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UAV Cloud Operating System

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Abstract. Unmanned aerial vehicle (UAV) which is a special case of mobile ad-hoc networks (MANETs) that attracts many researchers as it becomes a scope for both military and civilian applications. Also the trend of cloud computing when it is combined with UAV highlights this field of research in many aspects, but the most significant point of research is the operating system for the cloud. This paper investigates UAV cloud operating system showing the throughput (bits/Sec) for the system implemented when using both Windows and Linux operating systems in order to select the operating system used based on a real scientific results.

1. Introduction

"If you are far from the enemy, make him believe you are near," wrote Sun Tzu some 2,500 years ago in The Art of War. The Unmanned aerial vehicle, was changed in unmanned aircraft system to reflect the fact that these complex systems include ground control station and other elements beside the actual air vehicles. The wireless ad- hoc networks to consist of a collection of wireless nodes that communicate with a common wireless medium, mobile ad hoc networks are gaining momentum because they help realize network services for mobile users in areas with no preexisting communications infrastructure [1]. Ad hoc Networks to enable independent wireless nodes, each limited in transmission and processing power to be as a whole providing wider networking coverage and processing capabilities. The nodes can also be connected to a fixed-backbone network of a dedicated gateway device, enabling IP networking services in areas where Internet services are not available due to lack of the already exists infrastructure. And due to the widely and variety usage of ad-hoc networks in many fields such as complex military systems as Unmanned Aerial Vehicles (UAVs), the performance of these systems have to be more accurate, which led us to add cloud computing to the infrastructure of the UAVs.

This field of research leads us to cover the power of cloud computing by providing a perspective study on cloud computing and sheds light on the ambiguous understanding of cloud computing. The fact that the cloud can easily expand and contract is one of the main characteristics that attract users and businesses to the importance of cloud. Now a day the military applications focus on the importance of UAV in reconnaissance and attack roles in

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order to save lives, time and money. However, by supplying the UAV systems with cloud computing will streamline operations and reduce manning, this leads to investigate all challenges in order to merge cloud computing with the UAV system. The point of research is implemented by studying the performance of UAV based cloud computing, focusing on the effect of many different operating systems, respectively Linux operating system, Windows operating system, when changing the CPU resource parameters from single processor with memory sizes 128MB to multi-processor with memory sizes 256MB by using Opnet V.14 as shown in fig. 1

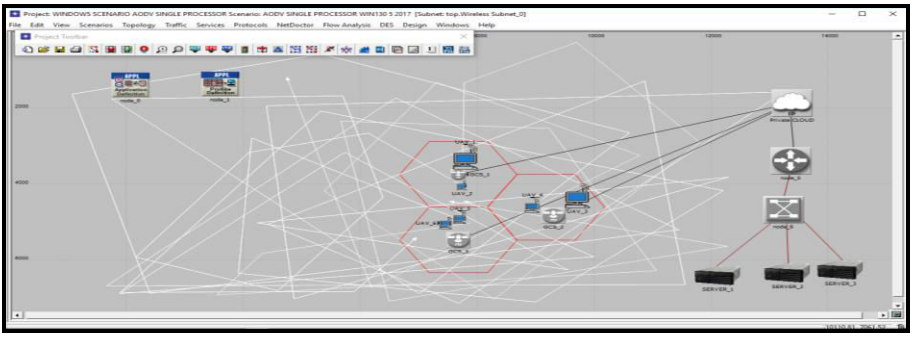

Fig. 1. The proposed scenario using Opnet v.14.

The implemented scenario is based on six UAVs, each two UAV connected to one ground control station (GCS) and the whole topology connects to a three servers via wireless connection, the three servers are a part of a private cloud connected via the military network instead of the internet, the routing protocol used is ad hoc on-demand distance vector (AODV) routing protocol. The Scenario will be repeated for four times as follows, the first scenario by using windows operating systems with a single processor and memory size 128 MB, the second scenario by using windows operating systems with multi-processor and memory size 256 MB, the third scenario by using Linux operating system with a single processor and memory size 128 MB and finally the fourth scenario by using Linux operating system with multi-processors and memory size 256 MB. The scenario parameters are as follows, the UAVs speed is 45 m/Sec with altitude up to 1500 m, the total time duration of the scenario is one hour, the working range is 14000 m as shown in fig. 1, the transmission technology used is DSSS (Direct-sequence spread spectrum). Selecting the best scenario in order to select the best operating system from the previous ones have been detected by calculating the values of the throughput (bits/Sec). This paper is organized as follows section two points upon Flying Ad-Hoc Network, section three studying cloud computing, section four points on a Cloud operating system, section five results and analysis and final section six conclude the paper.

2. Flying Ad-Hoc Network

FANETs are a special case of mobile ad hoc networks (MANETs) [2]. In an FANET, the topology of the network can change more frequently as compared to MANET or vehicle ad hoc network (VANET). FANET is a collection of small unmanned aerial vehicles (UAVs). Unmanned Aerial Vehicle systems (UAV), fly autonomously and it can be thought as an aircraft without no pilot on the board, the UAV can be remote controlled from a ground control station or can fly autonomously based on a pre-programmed flight plans. Usage of UAVs promises new ways for both military and civilian applications, ranging from search and rescue operations to disaster monitoring [3]. FANET develops a group of small UAVs which form a special kind of ad hoc networks Architecture. This type of networking architecture is called Flying Ad Hoc Networks (FANETs) [17]. FANET, which is a part of ad-hoc networks has a unique challenge when it is compared with the other types of ad-hoc networks represented by vehicular ad-hoc network, VANET and mobile ad-hoc network MANET, this was appeared when studying the connection between the nodes in each case [4]. So it was found that FANET has a high mobility, degree as compared to the other ad-hoc networks, and because of the high mobility of the UAVs, the topology of FANET node changes very frequently and all-time connectivity becomes an important constraint on the FANET based multi UAV task planning, this is shown in Fig.2 [5].

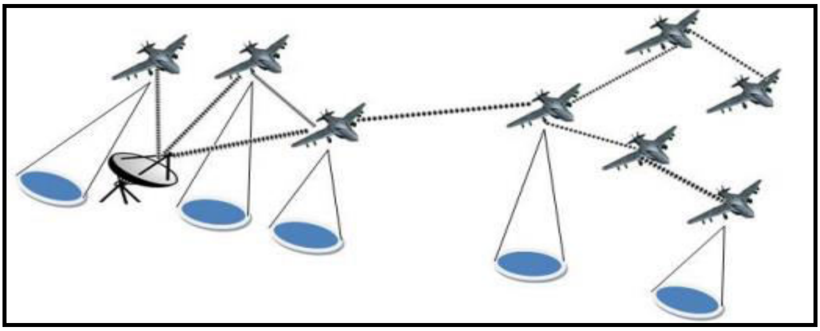

Fig.2 UAVs Communication [5].

3. Cloud Computing

Nowadays it is impossible to read a technology journal or blog without coming across the term cloud computing , while some might think that cloud computing is just a new buzzword , something companies use to sell services , but in the reality cloud computing is a type of computing that relies sharing , also it can be thought as the delivery of computing services over the internet , this section provides a perspective study on cloud computing and sheds light on the ambiguous understanding of cloud computing . Cloud computing is not just a service being offered from a remote data center, but it is a set of approaches that can help organizations quickly, effectively add and subtract resources in almost real time. Cloud computing provides the means through which resources such as computing power, computing infrastructure and applications can be delivered to users as a service wherever and whatever they need over the internet [6]. Cloud computing refers to as a model of network computing whose program or application runs on a connected server instead of a local computing device. Cloud computing depends on sharing among resources to achieve reliability. Cloud services allow individual and businesses to use software and hardware that are managed by third parties at remote locations. So cloud computing is the major concept of converged infrastructure and shared services.

4. Cloud Operating System

A key concept in all operating systems is the process. A process is basically a program in execution, associated with each process its address space, a list of memory locations from 0 to some maximum in which the process can read and write. The address space contains the executable program, the program's data and its stack also associated with each process are a set of resources, commonly including registers (including the program counter and stack pointer), a list of open files, outstanding alarms, lists of related processes and all the other information needed to run the program, a process is fundamentally a container that holds all the information needed to run a program [7, 8].

4.1 Microsoft

Microsoft, a dominant player of the PC era, is moving into almost all areas of Cloud services. In some respects, Microsoft's move into the Cloud is similar to that of the Amazon. Both faced pressures on other core businesses which catalyzed their Cloud strategies excess capacity requirements for Amazon, and for Microsoft, the need to decrease costs and increase the scale of its (often free) online services such as Hotmail and MSN Messenger. These services date from the mid-1990s and early 2000s, well before any conception of Cloud computing [16]. In many respects services such as Hotmail and Messenger are-and always have been Cloud services. They are massively scalable, with several hundred million global users, and available anywhere in the world via the Internet.

4.2 Linux

The widespread use of LINUX in the cloud benefit both those who run and operate clouds, as well as those who build upon them. Linux is the natural technology for enabling cloud computing: it's modular, its performance, its power efficient, it scales, its open source and its ubiquitous. "Every time you use Google, you are using a machine running the Linux kernel", as Google's Chris Dibona has said. "Linux today supports more hardware devices than any other OS in the history of world". Briefly, a Linux container is a set of processes that are isolated from the rest of the machine. A container can encapsulate any application dependency.

5. Results and analysis

The scenario implemented is based on six UAVs, each two UAV connected to one ground control station and the whole topology connects to a three servers via wireless connection as shown in fig. 1, the three servers are a part of a private cloud connected via the military network instead of the internet. We are going to examine and test the throughput (bits/Sec) for the whole scenarios seeking for the best operating system to be used.

5.1 Results taken from the system using a single processor

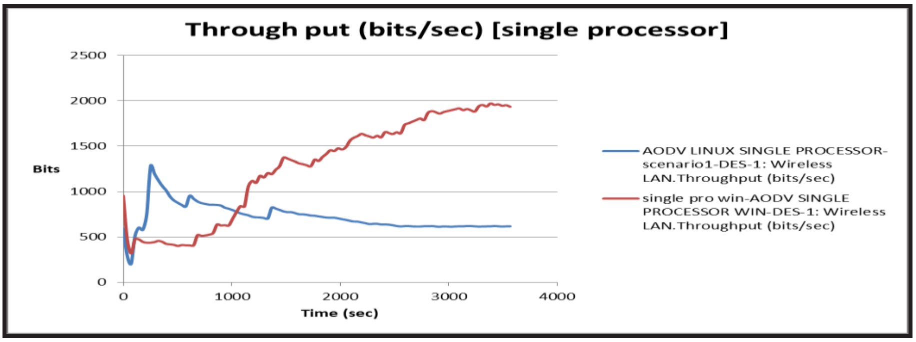

Fig.3 Throughput for the whole system (bits/Sec).

5.2 Results taken from the system using multi-processors

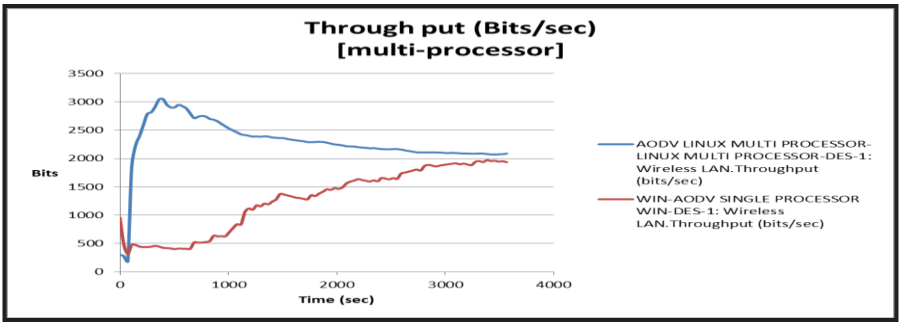

Fig.4 Throughput for the whole system (bits/Sec)**.**

And by comparing the results taken from the figures in order to have a relationship between delay and throughput to examine the behavior of routing algorithm as in [10], We get the delay- throughput operating curves as shown in figures 5, 6, 7 and 8.

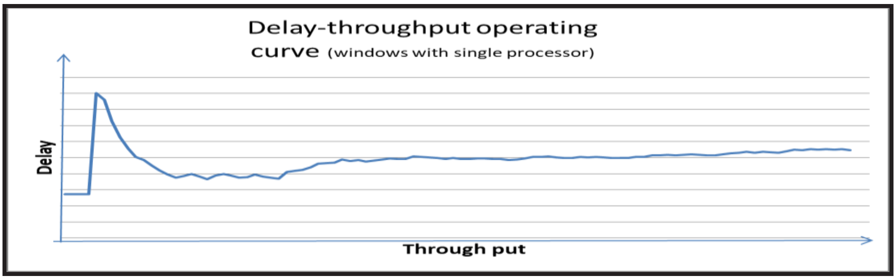

Fig.5 Delay-throughput operating curve with windows operating system and single processor.

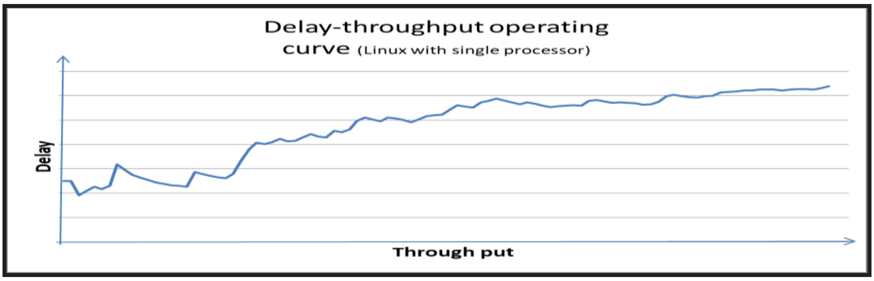

Fig.6 Delay-throughput operating curve with Linux operating system and single processor.

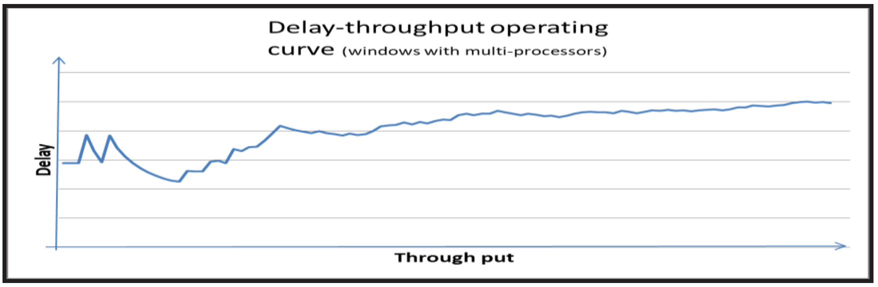

Fig.7 Delay-throughput operating curve with windows operating system and multi- processors.

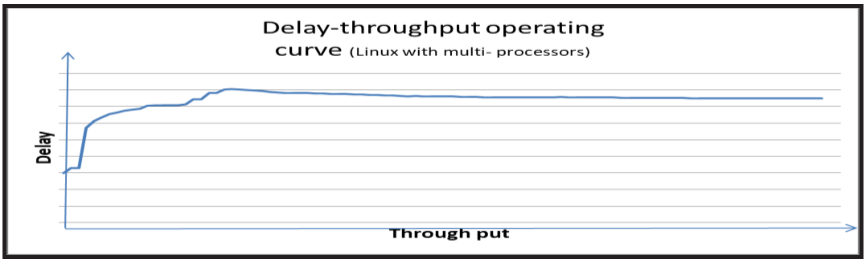

Fig.8 Delay-throughput operating curve with Linux operating system and multi- processors.

From the above four figures and comparing them with fig. 9 which is taken from [10], also [10] stated that basically the average packet delay (quality of service) and throughput (quantity of service) are affected by the routing algorithm as routing interacts with flow control in determining these performance measures.

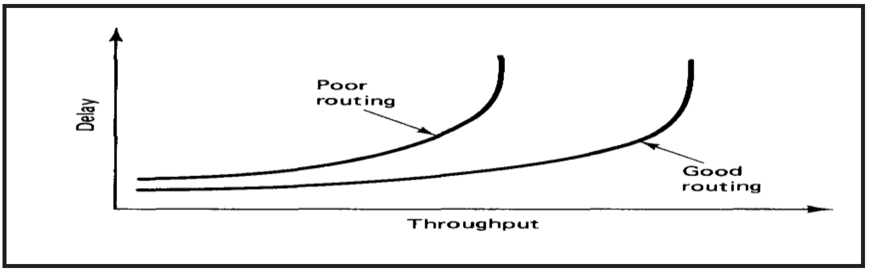

Fig.9 Delay-throughput operating curves for good and bad routing [10].

6. Conclusion

From the above results and from [10], it is clear that there is a good routing when using Linux operating system with multi-processors. The throughput, which refers to the average number of successful data delivery of the source node to the destination node, also it can be thought as an estimation of total packet, being transmitted from the source node. Fig.3 shows a comparison between the throughput of the two examined systems, with a single processor, the figure shows that windows operating systems with a single processor, gain a higher throughput than Linux operating system with a single processor, and this is due to the high delay and losses when using Linux operating system with a single processor. So we can say that the throughput can be affected by the mean of routing algorithm, because typical flow control schemes operate on the basis of striking a balance between throughput and delay. While fig. 4 shows that, the system with Linux operating system and multiprocessors has gain high performance with higher throughput than any other system and this is due to the properties of Linux operating system, which need high performance. These results taken are quite similar to the results taken in [10, 11, 12, 13, 14, 15]. Our results, tend to use Linux Operating system with multi-processor than using Windows Operating system.

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