_{2n}, Bx_{2n}, t) \diamond N(Tx_{2n}, Bx_{2n+1}, t) \end{pmatrix}\right\}$$

$$N(y_{2n}, y_{2n+1}, t) \leq \varphi\left\{max\begin{pmatrix} N(y_{2n-1}, y_{2n}, t) \diamond N(y_{2n-1}, y_{2n}, t) \diamond \\ N(y_{2n}, y_{2n}, t) \diamond N(y_{2n}, y_{2n-1}, t) \diamond \\ N(y_{2n-1}, y_{2n}, t) \diamond N(y_{2n-1}, y_{2n}, t) \diamond \\ N(y_{2n-1}, y_{2n-1}, t) \diamond N(y_{2n-1}, y_{2n}, t) \end{pmatrix}\right\}$$

$$N(y_{2n}, y_{2n+1}, t) \leq \varphi\left\{max\begin{pmatrix} N(y_{2n-1}, y_{2n}, t) \diamond N(y_{2n-1}, y_{2n}, t) \diamond \\ 1 \diamond N(y_{2n}, y_{2n-1}, t) \diamond \\ N(y_{2n-1}, y_{2n}, t) \diamond N(y_{2n-1}, y_{2n}, t) \diamond \\ 1 \diamond N(y_{2n-1}, y_{2n}, t) \end{pmatrix}\right\}$$

i.e $N(y_{2n}, y_{2n+1}, t) \leq \varphi\{N(y_{2n-1}, y_{2n}, t)\} < N(y_{2n-1}, y_{2n}, t)$ *as* $\varphi(t) < t$ *for each* $0 < t < 1$. *Thus* $\{M(y_{2n}, y_{2n+1}, t), n \geq 0\}$ *is an increasing sequence of positive real numbers in [0,1] which tends to a limit* $l \leq 1$, *also* $\{N(y_{2n+1}, y_{2n+2}, t), n \geq 0\}$ *is an decreasing sequence of positive real numbers [0 ,1] which tends to a limit* $k = 0$.

Therefore for every $n \in I^+$ $M(y_n, y_{n+1}, t) > M(y_{n-1}, y_n, t)$ & $\lim_{n\to\infty} M(y_n, y_{n+1}, t) = 1$, $N(y_n, y_{n+1}, t) < N(y_{n-1}, y_n, t)$ & $\lim_{n\to\infty} N(y_n, y_{n+1}, t) = 0$. *Now any positive integer p, we obtain* $\lim_{n\to\infty} M(y_n, y_{n+p}, t) = 1$ *and* $\lim_{n\to\infty} N(y_n, y_{n+p}, t) = 0$. *Which shows that* $\{y_n\}$ *is a*

Cauchy sequence in X. Let $w \in S^{-1}u$ *then* $Sw = u$. *we shall use the fact that subquence* $\{y_{2n+1}\}$ *also converges to* u.*Now by putting* $x = x_{2n}$, $y = w$ *in (3.4) and taking* $n \to \infty$

$$M(Ax_{2n}, Bw, t) \geq \emptyset \left\{ min \begin{pmatrix} M(Tx_{2n}, Sw, t) * M(Tx_{2n}, Ax_{2n}, t) * \\ M(Ax_{2n}, Sw, t) * M(Sw, Tx_{2n}, t) * \\ M(Bx_{2n}, Tw, t) * M(Bx_{2n}, Sx_{2n}, t) * \\ M(Tx_{2n}, Bx_{2n}, t) * M(Tx_{2n}, Bw, t) \end{pmatrix} \right\}$$

$$M(u, Bw, t) \geq \emptyset \left\{ min \begin{pmatrix} M(u, u, t) * M(u, u, t) * \\ M(u, u, t) * M(u, u, t) * \\ M(u, u, t) * M(u, u, t) * \\ M(u, u, t) * M(u, u, t) \end{pmatrix} \right\}$$

i.e $M(u, Bw, t) \geq \emptyset\{M(u, u, t)\} \geq \emptyset(1) = 1$ ……………………………………(*)

also

$$N(Ax_{2n}, Bw, t) \leq \varphi \left\{ max \begin{pmatrix} N(Tx_{2n}, Sw, t) \diamond N(Tx_{2n}, Ax_{2n}, t) \diamond \\ N(Ax_{2n}, Sw, t) \diamond N(Sw, Tx_{2n}, t) \diamond \\ N(Bx_{2n}, Tw, t) \diamond N(Bx_{2n}, Sx_{2n}, t) \diamond \\ N(Tx_{2n}, Bx_{2n}, t) \diamond N(Tx_{2n}, Bw, t) \end{pmatrix} \right\}$$

$$N(u, Bw, t) \leq \varphi \left\{ max \begin{pmatrix} N(u, u, t) \diamond N(u, u, t) \diamond \\ N(u, u, t) \diamond N(u, u, t) \diamond \\ N(u, u, t) \diamond N(u, u, t) \diamond \\ N(u, u, t) \diamond N(u, u, t) \end{pmatrix} \right\}$$

i.e $N(u, Bw, t) \leq \varphi\{N(u, u, t)\} \leq \varphi(0) = 0$ ……………………………………(**)

From (*) and (**), Let $u = Bw$. *Since* $Sw = u$ *we have* $Sw = Bw = u$ *i.e. w is the coincidence point of B and S. As B(X)* $\subseteq$ *T(X),* $= Bw \to u \in T(X)$. *Let* $v \in T^{-1}u$ *then* $Tv = u$. *Now by putting* $x = v$, $y = x_{2n+1}$ *in (3.1.4)*

$$M(Av, Bx_{2n+1}, t) \geq \emptyset \left\{ min \begin{pmatrix} M(Tv, Sx_{2n+1}, t) * M(Tv, Av, t) * \\ M(Av, Sx_{2n+1}, t) * M(Sx_{2n+1}, Tv, t) * \\ M(Bv, Tx_{2n+1}, t) * M(Bv, Sv, t) * \\ M(Tv, Bv, t) * M(Tv, Bx_{2n+1}, t) \end{pmatrix} \right\}$$

taking $n \to \infty$

$$M(Av, u, t) \geq \emptyset \left\{ min \begin{pmatrix} M(u, u, t) * M(u, Av, t) * \\ M(Av, u, t) * M(u, u, t) * \\ M(u, u, t) * M(u, u, t) * \\ M(u, u, t) * M(u, u, t) \end{pmatrix} \right\}$$

$$M(Av, u, t) \geq \emptyset\{min(1 * M(u, Av, t) * M(Av, u, t) * 1 * 1 * 1 * 1 * 1)\}$$

i.e $M(Av, u, t) \geq \emptyset\{M(u, Av, t)\} > M(u, Av, t)$ and

$$N(Av, Bx_{2n+1}, t) \leq \varphi\left\{max\begin{pmatrix} N(Tv, Sx_{2n+1}, t) \diamond N(Tv, Av, t) \diamond \\ N(Av, Sx_{2n+1}, t) \diamond N(Sx_{2n+1}, Tv, t) \diamond \\ N(Bv, Tx_{2n+1}, t) \diamond N(Bv, Sv, t) \diamond \\ N(Tv, Bv, t) \diamond N(Tv, Bx_{2n+1}, t) \end{pmatrix}\right\}$$

taking $n \to \infty$

$$N(Av, u, t) \leq \varphi\left\{max\begin{pmatrix} N(u, u, t) \diamond N(u, Av, t) \diamond \\ N(Av, u, t) \diamond N(u, u, t) \diamond \\ N(u, u, t) \diamond N(u, u, t) \diamond \\ N(u, u, t) \diamond N(u, u, t) \end{pmatrix}\right\}$$

$$N(Av, u, t) \leq \varphi\{max(1 \diamond N(u, Av, t) \diamond N(Av, u, t) \diamond 1 \diamond 1 \diamond 1 \diamond 1 \diamond 1)\}$$

i.e $N(Av, u, t) \leq \varphi\{N(u, Av, t)\} < N(u, Av, t)$

Therefore, we get $Av = u$. *we have* $Tv = Av = u$.

Thus v *is a coincidence point of a and T.*

Since the pairs $\{A, T\}$ *and* $\{B, S\}$ *are weakly compatible i.e.* $B(Sw) = S(Bw) \to Bu = Su$ *and* $A(Tv) = T(Av) \to Au = Tu$. *Now by putting* $x = u$, $y = x_{2n+1}$ *in (3.1.4)*

$$M(Au, Bx_{2n+1}, t) \geq \emptyset\left\{min\begin{pmatrix} M(Tu, Sx_{2n+1}, t) * M(Tu, Au, t) * \\ M(Au, Sx_{2n+1}, t) * M(Sx_{2n+1}, Tu, t) * \\ M(Bu, Tx_{2n+1}, t) * M(Bu, Su, t) * \\ M(Tu, Bu, t) * M(Tu, Bx_{2n+1}, t) \end{pmatrix}\right\}$$

taking $n \to \infty$

$$M(Au, u, t) \geq \emptyset\left\{min\begin{pmatrix} M(Au, u, t) * M(Au, Au, t) * \\ M(Au, u, t) * M(u, Au, t) * \\ M(u, u, t) * M(u, u, t) * \\ M(Au, u, t) * M(Au, u, t) \end{pmatrix}\right\}$$

$$M(Au, u, t) \geq \emptyset\left\{min\begin{pmatrix} M(Au, u, t) * 1 * M(Au, u, t) * M(u, Au, t) * \\ 1 * 1 * M(Au, u, t) * M(Au, u, t) \end{pmatrix}\right\}$$

i.e $M(Au, u, t) \geq \emptyset\{M(Au, u, t)\} > M(Au, u, t)$ and

$$N(Au, Bx_{2n+1}, t) \leq \varphi\left\{max\begin{pmatrix} N(Tu, Sx_{2n+1}, t) \diamond N(Tu, Au, t) \diamond \\ N(Au, Sx_{2n+1}, t) \diamond N(Sx_{2n+1}, Tu, t) \diamond \\ N(Bu, Tx_{2n+1}, t) \diamond N(Bu, Su, t) \diamond \\ N(Tu, Bu, t) \diamond N(Tu, Bx_{2n+1}, t) \end{pmatrix}\right\}$$

taking $n \to \infty$

$$N(Au,u,t) \le \varphi\left\{max\begin{pmatrix} N(Au,u,t) \diamond N(Au,Au,t) \diamond \\ N(Au,u,t) \diamond N(u,Au,t) \diamond \\ N(u,u,t) \diamond N(u,u,t) \diamond \\ N(Au,u,t) \diamond N(Au,u,t) \end{pmatrix}\right\}$$

$$N(Au,u,t) \le \varphi\left\{max\begin{pmatrix} N(Au,u,t) \diamond 1 \diamond N(Au,u,t) \diamond N(u,Au,t) \diamond \\ 1 \diamond 1 \diamond N(Au,u,t) \diamond N(Au,u,t) \end{pmatrix}\right\}$$

i.e $N(Au,u,t) \le \varphi\{N(Au,u,t)\} < N(Au,u,t)$

Therefore, we get $Au = u$. *So we have* $Au = Tu = u$. *similarly by putting* $x = x_{2n}$, $y = u$ *in (3.1.4) as* $n \to \infty$ $u = Bu = Su$. *Thus* $Au = Bu = Su = Tu = u$ *i.e.* u *is a common fixed point of A, B, S and T.*

Uniqueness: *Let* $w(w \ne u)$ *be another common fixed point of A, B, S and T. then by putting* $x = u, y = w$ *in (3.1.4)*

$$M(Au,Bw,t) \ge \emptyset\left\{min\begin{pmatrix} M(Tu,Sw,t) * M(Tu,Au,t) * M(Au,Sw,t) * \\ M(Sw,Tu,t) * M(Bu,Tw,t) * M(Bu,Su,t) * \\ M(Tu,Bu,t) * M(Tu,Bw,t) \end{pmatrix}\right\}$$

$$M(u,w,t) \ge \emptyset\left\{min\begin{pmatrix} M(u,w,t) * M(u,u,t) * M(u,w,t) * \\ M(w,u,t) * M(u,w,t) * M(u,u,t) * \\ M(u,u,t) * M(u,w,t) \end{pmatrix}\right\}$$

$$M(u,w,t) \ge \emptyset\left\{min\begin{pmatrix} M(u,w,t) * 1 * M(u,w,t) * M(w,u,t) * \\ M(u,w,t) * 1 * 1 * M(u,w,t) \end{pmatrix}\right\}$$

i.e $M(u,w,t) \ge \emptyset\{M(u,w,t)\} > M(u,w,t)$

and

$$N(Au,Bw,t) \le \varphi\left\{max\begin{pmatrix} N(Tu,Sw,t) \diamond N(Tu,Au,t) \diamond N(Au,Sw,t) \diamond \\ N(Sw,Tu,t) \diamond N(Bu,Tw,t) \diamond N(Bu,Su,t) \diamond \\ N(Tu,Bu,t) \diamond N(Tu,Bw,t) \end{pmatrix}\right\}$$

$$N(u,w,t) \le \varphi\left\{max\begin{pmatrix} N(u,w,t) \diamond N(u,u,t) \diamond N(u,w,t) \diamond \\ N(w,u,t) \diamond N(u,w,t) \diamond N(u,u,t) \diamond \\ N(u,u,t) \diamond N(u,w,t) \end{pmatrix}\right\}$$

$$N(u,w,t) \le \varphi\left\{max\begin{pmatrix} N(u,w,t) \diamond 1 \diamond N(u,w,t) \diamond N(w,u,t) \diamond \\ N(u,w,t) \diamond 1 \diamond 1 \diamond N(u,w,t) \end{pmatrix}\right\}$$

i.e $N(u,w,t) \le \emptyset\{N(u,w,t)\} < N(u,w,t)$. Hence $u = w$ for all $x, y \in X$ *and* $t > 0$.

Therefore u is the unique common fixed point of a, B, S and T.

This completes the proof.

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SURVEY ON MITIGATION TECHNIQUES OF ECONOMICAL DENIAL OF SUSTAINABILITY ATTACK IN CLOUD COMPUTING

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Abstract - *The promise of pay-as-you-go and scalable model of cloud computing has attracted a large number of medium and small enterprise to adopt E-commerce model of conducting on-line businesses. While E-commerce applications on cloud expand businesses by making them more widely acceptable, they also make these application susceptible to economic denial of sustainability attacks a form of application layer Distributed Denial of Service attack that drive up the cost of cloud computing by using up application resources. Economical Denial of Service attack intention is to consume all the resources (like memory, bandwidth and CPU etc.) of the web server thus making it unavailable to its legitimate users.*

Key Words: Cloud computing, DDoS, EDoS, EDoS-Shield, EDoS-ADS, EDoS-Eye

1. INTRODUCTION

Cloud computing is a strong contender to traditional IT implementations as it offers low-cost and "pay-as-you-go" based access to computing capabilities and services on demand providing ease users[1]. The cloud resources can be provisioned and frees with minimal cloud provider interaction by using an auto scaling feature. The auto scaling feature is activated by monitoring parameters such as CPU utilization, memory usage, response time and bandwidth.

1.1 INTRODUCTION TO DOS ATTACK

1. DoS and DDoSAttack

DoS attackers target the server, which is providing a service to its users, behaving like legitimate user, DoS attackers try to find active servers in such a way that service becomes unavailable due to large number of request pending and overflowing the service queue. A distributed DoS where attackers are group of machines targeting a particular service[1]

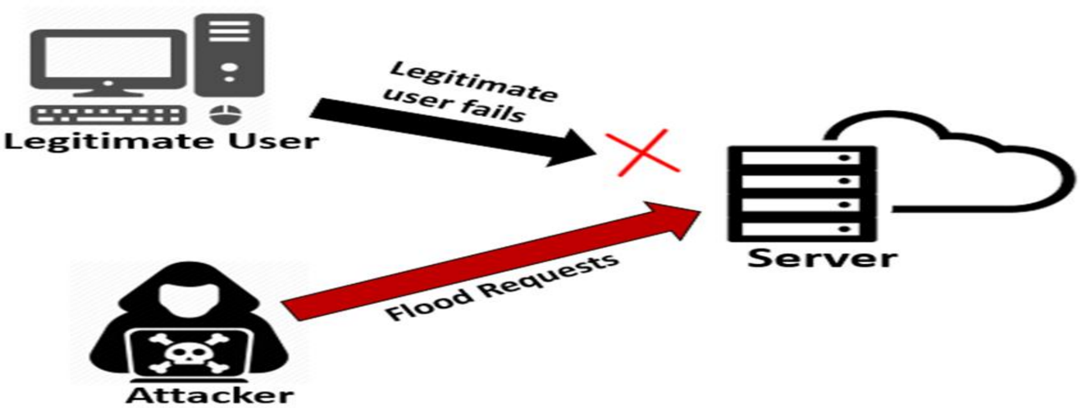

Fig -1: DoS Attack[1]

DDoS attacks have recently been very successful on cloud computing, where the attackers exploit the "pay-as-you-go" model. The three important features are reason behind the success trends of cloud computing. The same features are proven to be helpful to DDoS attackers in getting success in attacks. Those features are:Auto-scaling,Pay-as-you-go account and multi-tenancy[1].

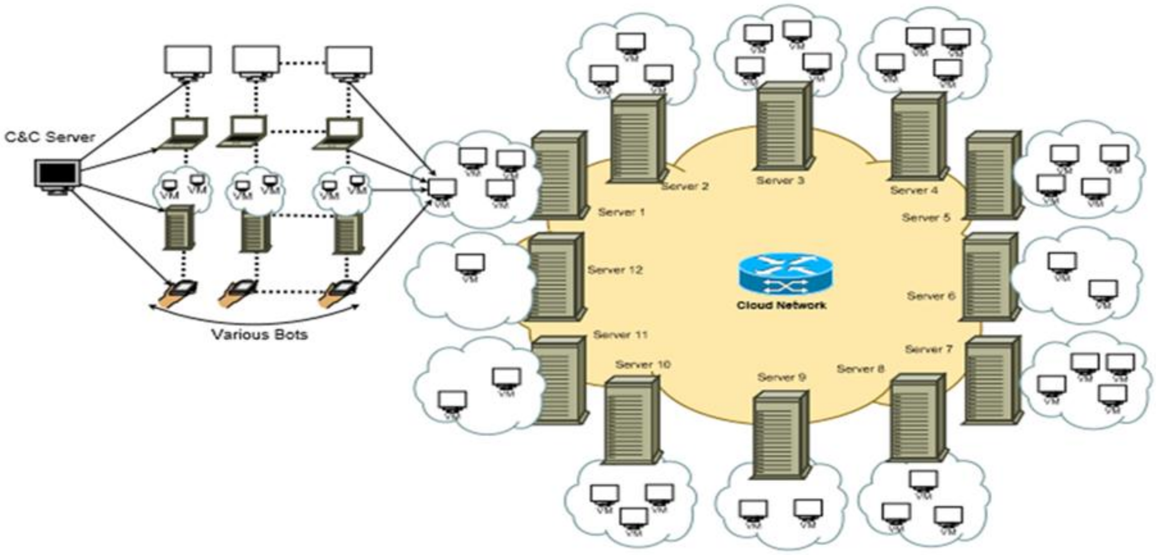

Fig -2: DDoS Attack[1]

2. EDoS Attack

The introduction of resource rich cloud computing platforms, where adopters are charged based on the usage of cloud's resources known as "pay-as-you-use" has transformed the Distributed Denial of Service(DDoS) attack problem in the cloud to financial one. This new type of attack targets the cloud adopter's economic resources and referred to Economical Denial of Sustainability(EDoS) attack [2].

A well-known tactic taken by EDoS attacks is to remotely control zombies to smoothly flood targeted cloud service by undesired requests. As a result of these requests and because of cloud elasticity feature, the service usage will be scaled up to satisfy the on-demand requests. And because of "pay-as-you-go", a cloud adopter's bill will be charged for those request leading to service withdrawal or bankruptcy.

2. Related Work

1.1 EDoS shield[2]

EDoS shield[] is a mechanism for mitigating EDoS in cloud computing. Main components of the architecture are: virtual firewall(VF) and verifier nodes(v-nodes).The virtual firewalls are used as filtering mechanism, Filtering is done based on IP address of source nodes as black list or white list. These lists are updated based on verification process.

The v-nodes has capability to verify legitimate users using graphical turing tests. V-node will update the virtual firewall list based on result of verification process. Black listed source addresses will be blocked for further requests. The whitelisted IP addresses will be served destined service.

Analysis results:

With the proposed mitigation technique, the response time corresponding to legitimate clients is approximately constant and low. The computing power utilization is not affected due to the attack rate since the attack requests will not reach the protected cloud service. The cost is constant since the rate of the legitimate requests is fixed

Advantages: This approach does not suffer from the problem of location-hiding as it is not required in our approach to hide the location of the protected cloud service.

Drawbacks:

Decreasing the response time, Not protecting the Scalability and no Strong Authentication

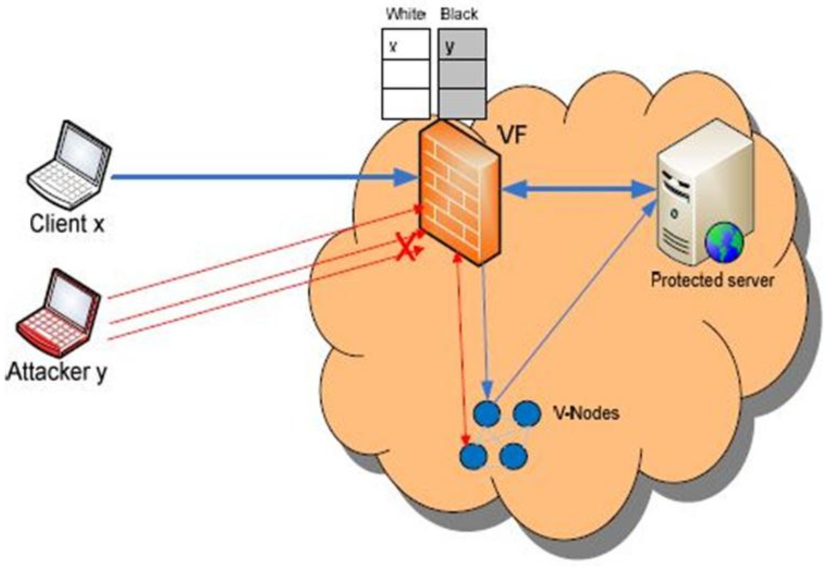

Fig -2: EDoS-Shield framework

1.2 Enhanced EDoS shield[3]

Architecture is same as of EDoS-shield with components as Virtual Firewall and V-nodes but it also looks into TTL values and counter of unmatched TTL for IP spoofing. Timestamp field in the black list is used to record start time of attack, which is time at which source IP address is put into blacklist every time TTL of requesting node is matched with VF table. Instead of dropping because of non-matching TTL, verification process will be done.

Four cases need to be considered in this as:

1. New request:

V-node performs verification using Graphical Turing Test(GTT), If pass then add IP to whitelist else blacklist with TTL, timestamp and unmateched counter will be incremented.

2. IP address in White list:

V-node performs verification phase, if it passes then just TTL will be updated and if it fails, Unmatched TTL counter will be incremented and IP will be added to blacklist with TTL and timestamp.

Case 3: IP address in Black list:

Packet dropped when TTL values matches or unmatched TTL counter exceeds threshold during attack lifetime. Otherwise V-node will perform verification process, if pass then add into whitelist and proceed. If fails, the verification then packet is dropped and entry in blacklist is updated.

Case 4: Both in whitelist and Blacklist:

Packet will be dropped when TTL matches in blacklist otherwise verification will be done.

Drawbacks:

Maximum allowable changes made to TTL value in proposed algorithm, it has been set to value of 5.

Effectively detect attack from individual but not able to prevent pattern attack

1.3 Enhanced DDoS-MS[4]

Enhanced DDoS-MS consists of Firewall, Client Puzzle Server(CSP), Intrusion Prevention System(IPS) and Reverse Proxy server(RP).

Verifier node is used to verifier using GTT. Firewall holds four lists: Black list, White list, Suspicious list and Malicious list. IPS is used to check content of the packet. RP server is used to hide location of protected server and to load balancing. Client puzzle server is used to verify when suspicious user is found.

Scenarios will be like: If it's the first requested packet, it will send GTT for verification. If user is in whitelist, it will be checked for TTL. If user is in black list TTL and start time is updated. The packet will pass through IPS, it will check for malware components. If malware components will be found, It will drop the packet and IP will be added to Malicious list. Then packet will pass through RP server, it will check for no. of packets, If found malicious packet then it will drop the packet and will add the IP to suspicious list. If IP is in suspicious list, it will be verified by V-node using GTT, If GTT is passed then will be further tested through puzzle server using crypto puzzle, if it fails the will be added to malicious list otherwise proceed further. If IP is in Malicious list packet will dropped.

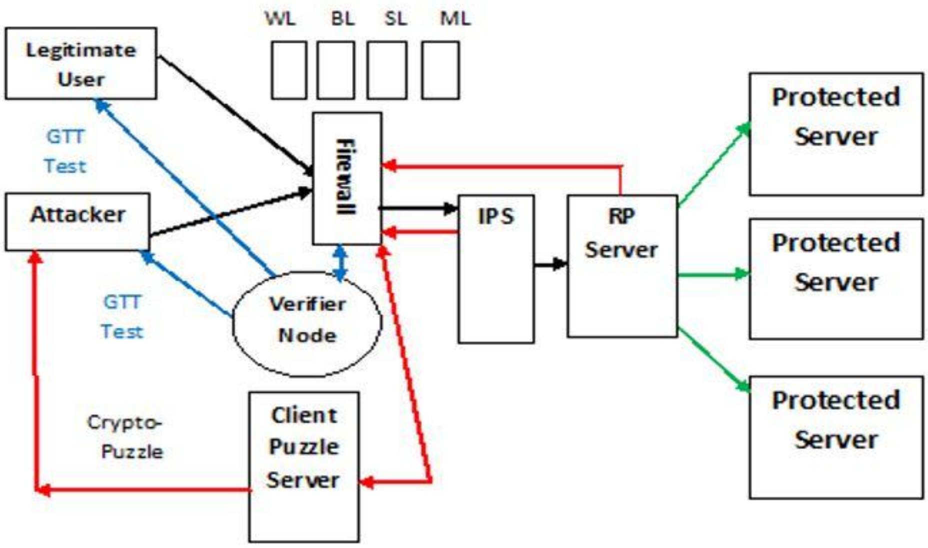

Fig -2: DDoS-MS framework[4]

Drawbacks:

The legitimate clients successfully pass the Turing test and the other checks but they flood the protected server by a large number of requests from a large number of legitimate sources.

1.4 EDoS Eye[5]

Edge router is gateway of both attack and legitimate traffic flows. The aggregate flow then distributes evenly through load balancer. Virtual firewall instances receive the distributed incoming flows. After filtering in virtual firewall instances, a portion of traffic reached at target VMs. Honeypot is incorporated, it is probing device to analyze traffic even it can capture new signatures of attack. Game Based Decision Module(GBDM) is integrated with virtual firewall, it generates optimal threshold values K1 and K2 to rate limit the incoming traffic.

Drawbacks:

Assumes Single attacker attack and as one flow from VMs/Bots.

Nothing is saved for checking IP next time, whole process is done as new.

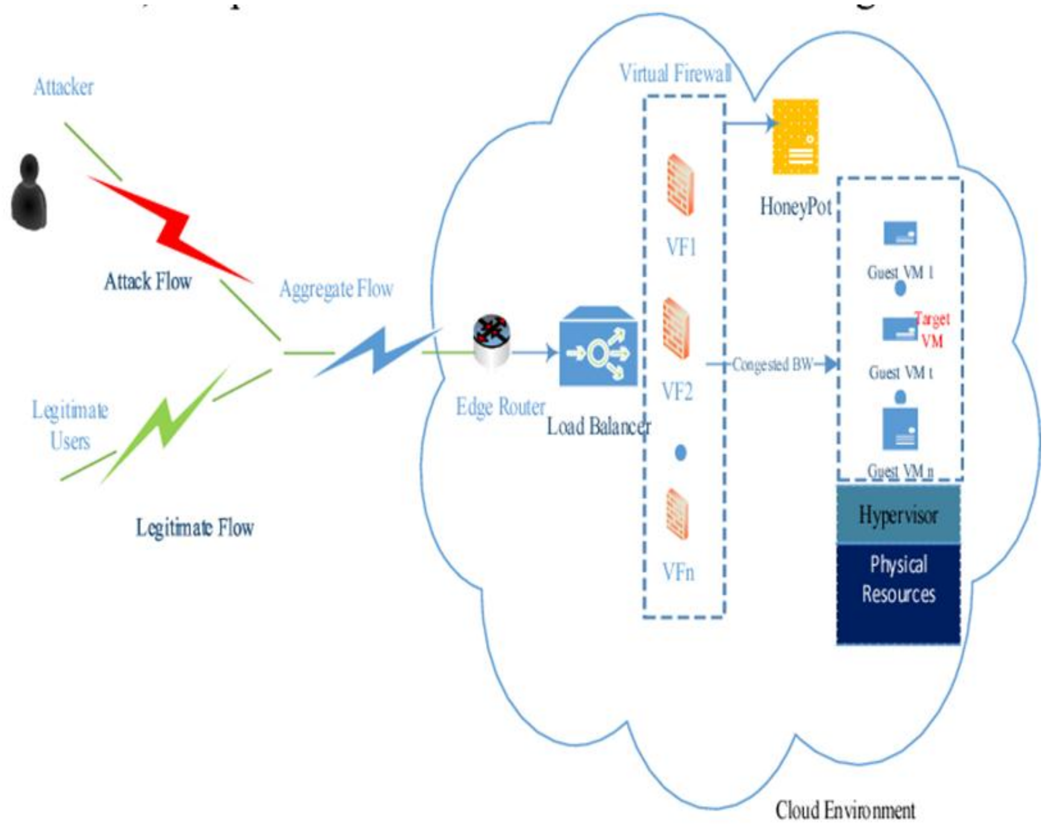

Fig -5: EDoS-Eye framework [5]

Flow is presented as bellow:

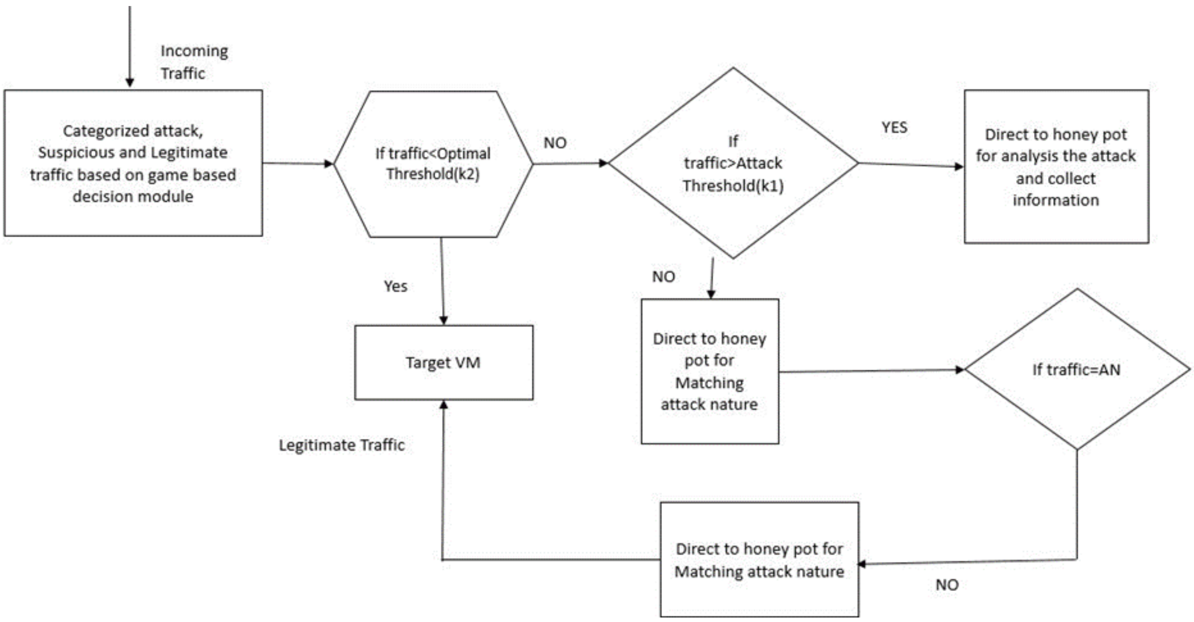

Fig -5: EDoS-Eye workflow[5]

1.5 EDoS-ADS[6]

It consists of Load balancer, Database and Defense shell. Works in four modes: Normal, Suspicion, Flash overcrowd and Attack mode. Defense shell work in different mode for different mode as suspicion shell and attack shell for suspicion mode and attack mode.

When Scaling-up upper threshold does not exceed limit, it works in suspicion normal mode. When it exceeds it, works in suspicion mode. Trust Factor (TF) value of user is set by suspicion shell. It is between o to 1 and by default o.5.If GTT failed then TF value is decremented and marked as suspicious user.

Virtual IP is provided by Defense shell. Upon receiving request, DS updates values of last seen and client request time. If time difference is more than one second Current request per second(CRPS) is set to 1 otherwise CRPS in incremented. Total Request Counter(TRC) is also maintained.

Suspicion shell:

If Current request per second(CRPS)<=Maximum request per second, then send URL redirection.

If CRPS>MRPS

Send URL redirection if client has good trust factor. It sends GTT to new clients if TF is low or average.

Suspicion shell counts no. of failed requests. It is triggered for upper threshold timer period. If timer does not expire and system utilization is decremented, then mode will be changed to Normal mode otherwise either in flash crowd or attack more. If MRC/TRC is 8% then new VM instances will be created and provisioning timer starts in flash overcrowd mode or in attack mode.

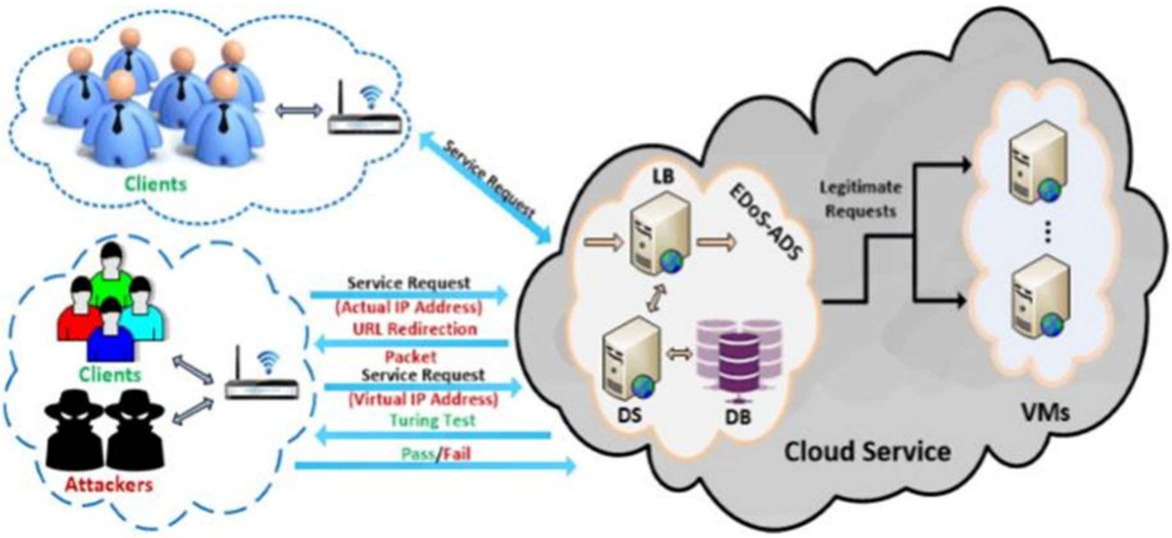

Fig -6: EDoS-ADS framework[5]

Attack Shell:

Sends URL redirect packet.

If client uses virtual IP address, If it does not exceed allowable RPS, it will be served otherwise GTT will be send.

If it fails to use virtual IP it will drop the packet.

Drawbacks:

URL direction to legitimate users also which may lead to flooding at that point.

User is not checked for until CPU utilization exceeds.

3. CONCLUSION

In this paper, we have conducted survey of different EDoS mitigation techniques. It shows basically how the technique works and what are the advantage and drawbacks are there in those techniques so that we can enhance the work in future. EDoS ADS is better than the EDoS-Shield in terms of performance metrics. EDoS-ADS seems better but it increases end-to-end delay.

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