ISSN : 2165-4069(Online)
ISSN : 2165-4050(Print)

IJARAI

International Journal of Advanced Research in Artificial Intelligence

Volume 5 Issue 7

www.ijarai.thesai.org

A Publication of
The Science and Information Organization

Editorial Preface

From the Desk of Managing Editor…

Artificial Intelligence is hardly a new idea. Human likenesses, with the ability to act as human, dates back to Geek mythology with Pygmalion's ivory statue or the bronze robot of Hephaestus. However, with innovations in the technological world, AI is undergoing a renaissance that is giving way to new channels of creativity.

The study and pursuit of creating artificial intelligence is more than designing a system that can beat grand masters at chess or win endless rounds of Jeopardy!. Instead, the journey of discovery has more real-life applications than could be expected. While it may seem like it is out of a science fiction novel, work in the field of AI can be used to perfect face recognition software or be used to design a fully functioning neural network.

At the International Journal of Advanced Research in Artificial Intelligence, we strive to disseminate proposals for new ways of looking at problems related to AI. This includes being able to provide demonstrations of effectiveness in this field. We also look for papers that have real-life applications complete with descriptions of scenarios, solutions, and in-depth evaluations of the techniques being utilized.

Our mission is to be one of the most respected publications in the field and engage in the ubiquitous spread of knowledge with effectiveness to a wide audience. It is why all of articles are open access and available view at any time.

IJARAI strives to include articles of both research and innovative applications of AI from all over the world. It is our goal to bring together researchers, professors, and students to share ideas, problems, and solution relating to artificial intelligence and application with its convergence strategies. We would like to express our gratitude to all authors, whose research results have been published in our journal, as well as our referees for their in-depth evaluations.

We hope that this journal will inspire and educate. For those who may be enticed to submit papers, thank you for sharing your wisdom.

Editor-in-Chief
IJARAI
Volume 5 Issue 7 July 2016
ISSN: 2165-4069(Online)
ISSN: 2165-4050(Print)

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CONTENTS

Diagrammatic Language for Artificial Intelligence: Representation of Things that Flow

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***Abstract*—This paper utilizes a diagrammatic language for expressing certain philosophical notions, such as possible worlds, beliefs, and propositions. The focus is on a diagrammatic representation that depicts "things" to show how their various important properties and relations can be explicated in terms of diagrams. The paper does not add a new contribution to philosophy (what is said in it); rather, it contributes a representation tool for philosophy. Akin to specifications in software engineering, the proposed is to provide a complementary technique for expressing different aspects of the involved philosophical concepts that are typically presented in the form of textual explanations. The resultant diagrams seem to be a viable tool that can be utilized in teaching, in communication, and to facilitate an understanding of philosophical problems.**

***Keywords*—*diagrammatic representation; philosophical diagrammatic language; possible* worlds**

I. Introduction

It has been a major objective of many philosophers and scientists to achieve a representation without ambiguity through building universal languages. One attempt in this direction is to represent things with symbols instead of words, with the addition of some grammatical rules; this was thought to be sufficient for expressing our conceptions [1]. A representation in this sense is a sign about things. A diagram of a man is a representation because it is about the man. In psychology, a representation is described as having a referent that can be represented in different ways (content and media) [2] or similar terms. Some versions of the so-called representational theory of mind (not of direct concern in this paper) explain the mind in terms of representations [3]. Representation can also be viewed as a relationship between that which represents (sign) and that which is represented [4].

In this paper, the term *representation* refers to "appearances" (public representation [4]), such as expressions in natural language, algebraic formulae, graphs, or geometric figures [5]. The focus is on a diagrammatic representation that depicts *things* (will be defined later) that "may exist in a possible or fictional world" [6]. In resemblance to Von Eckard's definition of mental representation, the representation of concern, here, includes such *things* as "concrete objects, sets, properties, events, and states of affairs in this world, in possible worlds, and in fictional worlds as well as abstract objects such as universals and numbers; that can represent both an object (in and of itself) and an aspect of that object (or both extension and intension); and that can represent both correctly and incorrectly" [7]. Such a representation is utilized "to characterize the kind of phenomena that occur in any knowledge process or that constitute it" [8]. This type of representation is "the means through which a person can externalize his/her mental representations in order to make them visible or accessible to others" [5]. It plays "a central role in social exchange, sophisticated communicators such as humans have developed ways to talk and think directly about representational properties such as truth, accuracy, meaning, and entailment" [4]. The resultant description assumes *things with representational properties* and aims to model them.

The proposed diagrammatic language is applied to the concepts of possible worlds, beliefs, and propositions to demonstrate how various important properties and relations of things can be explicated in terms of diagrams. For example, [9] invoked "the concept of possible worlds in order to give an analysis of what propositions are; to give an explanation as to why they need to be distinguished from the sentences, which may be used to express them; and to provide a method for identifying and referring to particular propositions [things]" [9]. Accordingly, the paper closely follows Bradley and Swartz's [9] discussion of these topics while recasting them in a diagram that reveals additional properties and relations.

The paper does not add a new contribution to philosophy (what is said in it); rather, it contributes to a linguistic varsity of philosophy. It offers a diagrammatic language akin to specifications in software engineering that provides a complementary means of expressing different aspects of the involved philosophical concepts typically presented in the form of verbose explanations. The resultant diagrams can be utilized in teaching, in communication, and to facilitate an understanding of philosophical problems.

> [Many students] consider philosophical texts as boring or think they are not clever enough to understand these texts. These views also give an indication why *visualization* might facilitate the process of understanding: sensual connections may lower the threshold to deal with such texts. [10](italics added)

Recently, many philosophers, psychologists, logicians, mathematicians, and computer scientists have become increasingly aware of the importance of multi-modal reasoning, and much research has been undertaken in the area of non-symbolic, especially diagrammatic, representation systems [11].

Visualization techniques used in science and the arts for the advanced analysis of information and theories can and should be similarly used in the humanities. Within the discipline of philosophy, there are both the possibility and the necessity to examine and present ideas using visualization techniques. [12]

The proposed diagrammatic language has been researched and utilized in software engineering and in several other applications [13-18], and for the sake of a self-contained paper, it will be briefly reviewed in the next section. However, the illustrative example of the vision mechanism of humans given here is a new contribution.

II. FLOWTHING MODEL

The Flowthing Model (FM) is a representation tool of things that flow, *flowthings,* which are defined as what can be *created*, *released*, *transferred*, *processed*, and *received* in a *flow system* (see Fig. 1). Hereafter, flowthings may be referred to as *things*. As will be discussed later, the notion of *thing-ness* is wider than the notion of physical, mental, and abstract objects. A *no-thing* is that which is not created, processed, released, transferred, and received, as will be illustrated later.

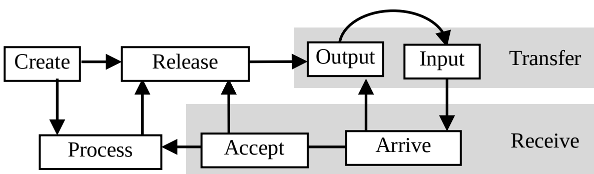

Fig. 1. Flow system

The flow system is an abstract *machine* used to handle (change though stages) things from their inception or arrival to their de-creation or transmission to the outside. Its stream of flow is a lifeline for things. The stages in Fig. 1 can be described as follows:

Arrive: A thing reaches a new machine.

Accepted: A thing is permitted to enter a machine. If arriving things are always accepted, *Arrive* and *Accept* can be combined as a **Received** stage.

Processed (changed): The thing goes through some kind of transformation that changes it.

Released: A thing is marked as ready to be transferred outside of the machine.

Transferred: The thing is transported somewhere from/to outside of the machine.

Created: A new thing is born or appears in a machine.

FM also uses the notions of *spheres and subspheres*. These are the "worlds" of things and their flow machines. For example, the actual world is the sphere of all of that is really in it (a human is born, is processed [grows up], and moves from one subsphere to another). A thing is whatever *appears* in at least one sphere. Note that a sphere can be a thing (e.g., created, processed, …), e.g., the ship is a sphere of such things as sailors, shipments, supplies, … machines. Additionally, the ship is a thing that is created (constructed), processed, etc.

When FM represents a portion of reality, spheres, subspheres, flowthings, and triggering are associated with their identifiable counterparts in that portion of reality. Thus, we actually match elements of an FM representation with elements of the target domain. According to Frigg [19]:

A system is a "compact" and unstructured entity and we have to carve it up in order to impose a structure on it. Structures do not really exist until the scientist's mind actually "creates" them or, to put it in a less pretentious way, ascribes them to a system. More specifically, what we have to do is to identify a set of individuals, which can serve as the domain of the structure and then identify a set of relevant relations and operations on this set… Structures are not "ready-made" but result from a way of taking, or demarcating, the system. [Structure] is an imagined physical item, which is equipped with an exactly describable "inner constitution" consisting of a web of properties and their interactions. (Italics added)

The modeler perceived an unstructured reality and processed (carved up) it to trigger the creation of a structured version of reality, such as gazing at a cloud and seeing shapes in it.

Triggering in FM is the activation of a flow, denoted by a *dashed arrow*. It is a dependency among flows and parts of flows. A flow is said to be triggered if it is activated by another flow (e.g., a flow of electricity triggers a flow of heat) or activated by another point in the flow. Triggering can also be used to initiate events, such as starting up a machine (e.g., remote signal to turn on). Multiple machines captured by FM can interact by triggering events related to other machines in those machines' spheres and stages.

Example: Jin Ma et al. [20] proposed an adapted "Requirement–Function–Behavior–Principle" solution for aiding creative design activities during the conceptual design process. They analyzed the *vision mechanism of human* to produce summary diagram of functions that is shown in Fig. 2.

[The] human vision system, consists of the basic functions to form vision and the control functions to adjust definition and direction of vision. By processing the visual signal to form instructions to control the incident angle of light and the incident light intensity,... Jin Ma et al. [20]

Such a representation is expressed in a type of transitive verb + noun + complement and input/output flow. A function is discomposed into sub-functions: Adjust the focus, regulate the rotate angle, regulate the light intensity, …

The purpose of showing Fig. 2 is not to give a fair description of the diagramming method. Rather, the purpose is to display this form of representation that includes heterogeneous shapes. It is difficult to compare the figure with the corresponding FM diagram by listing different shapes and notations, the type of flows and arrows, etc.

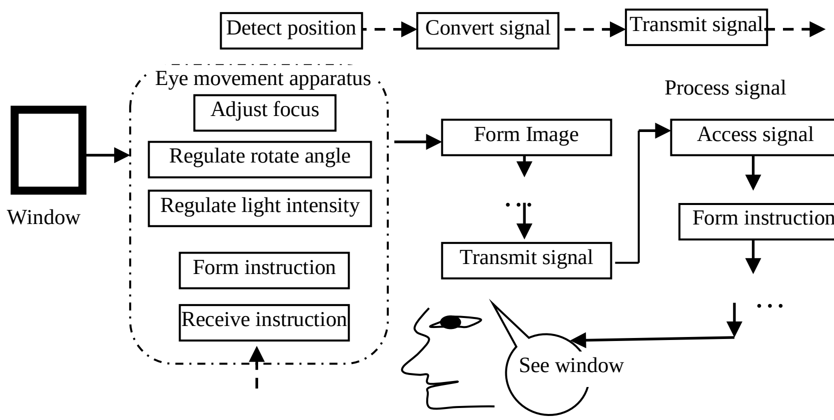

Fig. 2. "Whole flow path of the artificial vision system" (partial figure – re-drawn from Jin Ma et al. [20]

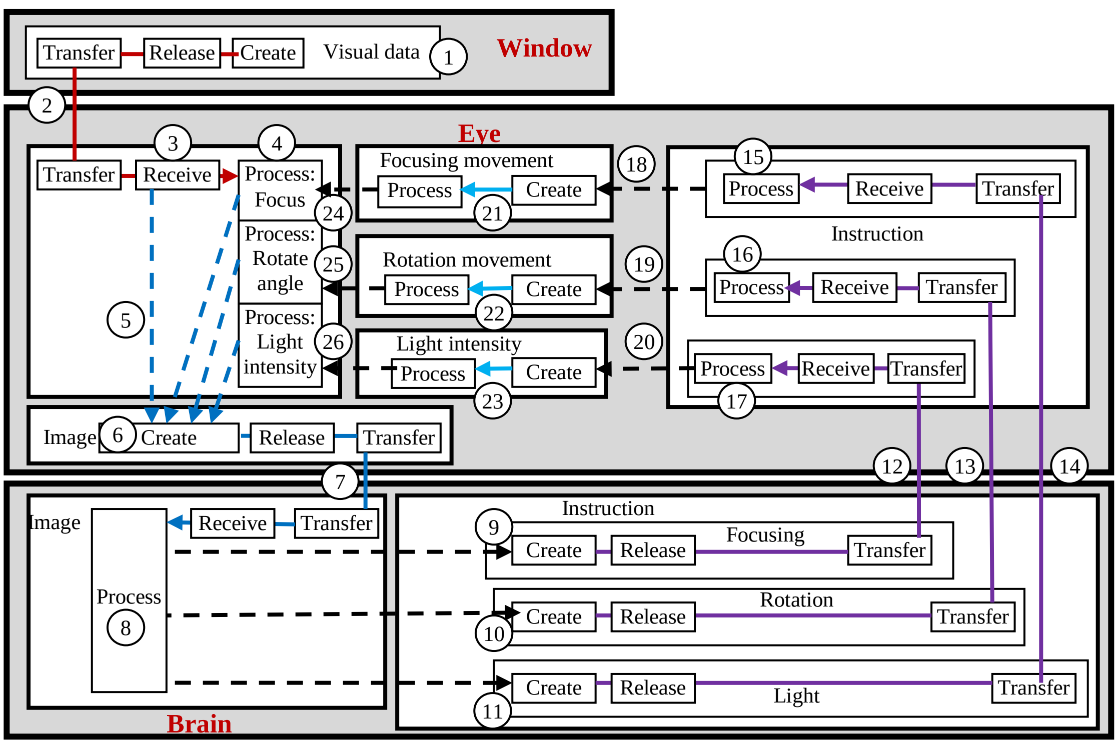

Fig. 3. FM representation of the artificial vision system

A more convenient way is to place the two diagramming representations side by side to contrast their features. Fig. 3 shows the FM diagram that corresponds to a simplified version of the involved system, as we understand it. First, data are generated (circle 1) via the sight of the window, and they flow to the eye (2), where they are received (3) and processed (4). Three types of processed data exist, each placed in a different box to emphasize the differences. According to our understanding, the received raw data trigger (5) the generation (6) of an image that flows to the brain (7), where it is processed (8). The process results in the creation of instructions for:

- Focusing the image (9) and/or
- Rotating the angle of the sight (10) and/or
- Regulating the light's intensity (11)

Then, the instruction(s) flow to the eye (12, 13, and 14), where it (they) is/are processed (15, 16, and 17) to trigger (18, 19, and 20) the creation and processing of the required eye movement (21, 22, and 23). This involves the processing of the incoming data (24, 25, and 26) to create a refined image (6).

From contrasting Fig. 2 and Fig. 3, such features as the heterogeneity of notions and the uniformity and systematization of each representation appear to be present.

III. EXPLORING FM REPRESENTATION

As mentioned previously, this paper focuses on a diagrammatic representation that that can stand for concrete objects in the actual world, in possible worlds, and in fictional worlds, as well as abstract objects. All such things as thoughts, beliefs, desires, perceptions, and imaging are represented as *flow things* that can be created, processed, received, released, and/or transferred. The resultant apparatus also depicts its dynamic trajectory during tits "life" through flow systems. This section explores a variety of these things.

A. *Existence*

In Platonic realism, abstract things exist independently of human thinking. The actual world (sphere) is all that really exists: the universe as a whole [9]. An aspect of *eexistence* in FM can be modelled as a *Creation* machine in a flow system in a certain sphere.

Consider the status of things such as a *gold mountain*, which is not real (this example is from Hirst [21] in the context of discussing [22] ideas).

Note that the question is not about the concept or idea of the gold mountain and whether that exists; clearly, it does. But when we say that the gold mountain is 1000 meters tall, we aren't just talking about an idea; it is not the idea that is 1000 meters tall but the alleged thing that the idea is about. [21]

Golden mountain is represented in Fig. 4. There is *gold*, and there is a *mountain*. There is also a *golden mountain*, but it does not exist (has no *Create* stage) and receives the property (has the property) of receiving (being filled by) gold.

The same representation can be used for the classical example of a *round square* as shown in Fig. 5. Note that these diagrams are shown to demonstrate that they express the involved notions diagrammatically without any attempt here to discuss the philosophical issues involved with them.

B. *Existence, propositions, and sentences*

Propositions are things that are expressible by sentences (e.g., strings of symbols) [9]. Thus, the sentence *Fido slept on the mat* is a *thing* that can be created (meaning: there's a sentence), processed (e.g., it is made bold), released, transferred, and received. The *referred to* (e.g., my dog) Fedo is also a (physical) *thing* that can be created (e.g., born, appears in the current presentation), processed (e.g., cleaned), …. Additionally, the "meaning" of the sentence is a *thing* that can be created, processed, …. For example, *Fido slept on the mat* (the sentence) is created by me, released, transferred, and received by my wife, who processed it to create her understanding of some cause, say, of the dirt on the mat. In this case, the meaning is: *At a previous time, my dog, Fido, was received on the mat and then released and transferred from the mat*. Accordingly, all of these things—the sentence, (physical) Fido, and meaning—are *represented* not as mere things but also with their *flow* among creation in processing, releasing, transferring, and receiving *states*. These five "flow stoppages in flow (*stages*)" come inevitably with a *thing*.

In Fig. 6, the left diagram represents that Fido *exists* where Fido is represented by the outer box and the stage *Create*, and that means that *There exists Fido* is a *thing* in this presentation. In *reality*, Fido appears without the *tag* Create (exists) because the *mere appearance* of Fido as a physical object, toy, picture, concept, or character in a story implies it exists in that context *as a thing*. In a *representation*, this has to be specified explicitly.

In the right diagram of Fig. 6, Fido appears to be a *thing* that flows through *stages* to the mat, assuming it was created previously. The point is that a *thing* always appears in at least one flow stage. The diagrammatic representation refers to the *referent* and its flow in the given sphere (*contexts* of flow).

In Fig. 7, a *Unicorn* does not exist in the actual world (no creation stage), but it exists in Greek methodology, which is in the actual world.

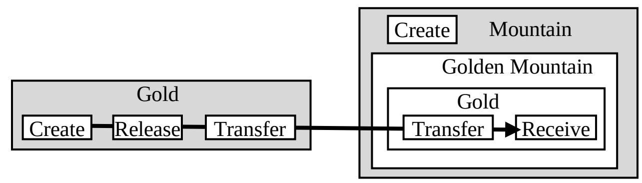

Fig. 4. Golden mountain as a non-existing sphere

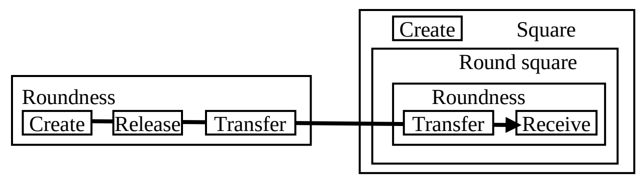

Fig. 5. Round square as a non-existing sphere

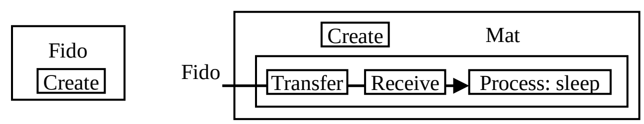

Fig. 6. The thing Fido and possible flows

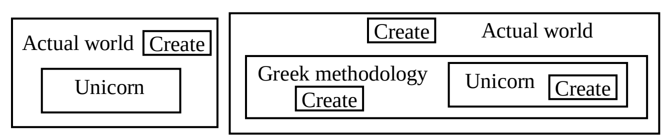

Fig. 7. Non-existence sphere and Unicorn as a thing

The sphere is the background (the frame) where things appear, e.g., painting appears on the surface of a paper and a sound "appears" in air, etc. Accordingly, Fig. 7 (left) says that the *Unicorn* sphere appears in the sphere of the actual world but it does not exist (no *Create* stage). That is, it is nothing in the actual world. A non-existent sphere is similar to the outer sphere mentioned previously: It has no stage. When a critic talks about the *depth* of a painting, he/she is talking about the non-existence sphere. It is *the between-the-words* sphere, which has no *thing*. In the right diagram of Fig. 7, the unicorn is a thing created in Greek methodology. Note that the actual world and Greek methodology spheres are things. An existing sphere can be, in its turn, a thing (e.g., created, processed, …).

C. *Attributes*

In FM, the so-called "attribute" is a *thing*, e.g., "the Rose is red" is expressed diagrammatically as the sphere *Rose*, which receives the (flow) Red thing as shown in Fig. 8. The diagram expresses that in some sphere (e.g., actual world – the outer box), there exists (created) a rose that is red. That is, in the sphere under the *process of representation*, there is the sphere *Rose* (also a thing since it has the *Create* stage) that gets the *thing*'s Redness. It is assumed that the outer sphere includes a subsphere that creates Red(ness). For simplicity's sake, when appropriate, the outer sphere (box) will not be drawn – Fig. 9 (as we did in the diagrams of the subsection *A. Existence*). This outer sphere "exists" *by representation* (it appears in front of our eyes); hence, it is not necessary to insert the *Create* stage in it. The outer sphere is just a canvas where a painter creates his/her painting, but the canvas is not part of the painter's creation. It is "the spatial aspect …that provides the raw material for the creation and transformation of diagrams" [23].

Fig. 10 shows a sphere of a red rose and red car. For simplification purposes, the boxes of the subspheres' Red(ness) in *Car* and *Rose* (bold circumstance) may be eliminated.

Fig. 11 shows two worlds (drawn as ellipses for illustrative purposes), one with red roses and the other with black roses.

Fig. 12 shows that the *black rose* is fiction in the actual world (which is, by assumption, the background of the figure).

D. Beliefs

According to Bradley and Swartz [9], the term *belief* is ambiguous in terms of (a) the state, act, or disposition of believing, and (b) that which is believed.

Suppose John Doe believes himself to be ill… In such a case we would be asking about John Doe's *state of belief* (or, as some would say, his "act of believing"). His belief, in this sense of the word…, is something which may *arise* at a specific moment of time and persist through time; it may be brought about or caused by some other event or state of affairs, e.g., by his having eaten too much. [9] (italics added)

Fig. 13 shows the FM representation of this state of belief. States of affairs are obtain (ON) or not (OFF) [24]. Thus, a state is either belief or non-belief. Its creation (1), as in the left diagram of Fig. 13, occurs due to *illness* (2), which is processed (takes its course) and, in turn, is triggered (3) by something. On the other hand, its creation, as in the right diagram, is triggered by something without one's actually being ill. Thus, a state may or may not have a content (illness).

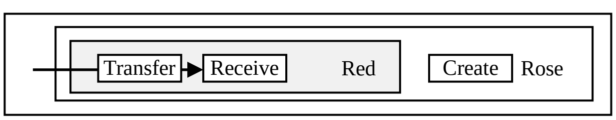

Fig. 8. The sphere *Rose* receives the Red *thing*

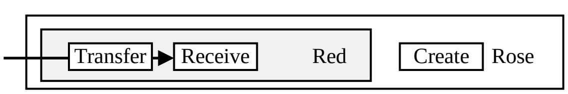

Fig. 9. Simplification of Fig. 8

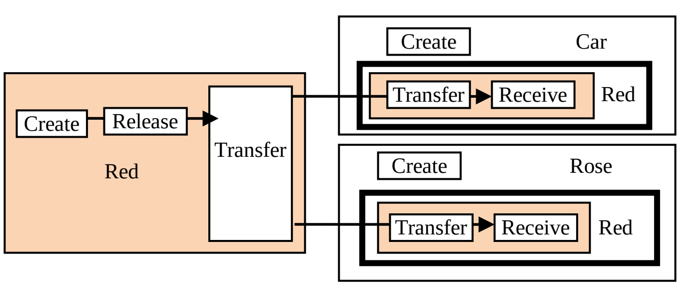

Fig. 10. The spheres of Red *Rose* and Red *Car*

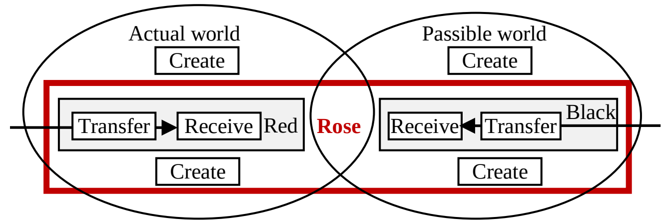

Fig. 11. Two worlds, one with red roses and the other with black roses

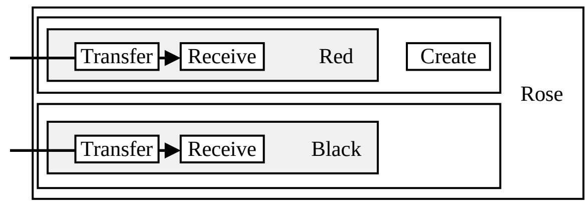

Fig. 12. A black rose is one of things in this world, but it does not exists (no *Create* stage)

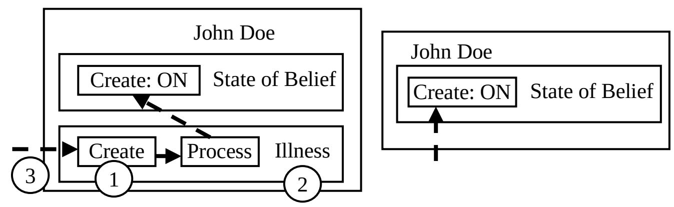

Fig. 13. Two situations that may create State of belief

On the other hand we may distinguish the content of his belief, that which he believes. It is this latter feature which may occur in *other persons' beliefs* as well. Although no other persons can have John Doe's belief in the sense that their acts of believing cannot be the same act as John Doe's, what they believe, viz., that John Doe is ill, may be shared both by them and John Doe. In this second sense of "belief, the sense in which we talk of what is believed …, a belief may be shared by many persons. [9] (italics added)

Fig. 14 shows the representation of this case. An actual illness (content) (circle 1) triggers a belief (2) in John Doe. Process (3) means that the illness has taken its course. Thus, the occurrence (creation, existence) of an illness (sooner or later) triggers (4) the generation (5) of an illness sign, which is communicated (flow) to others (6). Processing such a sign (7) triggers (8) the belief in any other person that John Doe is ill.

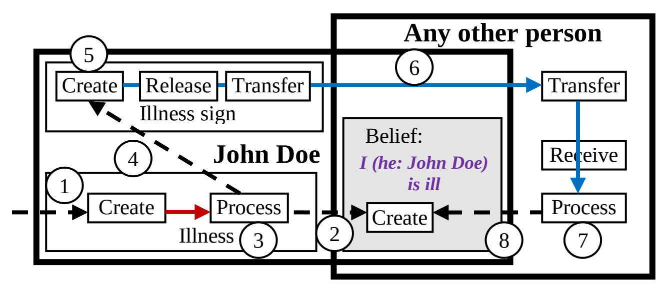

Fig. 14. Sharing belief

The total picture would be further fixed if we introduce truth values as shown in Fig. 15. The belief sphere (circle 1) includes the belief itself (2), its truth value (3), the illness (4), and its truth value (5). Note that the belief (1) is in John Doe, and it includes two sub-spheres: itself (2) and its content illness (4). However, the truth value of the belief (3) is not inside John Doe; rather, it exists in abstract. Similarly, the truth value of illness is not in John Doe or his belief but rather in abstract. Let us refer to the truth values by their numbering, 3 and 5.

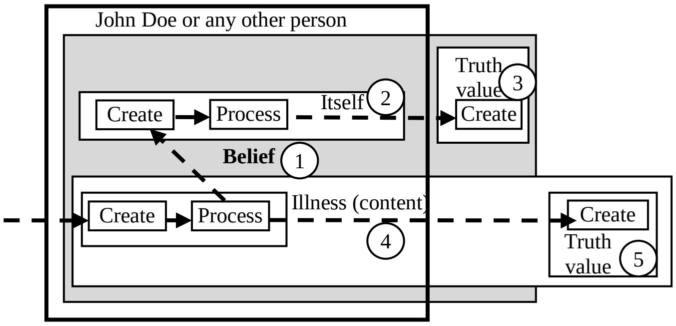

Fig. 15. John Doe, his belief and truth values

IV. Conclusion

This paper has utilized a diagrammatic language for expressing philosophical concepts that potentially can be applied in “diagrammatic thinking and representations” in artificial intelligence. The contribution of this paper is limited to proposing the use of the diagrammatic representation and demonstrating its viability for representing certain philosophical concepts. A great deal of materials has been left out for future work. Nevertheless, the diagrammatic language is worth further discussion and investigation in philosophy that may prove some advantages at least in portraying certain philosophical problems.

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Enhanced Tunneling Technique for Flow-Based Fast Handover in Proxy Mobile Ipv6 Networks

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***Abstract*—In the Mobile IPv6 network, each node is highly mobile and handoff is a very common process. When not processed efficiently, the handoff process may result in large amount of packet loss. If the handover process is performed without appropriate connection verification and through specified tunnels, then this may result in inappropriate traffic flow since the required traffic redirection may not happen in this case. To overcome these issues, we propose to develop an Enhanced Tunneling Technique for Flow-based Fast Handover in Proxy Mobile IPv6 Networks. In this technique, the packets are buffered to minimize the packet loss during handover and then the Flow based Fast Handover techique is employed to ensure that the traffic is redirected to the new subnet after handover process. Thus ensuring efficient network operation.**

I. Introduction

A. Mobile IPV6 Networks

The Mobile IPv6(MIPv6) is an IETF standard that allows mobile device users to move from their Home Network to another while maintaining a permanent IP address, thereby ensuring location transparency (similar to a Distributed System Environment). This facility allows for seamless and continuous internet connectivity. However, the reason for the lack of popularity in deploying Mobile IPv6 is due to poor handoff latency and other drawbacks leading to packet loss and poor performance for live audio and video streaming-based applications. MIPv6 has not seen commercial interest because it requires the mobile equipment itself to participate in the mobility process and this reduces the battery life of the mobile equipment. While MIPv6 manages mobility for a single host, the Network Mobility Basic Support Protocol (NEMO BSP) Although host-based Mobile IPv6 protocols have been studied extensively, a different approach where the entire network moves, known as Network Mobility (NEMO) is of great interest in the manages mobility for an entire network [1].

Mobility in IPv6 networks has evolved remarkably compared to Mobile IPv4 protocol. Mobile IPv6 (MIPv6) enables transparent routing of IPv6 packets to Mobile Nodes (MNs) from Correspondent Nodes (CNs). The mobility is made possible by using a Home Agent (HA) and a local Care-of-Address (CoA). Unfortunately it is still unsolved how to minimize the handover time between two logical subnets so that the outtime is as short as possible. [2].

Proxy Mobile IPv6 (PMIPv6) provides IP mobility to a mobile node by the proxy mobility agent called a Local Mobility Anchor and a Mobile Access Gateway without requiring mobile node's participation in any mobility-related signaling. The route optimization for PMIPv6 is realized by using the direct tunnel established between the MAGs, to which mobile nodes are attached [3].

Bidirectional tunneling is presented in Mobile IPv6 in which MN and HA are connected to each other via a tunnel, so signaling is required to construct a tunnel between MN and CN [4].

II. Related Works

In Flow based Fast Handover for MIPv6 (FFHMIPv6) [2], each traffic flow can be identified and redirected to a new location using the IPv6 Flow Label. It allows the reception of packets simultaneously with the BU registration process, thus minimizing the delay experienced in the handover.

A right-time path switching method has been proposed [3] for providing PMIPv6 route optimization. By using signaling messages, this method initiates the path switch when the optimized path is ready. Out-of-sequence packets are preventing by this feature. The disruption duration is reduced in the route optimization procedure. By using actual PCs, this procedure is evaluated in an experimental test-bed. Results show that this method prevents out-of-sequence packets, whereas the baseline route optimization procedure causes them. During the route optimization procedure, this method has performance improvement in TCP throughput or seamless continuity of real-time applications. Communication disruption duration, delay gap, and number of out-of-sequence packets are the performance metrics used. However, it may be affected by malicious nodes in the network [3].

An improved tunneling-based route optimization mechanism is proposed [4] to reduce the packet overhead. The tunnel manager is changed and binding update messages are altered for maintaining the compatibility with standard mechanisms. This mechanism shows the reduced packet overhead when compared to bidirectional tunneling, route optimization, and tunneling-based route optimization. In mobile IP communication, more data can be transmitted via network because of less overhead for each packet. Overhead and delay are the performance metrics used. However, the total delay is same as that of the bidirectional tunneling, route optimization, and tunneling-based route optimization mechanisms; hence, it must be reduced.

Khaled Zeraoulia et al [5] have introduced a novel mobility management strategy for mobile IP networks, in which they developed a seamless handover scheme called SHMIPv6 (Seamless Multimedia handoff for hierarchical Mobile IPv6). By integrating MAC and Network layer handovers efficiently, SHMIPV6 can significantly reduce the system signaling cost and handover delay.

Ali Safa Sadiq et al [6] have proposed an Advanced Mobility Handover scheme (AMH) in this paper for seamless mobility in MIPv6-based wireless networks. In the proposed scheme, the mobile node utilizes a unique home IPv6 address developed to maintain communication with other corresponding nodes without a care-of-address during the roaming process.TheIPv6 address for each MN during the first round of AMH process is uniquely identified by HA using the developed MN-ID field as a global permanent, which is identifying uniquely the IPv6 address of MN. Moreover, a temporary MN-ID is generated by access point each time an MN is associated with a particular AP and temporarily saved in a developed table inside the AP. When employing the AMH scheme, the handover process in the network layer is performed prior to its default time. That is, the mobility handover process in the network layer is tackled by a trigger developed AMH message to the next access point. Thus, a mobile node keeps communicating with the current access point while the network layer handover is executed by the next access point.

Mohit Bagde and P. Sankar [7] have proposed a method for improving the mobility using the fast handover of Mobile IPv6 (FMIPv6) and the Reverse Routing Header Protocol (RRH). The (RRH) protocol is employed is to record the route through which the packet travels from the Correspondent Node to the Mobile Node.

III. Enhanced Tunneling Technique for Flow-Based Fast Handover in Proxy Mobile IPv6 Networks

A. Overview

In our previous paper, we propose to design a tunneling-based routing and handover decision model for Proxy Mobile IPv6 networks. A tunneling based route optimization is applied in the architecture of PMIPv6 followed by a handover decision model for network selection based on various priorities of traffic classes.

As an extension to this work, we propose an Enhanced Tunneling Technique for Flow based Fast Handover in Proxy Mobile IPv6 networks.

In this technique, first the flow based fast handover (FFH) technique [2] is implemented. Then the loss-free buffering process [5] is applied to minimize the packet loss during handover process by enabling the temporary storage of the tunnel.

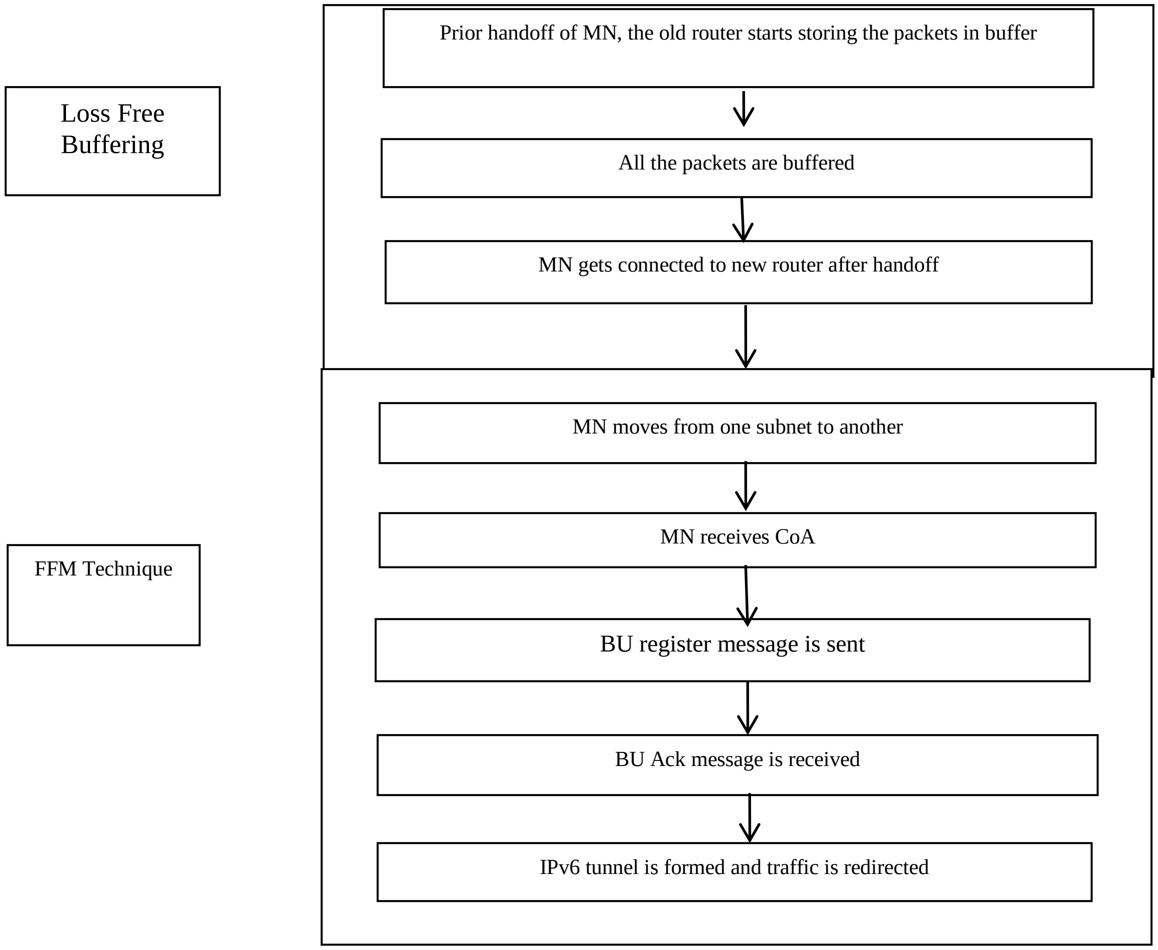

Fig. 1. Block Diagram

B. *Loss Free Buffering Process*

During the handover process, the connection between the mobile node being handovered and the access router gets broken and the mobile node gets connected to a new access router belonging to the new subnet. During the period from when the mobile node gets disconnected from the old access router and till it gets connected to a new access router, there are chances for packets to be lost from the mobile node [5]. To avoid or to reduce the packet loss occuring during handoff process, the packets can be temporarily stored in a buffer. This buffering process to reduce packet loss is described in algorithm 1.

Algorithm 1

Notations:

1. MN	:	Mobile Node
2. SS	:	Signal Strength
3. Sec_{Th}	:	Security Threshold
4. SS_{Th}	:	Signal Strength Threshold
5. R_{old}	:	old access router
6. R_{new}	:	new access router

Algorithm:

1) Before the handover process, a *Handoff_Initiate* message is broadcasted in the network.

2) After boadcasting the message, the MN defines the S_{Th} for the packets.

3) Then the MN keeps monitoring the SS of the packets.

4) When Sec_{Th} = SS, then the MN sends an Buffering_initiation message to the R_{old} .

5) When the R_{old} receives this message, it initiates storing the packets in a buffer.

6) While buffering, the R_{old} also sends copy of the packets to the MN.

7) When the SS < SS_{Th}, the connection between the MN and R_{old} is disconnected, and so, the R_{old} stops sending the copy of the packets to the MN.

8) When the MN gets connected to a R_{new}, the R_{old} stops storing the packets in the buffer.

9) Then the MN operates with aid of the $R_{new.}$

In this way, the packet loss is minimized during handoff in the network by storing the packets in the buffer.

C. *Flow based Fast Handover (FFH) technique [2]*

The Flow based Fast Handover (FFH) technique is employed to handle the handover process in an efficient way. When the Mobile Node moves from one subnet to another, the router controlling the traffic flow towards the mobile node also changes. This information about the new subnet should be registered inorder to ensure that the traffic flow is redirected in the appropriate path.

The process of FFH performing the handoff technique along with the creating of MIPv6 tunnel is described in algorithm 2.

Algorithm 2

Notations:

1. MN	:	Mobile Node
2. CoA	:	Care of Address
3. HA	:	Home Agent
4. CN	:	Correspondent Node
5. FFH	:	Flow based Fast Handover
6. MIPv6	:	Mobile Internet Protocol version 6
7. BU	:	Binding Update

Algorithm:

1) When a MN moves from one logical subnet to another, it recieves a new CoA.

2) On receiving the CoA, a Flow Label of the prior mobile connection and a Hop by Hop frame containing the address of the HA and CN are added into BU register message.

3) The BU register message is sent to the immediate crossover router.

4) The Hop by Hop frame contains a new FFHMIPv6 identifier which indicates that IPv6 tunnel has not yet created.

5) Every router that receives the BU register message, checks the Hop by Hop frame.

6) If a router detects the FFHMIPv6 identifier, then it handles the register message to create a tunnel.

7) Ob the basis of the traffic information present in the messge, the router determines the connection.

8) Then an BU Ack message is sent to the MN's new CoA inorder to inform it about the crossover router.

9) Next an IPv6 tunnel is developed between the crossover router and MN, and the traffic is redirected through the tunnel.

*10)*In the Hop by Hop frame, the FFHMIPv6 identifier is set to 1 to indicate that the tunnel is already created and traffic can directly be transferred through the tunnel.

*11)*Then the BU register message is forwarded to HA and CN.

*12)*Similarly, a BU Ack message is sent by HA and CN after verifying the connection.

*13)*Then a IPv6 tunnel is created between the new CoA and HA and then similarly between new CoA and CN.

*14)*Finally all the traffic flowing towards the old CoA are encapsulated to a new IPv6 packet and redirected towards the new CoA.

So, all the traffic are redirected after the handover process. This is performed after ensuring the connection and thus ensuring packet security. To assure secure traffic flow after handover, the traffic flow is encapsulated and transmitted through the IPv6 tunnel. Thus assuring safe network operation.

IV. SIMULATION RESULTS

A. Simulation Parameters

We use NS2 to simulate our proposed Enhanced Tunneling technique for Flow based Fast Handover (ETFH) in Proxy Mobile IPv6 Networks. The area size is 600 meter x 600 meter square region for 50 seconds simulation time.

Our simulation settings and parameters are summarized in table 1

TABLE I. SIMULATION PARAMETERS

No. of Nodes	16
Area	600 X 600m
MAC	802.11
Simulation Time	50 sec
Traffic Source	CBR and Exponential
Rate	50,100,150,200 and 250Kb
Propagation	TwoRayGround
Antenna	OmniAntenna
Psize	512

B. Performance Metrics

We evaluate performance of the mainly according to the following parameters. We compare the Flow based Fast Handover (FFH) technique [2] with the proposed ETFFH.

Average Packet Delivery Ratio: It is the ratio of the number of packets received successfully and the total number of packets transmitted.

Delay: It is the time taken by the data packets to reach the destination.

Packet Drop: It is the number of packets dropped during the data transmission.

C. Results & Analysis

The simulation results are presented in the next section.

1) Varying the Rate

In our first experiment we vary the transmission rate as 50, 100,150,200 and 250Kb for both CBR and Exponential (EXP) traffic flows.

Case-1(CBR)

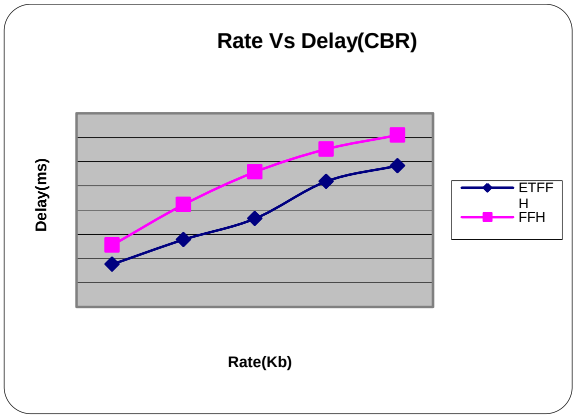

Fig. 2. Rate Vs Delay

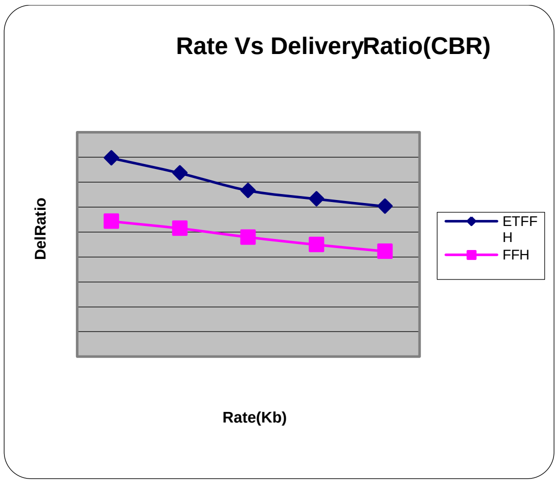

Fig. 3. Rate Vs Delivery Ratio

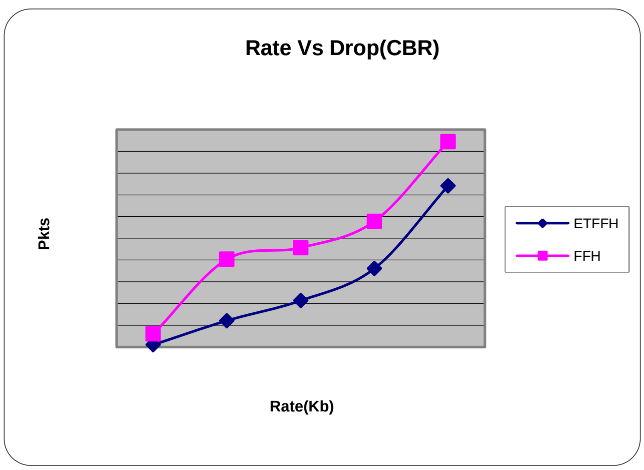

Fig. 4. Rate Vs Drop

Figures 2 to 4 show the results of delay, delivery ratio and packet drop for ETFFH and FFH when varying the rate of the CBR traffic flows. When comparing the performance of the two protocols, we infer that ETFFH outperforms FFH by 27% in terms of delay, 29% in terms of delivery ratio and 53% in terms of packet drop.

Case-2 (EXP)

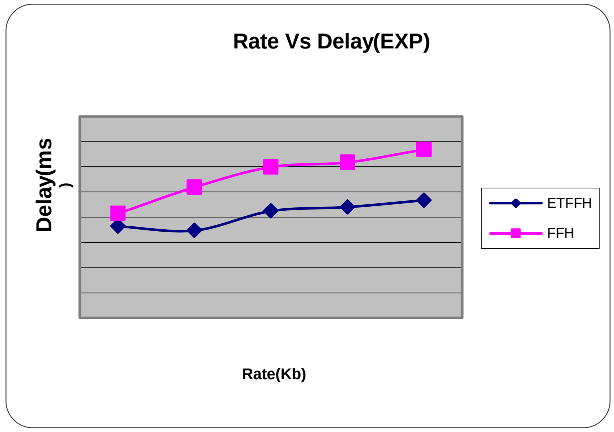

Fig. 5. Rate Vs Delay

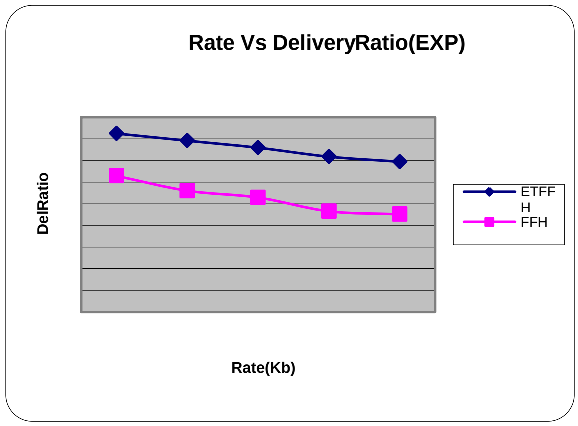

Fig. 6. Rate Vs Delivery Ratio

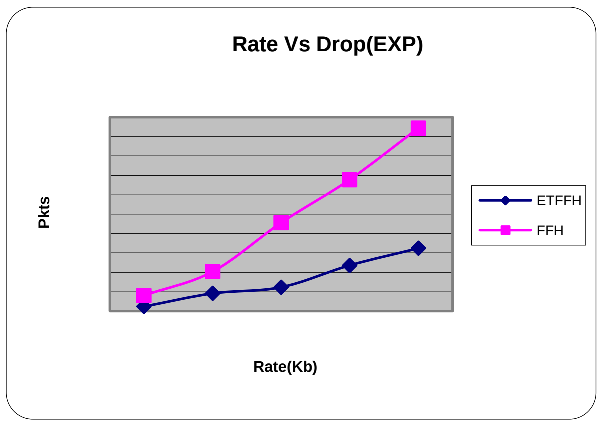

Fig. 7. Rate Vs Drop

Figures 5 to 7 show the results of delay, delivery ratio and packet drop for ETFFH and FFH when varying the rate of the EXP traffic flows. When comparing the performance of the two protocols, we infer that ETFFH outperforms FFH by 26% in terms of delay, 30% in terms of delivery ratio and 65% in terms of packet drop.

2) Varying the Traffic Flows

In third experiment, we vary the number of combined CBR and EXP traffic flows from 1 to 5.

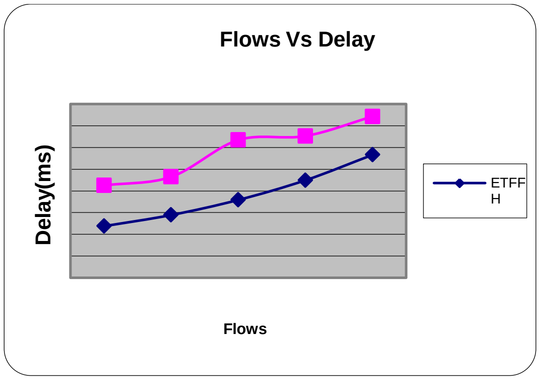

Fig. 8. Flows Vs Delay

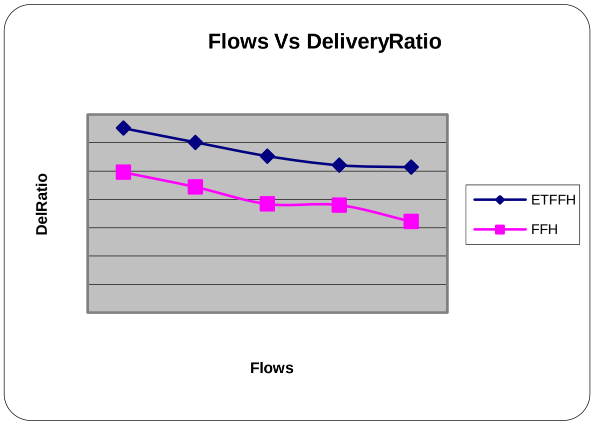

Fig. 9. Flows Vs Delivery Ratio

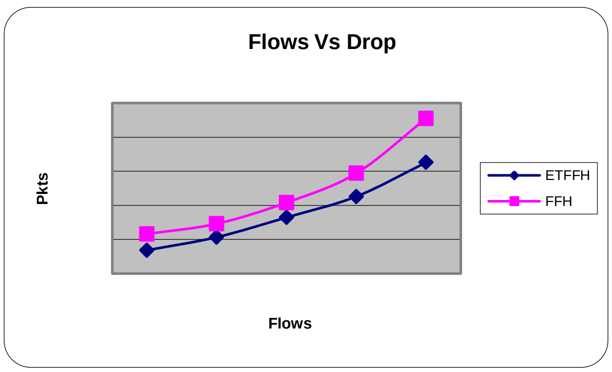

Fig. 10. Flows Vs Drop

Figures 8 to 10 show the results of delay, delivery ratio and packet drop for ETFFH and FFH by varying the flows. When comparing the performance of the two protocols, we infer that ACLBT outperforms MBLFGCP by 36% in terms of delay, 29% in terms of delivery ratio and 28% in terms of packet drop.

V. CONCLUSION

In this paper, we have proposed an Enhanced Tunneling Technique for Flow-based Fast Handover in Proxy Mobile IPv6 Networks. The proposed technique deals with the handoff operation being processed in Mobile IPv6 networks. This technique initially performs packet buffering prior handoff to ensure that during handoff packets are not lost. Next during the handoff process, the Flow Based Fast Handover technique is used. In this technique, the new subnet to which the mobile node is moving is regisstered at the Home Agent and at all the related routers. Then after verifying the connection, IPv6 tunnel is formed and traffic flow is redirected to the new subnet.

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