EXHIBIT O

UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.

Before the Honorable Paul J. Luckern
Chief Administrative Law Judge

In the Matter of CERTAIN WIRELESS COMMUNICATION DEVICES, PORTABLE MUSIC and DATA PROCESSING DEVICES, COMPUTERS AND COMPONENTS THEREOF	Investigation No. 337-TA-745

APPLE'S MOTION TO SUPPLEMENT ITS NOTICE OF PRIOR ART TO ADD AN OMITTED REFERENCE AGAINST THE '223 PATENT

Pursuant to Commission Rule 210.15 and the Ground Rules in the above-captioned Investigation, Respondent Apple Inc. ("Apple") hereby moves to supplement its notice of prior art to add a single prior art reference entitled "WBTPE: A Priority Ethernet LAN Protocol", by M.S. Obaidat and D.L. Donahue, published in 1993 ("Obaidat"), attached hereto as Exhibit A.

Good cause exists for Apple's request because at the time Apple submitted its original prior art list, the existence, and therefore the significance and materiality of Obaidat, was unknown to Apple. Moreover, Motorola will not be prejudiced because its expert report on invalidity is not due until May 20, and Motorola thus will have sufficient time to respond to Apple's contentions concerning Obaidat.

Pursuant to Ground Rule 3(i), a separate memorandum of points and authorities is attached hereto. Pursuant to Ground Rule 3(ii), Apple contacted the Office of Unfair Import Investigations and counsel for Motorola concerning Apple's motion. Staff stated that it would take a position after reviewing Apple's motion. Motorola's position was unavailable as of the time of this submission.

Dated: May 4, 2011

Respectfully submitted,

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UNITED STATES INTERNATIONAL TRADE COMMISSION
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Before the Honorable Paul J. Luckern
Chief Administrative Law Judge

In the Matter of CERTAIN WIRELESS COMMUNICATION DEVICES, PORTABLE MUSIC and DATA PROCESSING DEVICES, COMPUTERS AND COMPONENTS THEREOF	Investigation No. 337-TA-745

MEMORANDUM IN SUPPORT OF APPLE'S MOTION TO SUPPLEMENT ITS NOTICE OF PRIOR ART TO ADD AN OMITTED REFERENCE AGAINST THE '223 PATENT

Respondent Apple Inc. ("Apple") hereby moves to supplement its notice of prior art to add a single prior art reference entitled "WBTPE: A Priority Ethernet LAN Protocol", by M.S. Obaidat and D.L. Donahue, published in 1993 ("Obaidat").

Under the Procedural Schedule (Order No. 5), the identification of prior art upon which the parties will rely at the hearing was due just under three weeks ago on April 15. Since Apple submitted its notice of prior art, Apple continued to conduct prior art searches and analyze potential prior art, including up through the April 22 deadline for Motorola to provide its contention interrogatory responses concerning Apple's invalidity defenses, and continuing through the preparation of initial expert reports due on May 6. The Obaidat reference was identified by prior art searchers after the April 15 deadline for Apple's notice of prior art. Apple subsequently and promptly worked to analyze the relevancy of the reference to the asserted patents. Apple now moves to supplement its notice of prior art to identify a single prior art reference, Obaidat. Apple has promptly filed this motion upon its realization of the significance of Obaidat this week.

Good cause exists for Apple's request because at the time Apple submitted its original prior art list, the existence, and therefore the significance and materiality of Obaidat, was unknown to Apple. Moreover, Motorola will not be prejudiced because Apple seeks to add only a single prior art reference, and Motorola's expert report on invalidity is not due until May 20. Motorola will thus have sufficient time to respond to Apple's contentions concerning Obaidat. In summary, Apple respectfully requests that it be permitted to supplement its prior art list to add the Obaidat reference.

Dated: May 4, 2011

Respectfully submitted,

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Exhibit A

WBTPE: A PRIORITY ETHERNET LAN PROTOCOL

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ABSTRACT- *This paper analyzes a scheme for introducing priorities into the CSMA/CD protocol known as Ethernet. This scheme allows for the rapid transmission of important messages, even under heavy traffic conditions. The Ethernet protocol, which is widely used in industry, can be modified using existing chips and software to allow for prioritizing of packets by the scheme outlined in this paper. The scheme consists of random waiting times based upon the packets priority level and the worst-case propagation delay(or slot-time). The performance of the proposed protocol is studied using simulation.*

Index Terms: *LAN, Priority Ethernet, Protocol Evaluation.*

I. INTRODUCTION

In the early 1970's, the concept of the LAN(Local Area Network) was first introduced. The first step towards its creation was the interconnection of two identical computers in the same building. Once the advantage of this type of system was realized, design and development of LANs began at a rapid pace. Bus [1],[2], star and ring[3] networks revolutionized the data communication field.The Ethernet LAN, is one of the most widely used LANs today. It, as well as other types of CSMA/CD (Carrier Sense Multiple Access with Collision Detection), accounts for over 75% of the installed LANs. It is employed by companies such as Xerox Corporation and Digital Equipment Corporation. Its operation is fairly straight-forward. When a station has a packet to be transmitted, it listens to the transmission medium (or bus) via carrier-sensing to determine whether or not it is in use. If it is idle, the station immediately begins to transmit. If it is busy, the station patiently waits until the cable becomes idle and then begins to transmit.

If two or more stations begin to transmit simultaneously, or if one station begins to transmit before the signal from another station has reached it, there will be a collision. The feature of collision detection allows each station to determine if a collision has occurred. When a station does detect a collision, it aborts its transmission and emits a short noise burst called a jamming signal to warn all stations that a collision has taken place. Each station involved in the collision then ceases its transmission and implements a random delay algorithm, based on the number of times it has been involved in a collision, before attempting to retransmit. Thus each station possesses the ability to abort a collided transmission, saving valuable transmission time.

The random delay algorithm used in the Ethernet LAN, is the binary exponential backoff algorithm. In this scheme, time is divided into the worst case, round trip propagation delay time on the cable (2T), which is called the slot time. To accommodate the longest cable allowed by IEEE 802.3, this slot time has been set at 51.2 microseconds. After a collision, a station chooses a random number between 0 and $2^i -1$, where i is the number of times that particular packet has been in a collision, and waits that number of slots, before attempting to retransmit. After 10 collisions, the station will freeze the maximum number of slots at 1023. And after 16 collisions, the controller reports failure back to the computer. The computer must then decide whether to abort or to continue that attempted

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transmission.

Since the time of Robert Metcalf, a need has arisen to incorporate priorities into the Ethernet system so that packets of lesser importance will not impede packets of greater importance. Various methods have been introduced in the literature to solve this problem [4]-[10]. In this paper, we present another solution to the problem of prioritizing the Ethernet system: The Wait-Before-Transmit Priority Ethernet or the WBTPE.

In the WBTPE protocol proposed in this paper, the priority is based upon the importance of the individual packets. A packet can have any level of importance, with 0 being the most important priority level. Each packet incorporates a random delay before transmission to allow higher priority packets first opportunity to transmit, and a collision delay which allows higher priority packets first opportunity to transmit during collisions.

The goal of this paper, is to devise a new priority Ethernet protocol which we called WBTPE protocol and to evaluate its performance.

In section II of this paper, we present the devised scheme. Section III presents the performance model while section IV presents the performance results. Finally, section V contains the concluding remarks.

II. THE PROPOSED SCHEME

The Wait-Before-Transmit Priority Ethernet (WBTPE) is an Ethernet Local Area Network which is modified to allow prioritizing of packets. With this system, packets of greater importance, such as urgent messages or alarms, have greater access to the bandwidth and will not be impeded by lesser important packets, such as mail messages.

In the WBTPE, each station always waits a random amount of time, t, based upon its priority level, where 0 is the most important priority, before transmitting and t is given by the following formula:

$$1.5 \times P \times T =< t =< (1.5 \times P + .5) \times T$$

P= Priority level of the highest priority packet in a stations buffer at the moment t is calculated, where the higher the priority, the lower the priority number (index).

T= Worst case one way propagation delay (25.6 microseconds).

The value of t is chosen randomly with the intent of staggering transmission times of equal priority level packets, thus reducing the number of collisions.

A station containing a 0 level priority packet senses the bus and if busy, continues to sense until it is idle. When the bus is idle, it determines its wait-before-transmit time t, and waits that amount of time. After this time has passed, it once again senses the bus and if it is idle, it transmits. If the bus is busy, it continues sensing the bus until it is idle. If the bus becomes idle due to a collision, the station immediately transmits. If the bus becomes idle due to a completed transmission, the station once again implements the wait-before-transmit algorithm. This feature of the algorithm is implemented to reduce the number of collisions and waiting time for the highest priority level packets. When a 0 level packet detects a collision not involving itself, it now has the advantage of immediately beginning to transmit instead of waiting for another delay time, thus reducing its total delay time.

If a station does not contain a packet with the highest priority level possible, it senses the channel from the moment it becomes ready to transmit, until it's wait before transmit delay time is completed. If it notices a transmission during this time, it does not transmit, but instead senses the bus until it notices a completed transmission. At that point, it repeats the algorithm. This provision means that if two stations of a high priority collide, a station with a lower priority will not be allowed to transmit during the colliding packets backoff time. If the lower priority packet was allowed to be transmitted, it might impede the transmission of the higher priority packets.

Another feature of this algorithm, is that when a station is involved in a collision, it automatically waits and senses the bus for a period of time equal to:

$$2 \times P \times T \text{ Seconds}$$

before attempting to transmit. During this waiting time, each station senses the bus and if it notices an attempted transmission, it will not attempt to transmit, but instead will wait until it detects a complete transmission and then it will repeat the algorithm. If it does not notice an attempt to transmit, the station automatically implements the binary exponential backoff algorithm. This delay is necessary to allow the station with the highest priority of packet the first access to the cable.

Figure 1 shows a flowchart that describes the operation of the WBTPE protocol.

In order to evaluate the WBTPE, certain assumptions are made with IEEE 802.3 standard in mind. They are:

1. Channel Bandwidth is 10 Mbps.

2. Same frame format as the IEEE 802.3, with the source and destination addresses being 6 bytes each.

3. Round trip propagation time (2T) is 512 bit times or 51.2 microseconds.

4. Jamming signal is 48 bit times or 4.8 microseconds.

5. Any number of priority levels is possible with 0 being the highest priority level.

6. Longest path allowed is 2.5 km and 4 repeaters.

III. PERFORMANCE SIMULATION MODEL

In order to evaluate the WBTPE, SIMSCRIPT II.5 simulation language was used. Simulation is more accurate than analytic modeling and faster than the measurement technique[11]-[13]. In the SIMSCRIPT II.5 model, each packet, which is called an arrival, is modeled as a 'process' and is assigned to the queue of a station. Each station is modeled as a 'permanent entity', and its queue is modeled as a set. When a station wishes to transmit, it attempts to seize the transmission medium which is called the transmitter and is owned by the system. If the transmission medium is busy, the packet is filed in the hold, which is also 'owned' by the system. A packet will remain in the hold until the current transmission is completed. At that point it is removed from the hold. When a collision occurs, the arrival goes into the "Collision Algorithm". This algorithm handles all aspects of a real collision. It takes into account the jamming signal, the waiting before implementing the backoff algorithm, which allows the higher priority packets the first opportunity to transmit, and the backoff algorithm itself. With this approach, it is possible for multiple events to occur simultaneously.

In each experiment, the number of stations, network length, packet length, the number of priorities, and the probability of a packet being a certain priority are used as parameters.

For each packet, a size is determined. This size must be between 64 and 1518 bytes, as defined by IEEE 802.3, and can either be a constant size or a variable size. After this, a source and a destination are determined and cannot be the same. Next the priority of the packet is determined, based upon the probability of a packet being a certain priority level. Each station is assigned a queue and can therefore contain several packets simultaneously, however, only the first packet in the queue can be transmitted. The rest, patiently wait until they are the first in the station's queue.

It is assumed that the channel is noise free, the stations are equal distance apart, and arrivals to the system form a poisson process with a mean of L packets per second. Figures 2a and 2b summarize the flow of the simulator.

IV. RESULTS AND DISCUSSIONS

This section presents and discusses the performance evaluation results. The performance metrics used in this study are the mean throughput and average packet delay. The throughput is calculated by taking the total number of bits transmitted and dividing it by the simulation time and the channel bandwidth. The average packet delay is measured as the average amount of time that passes from the moment a packet first arrives at a station, to the moment the entire packet has been successfully received by the destination station.

It should be noted that the total system throughput for the standard Ethernet is slightly greater than that of the WBTPE, due to the delays associated with determining access to the bandwidth for the priorities. Therefore, in figures 9-14, not all of the Ethernet curves are shown. Just that portion which corresponds to the throughput values obtained for the WBTPE. The actual Ethernet curves would continue for slightly larger values of throughput.

Figures 3-14 show results for systems in which the number of stations and packet size has been varied. Thus we are able to study the sensitivity of average packet delay, throughput and arrival rate to various changes in the system.

Each of figures 3-8 show average packet delay vs. percentage of maximum arrival rate for a system with three possible priority levels, with each priority level equally likely, and maximum arrival rate equalling the channel bandwidth (10 Mbps) divided by the average packet length in bits and the number of stations. At all values of arrival rate, packets with higher priority levels have less delay time than packets with lower priority levels. However, there is only moderate difference in delay time for smaller values of arrival rate, due to the small number of packets entering the system.

But, each system reaches a point where there is a significant difference in the delay times of the different priority level packets. In figures 3 and 4 (packet size of 200 bytes) this point is about 30% of the maximum arrival rate. In figures 5 and 6 (packet size of 512 bytes) this point is approximately 45% of the maximum arrival rate. And in figures 7 and 8 (packet size of 1500 bytes) this point is about 55% of the maximum arrival rate. This tells us that beginning at that point, the number of packets entering the system is critical. Packets are arriving to the system at a fast rate and lower priority packets are constantly waiting in their respective buffers while more important packets are being transmitted.

From this critical point and onward, packets with a priority level of 1 wait 2 to 3 times longer then packets with a priority level of 0. Packets with a priority level of 2, wait 10 to 30 times longer than packets with a priority level of 1, and 15 to 90 times longer than packets with a priority level of 0. This is good news because it shows that in this protocol, lesser important messages, such as mail, are not hindering greater important messages, such as alarms, and we have accomplished our goal of giving higher priority packets the first opportunity to transmit.

Each of figures 9-14, shows average packet delay versus total system throughput for the same systems as shown in figures 3-8. When viewing these figures, one can see that higher priority packets, at all values of throughput, have lower average packet delay than lower priority packets. At lower values of throughput, which corresponds to lower values of arrival rates, this difference is less pronounced, and is due to packets arriving at the stations at a slow rate and hence the lower priority packets only having to wait for a few higher priority packets to be transmitted before they themselves can be transmitted.

Once again, each system reaches a point where the difference in packet delay becomes extremely significant. In figures 9 and 10, this point corresponds to a throughput of about .25. In figures 11 and 12, it is a throughput of about .45. In figures 13 and 14, it corresponds to a throughput of approximately .55. Beyond these values of throughput, there is a tremendous difference in packet delay and our prioritizing system becomes extremely important, due to packets arriving at a very fast rate to each station. At the critical points and beyond, there are a great number of higher priority packets to be transmitted and each low priority packet must patiently wait its turn. Thus low priority packets have very high waiting times.

When studying and comparing each system to every other system, some interesting conclusions can be drawn. First, when comparing the difference in delays between priority level 0 packets and priority level 1 packets, each system with 50 stations appears to have a slightly larger difference in delay than its *counterpart of 30 stations. This is probably due to the fact that with more stations, there is a greater chance of at least one station having a 0 level priority packet, thus the lower level priority packet must wait longer before being able to transmit. Thus it appears, as far as the high level priority packets are concerned, the higher the number of stations, the better the performance.*

Second, when comparing the difference in delays between priority level 1 packets and priority level 2 packets, each system with 50 stations appears to have a slightly larger difference in delay than its counterpart of 30 stations. Again, the same line of reasoning would apply as above: the more stations, the greater the chance of a priority level 1 packet being queued for transmission, thus the longer the wait for a priority level 2 packet. So when comparing the difference in the delay times, the higher priority level packets seem to favor more stations and less packets per second.

In figures 3-8, we see that the Ethernet delay time curve is less than the priority 1 delay time curve for arrival rates up to 45 to 55% of maximum rate. Beyond these arrival rates, even packets with priority level 1 have substantially less delay time than the standard Ethernet. In figures 9 and 10, we see for a packet size of 200 bytes, the Ethernet system always performs better than priority levels 1 and 2. However, in figures 11-14, we see that there is a point (approximately 50% of maximum throughput) where both priority levels 0 and 1 perform better than the standard Ethernet.

We see from the results that in many situations, 2 of the 3 priority levels perform better than the standard Ethernet with respect to packet delays. Thus on average, these packets will reach their destination much faster than if they were using the standard Ethernet protocol. This is one result that tells us how efficient is the proposed scheme.

Another characteristic of great interest, is that for our highest priority level, there is very little increase in delay time. This is extremely important. It tells us that even at high traffic rates, important messages are being transmitted with very little delay. Thus our prioritizing system does indeed allow important messages to be transmitted rapidly, and we have achieved our goal.

V. CONCLUSION

The Ethernet LAN, is a popular, attractive solution for Local Area Networks which is widely used in industry. One drawback of Ethernet, is that the standard does not allow for prioritizing of packets. Thus important messages, such as alarms, must fight for access to the medium against lesser important messages, such as mail. This paper proposed one solution to this problem known as the Wait Before Transmit Priority Ethernet. We evaluated this system and determined that indeed higher priority messages would have less waiting time than lower priority messages. Thus, it is possible to obtain short transmission times for some important messages, even under heavy load conditions.

VI. REFERENCES

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[3] IEEE: 802.5: Token Ring Access Method, New York: IEEE, 1985c

[4] W. Franta and M. Bilodeau, "Analysis of Prioritized CSMA Protocol Based on Staggered Delays", Dept of Computer Science University of Minnesota, Minneapolis Tech. Rep. TR-77-18, Sept 1977.

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[10] S. Sharrock, D. Du, "Efficient CSMA/CD-Based Protocols for Multiple Priority Classes", IEEE Transactions on Computers, Vol. 38, No. 7, pp 943-954, July 1989.
[11] M.S. Obaidat, "Simulation of Queueing Models in Computer Systems", in Queueing Theory and Applications (S. Ozekici ed.), Hemphesphere, 1990.
[12] M.S. Obaidat,"Protocol for Token Ring Local Computer Networks," IEE Electronics Letters, Vol. 27, No. 25, pp. 2393-2394, Dec., 1991.
[13] M.S. Obaidat et al ", MTR: A Modified Token Ring Protocol and Its Performance", Proceedings of the 1992 ACM Annual Computer Science Conference, pp. 261-266, March, 1992.

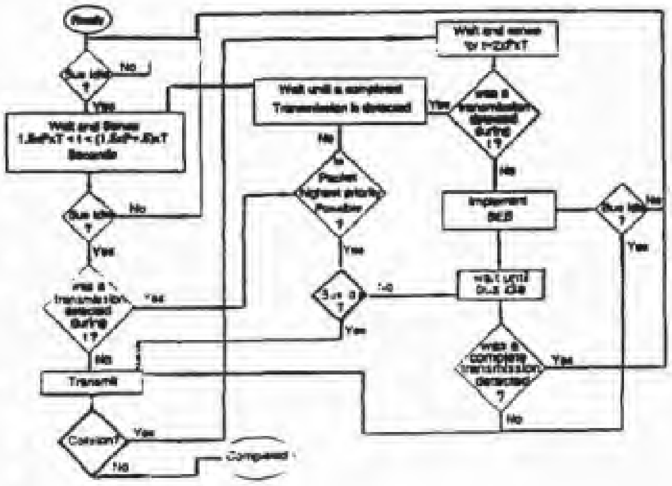

Fig.1 Protocol operation

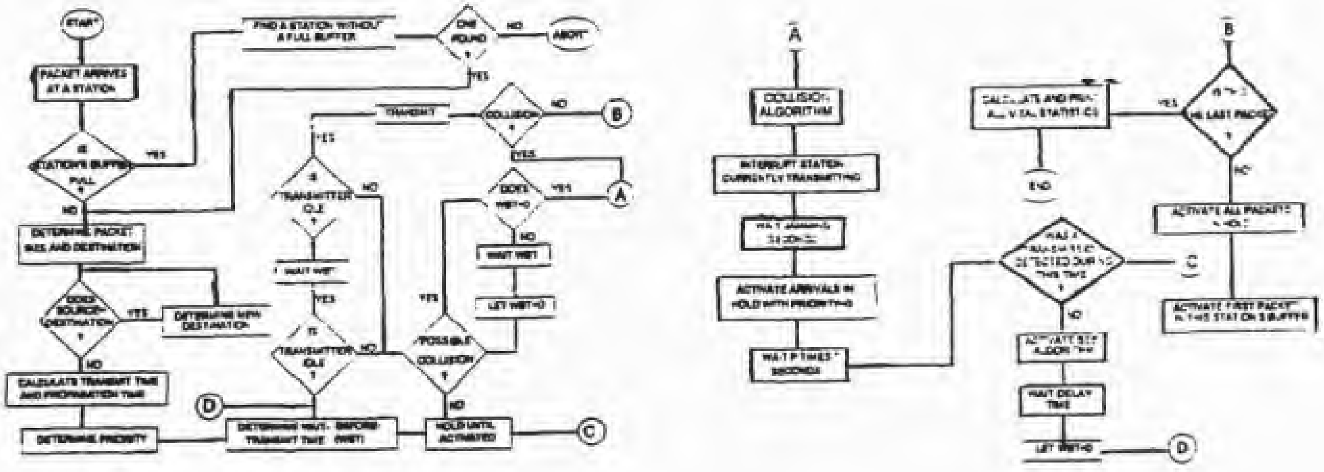

Fig.2 The Simulator

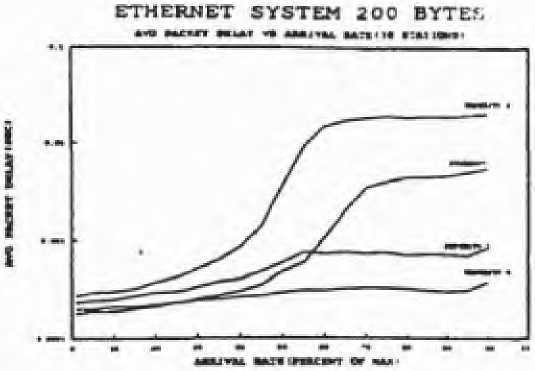

Fig.3 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=30,L=200

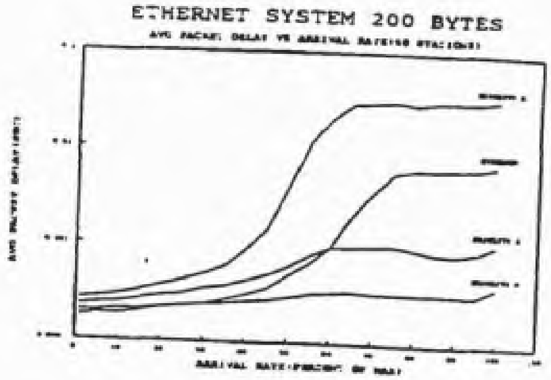

Fig.4 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=50,L=200

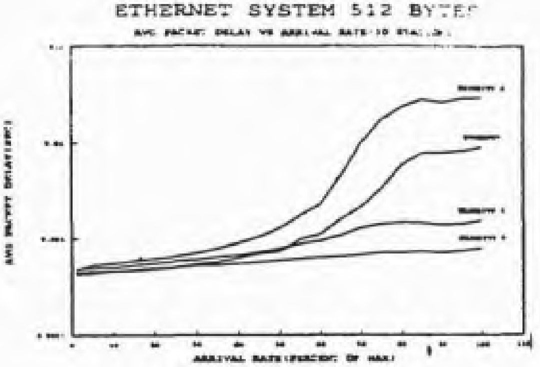

Fig.5 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=30,L=512

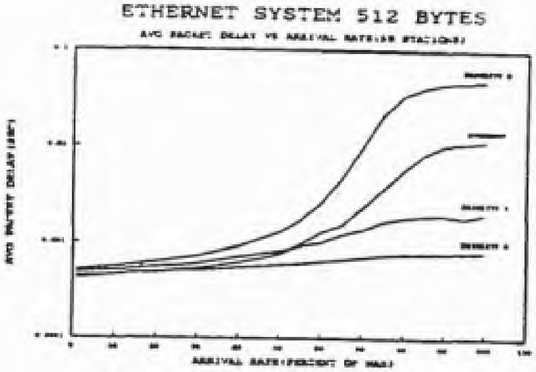

Fig.6 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=50,L=512

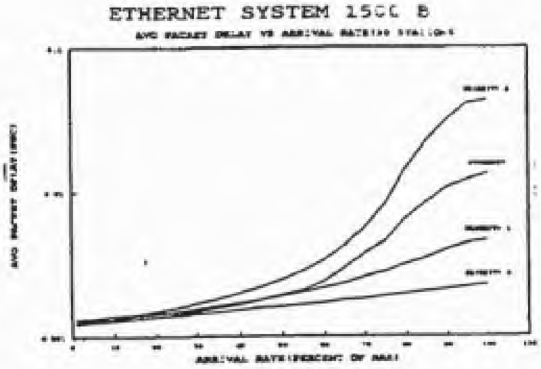

Fig.7 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=30,L=1500

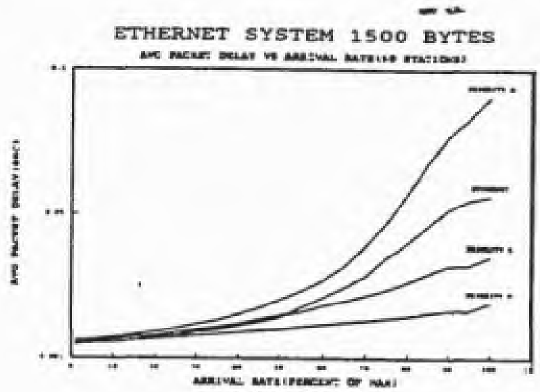

Fig.8 Avge.pkt.delay vs arrival rate for
P(0)=P(1)=P(2)=1/3,N=50,L=1500

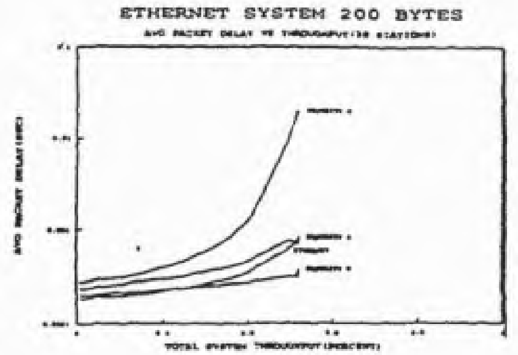

Fig.9 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=30, L=200

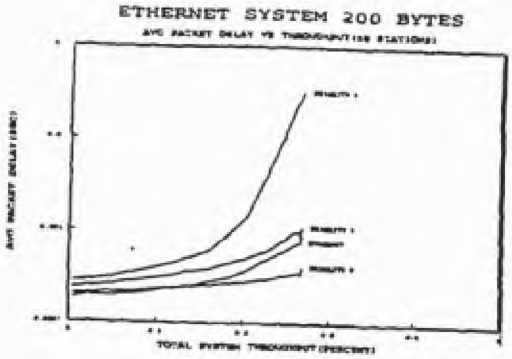

Fig.10 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=50, L=200

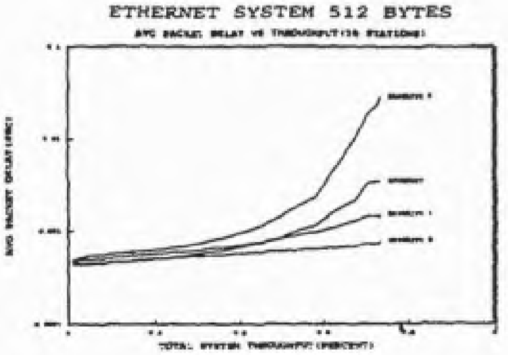

Fig.11 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=30, L=512

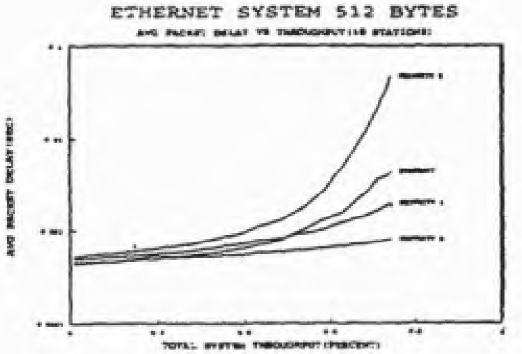

Fig.12 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=50, L=512

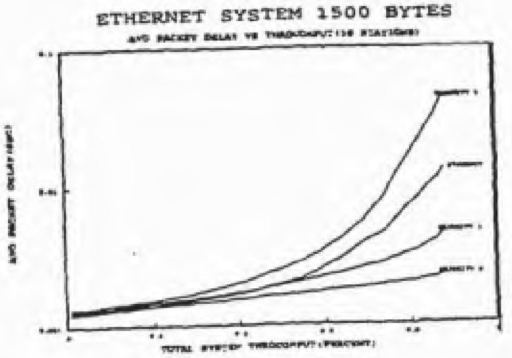

Fig.13 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=30, L=1500

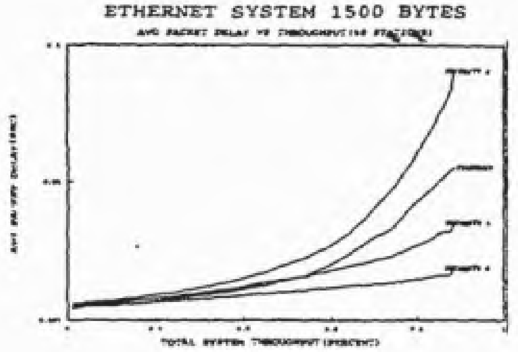

Fig.14 Avge pkt. delay vs total sys. throughput
for P(0)=P(1)=P(2)=1/3, N=50, L=1500

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing was served on May 4, 2011 as indicated, on the following:

Via EDIS James R. Holbein Acting Secretary U.S. International Trade Commission 500 E Street SW, Room 112 Washington, D.C. 20436	***Via Hand Delivery (2 copies)*** The Honorable Paul J. Luckern Office of the Administrative Law Judge U.S. International Trade Commission 500 E Street SW, Room 317-H Washington, D.C. 20436
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