United States Patent [19]

Kiel et al.

[54] **SYSTEM FOR SELECTIVELY COMPRESSING DATA FRAMES BASED UPON A CURRENT PROCESSOR WORK LOAD IDENTIFYING WHETHER THE PROCESSOR IS TOO BUSY TO PERFORM THE COMPRESSION**

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[52] U.S. Cl. 395/800; 358/426; 364/514; 364/260.6; 364/DIG. 1; 375/122; 382/56; 395/650

[58] Field of Search 395/800, 325, 650, 200; 341/67; 364/514; 375/122; 358/213.25, 426; 382/56

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,386,416	5/1983	Giltner et al.	395/375
4,598,411	7/1986	Berkovich et al.	375/27
4,631,598	12/1986	Burkhardt et al.	358/425
4,633,490	12/1986	Goertzel et al.	375/122
4,663,660	5/1987	Fedele et al.	358/136
4,684,923	8/1987	Koga	341/63
4,700,234	10/1987	Nagashima	358/426
4,823,342	4/1989	Morita et al.	370/109
4,876,541	10/1989	Storer	341/51
4,905,171	2/1990	Kiel et al.	364/551.01
4,965,754	10/1990	Stansfield et al.	364/526
5,031,089	7/1991	Liu et al.	395/725

FOREIGN PATENT DOCUMENTS

0123783	11/1984	European Pat. Off. .
0316250A3	5/1989	European Pat. Off. .
59-189751	10/1984	Japan .
61-198941	9/1986	Japan .
63-203057	8/1988	Japan .

OTHER PUBLICATIONS

IEEE Transactions on Instrumentation and Measurement vol. IM–28, No. 4, Dec. 1979, New York U.S. pp. 306–311 H Ikeda et al.: "Microprocessor–controlled time–sharing services terminal with interfaces for instruments and its application to precision measurement of high VSWR".

[57] **ABSTRACT**

A method and computer system having a processor are provided for selectively compressing a data communication frame for data transfer between the computer system and at least one other system. A processor work load is periodically identified for the processor. A predetermined stored threshold value is identified and compared with the identified processor work load. Responsive to an identified processor work load greater than the identified predetermined threshold value, the data communication frame is transmitted without compressing the data communication frame. Otherwise the data communication frame is compressed and then transmitted responsive to an identified processor work load less than or equal to the identified predetermined threshold value. A state of a communication line is identified for the data transfer. Responsive to an identified idle state of the communication line, the data communication frame is transmitted without compressing the data communication frame.
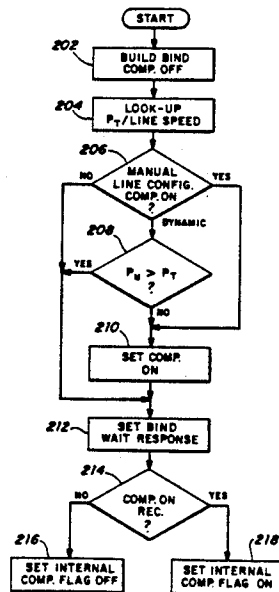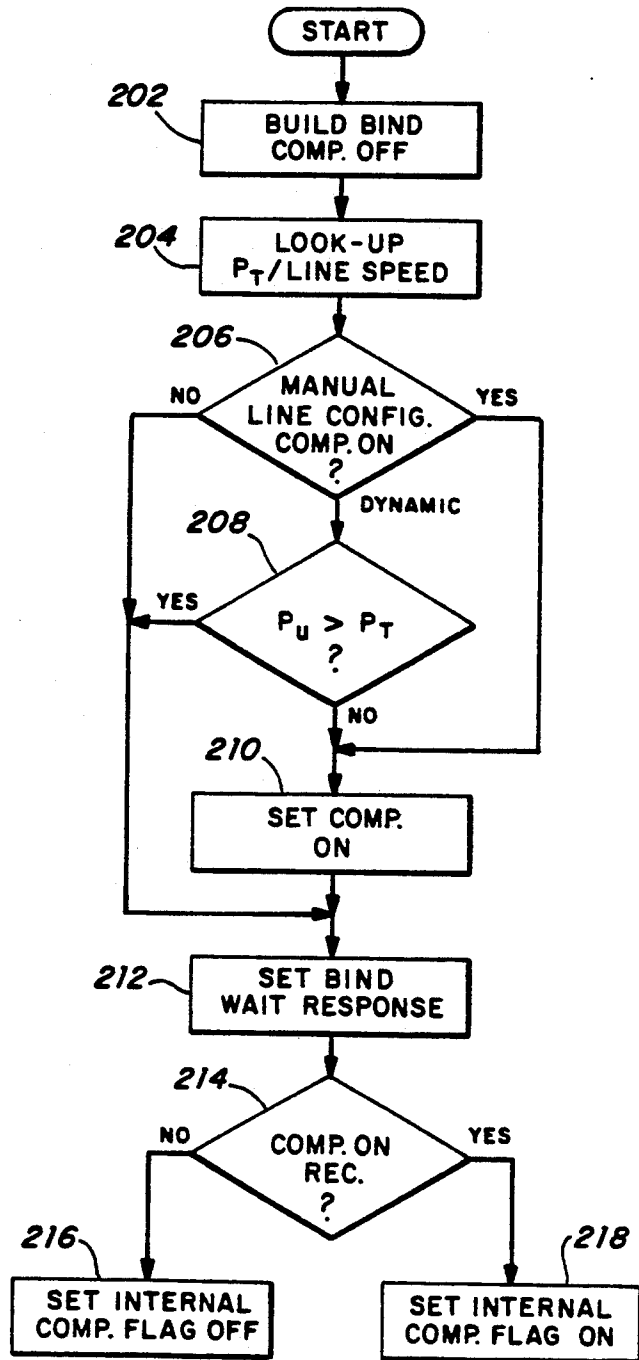
17 Claims, 3 Drawing Sheets

Fig.1

Fig.5

Fig.4

Fig. 2

START

202 → BUILD BIND COMP. OFF

204 → LOOK-UP P_T/LINE SPEED

206 → MANUAL LINE CONFIG. COMP. ON ? — NO / YES / DYNAMIC

208 → $P_u > P_T$? — YES / NO

210 → SET COMP. ON

212 → SET BIND WAIT RESPONSE

214 → COMP. ON REC. ? — NO / YES

216 → SET INTERNAL COMP. FLAG OFF

218 → SET INTERNAL COMP. FLAG ON

Fig. 3

30? GET FRAME

304 → ADD HEADER COMP. OFF

306 → MANUAL LINE CONFIG. COMP. ON ? — YES / NO / DYNAMIC

310 → COMP. SUPPORTED ? — NO

312 → LOOK-UP T_T/LINE SPEED

314 → $T_Q > T_T$? — YES / NO

316 → RECEIVING DATA OR TRANSMIT FRAME QUEUED ? — YES / NO

LOOK-UP B_T

318

320 → $B_Q \geq B_T$? — YES / NO

308 → COMP. FRAME
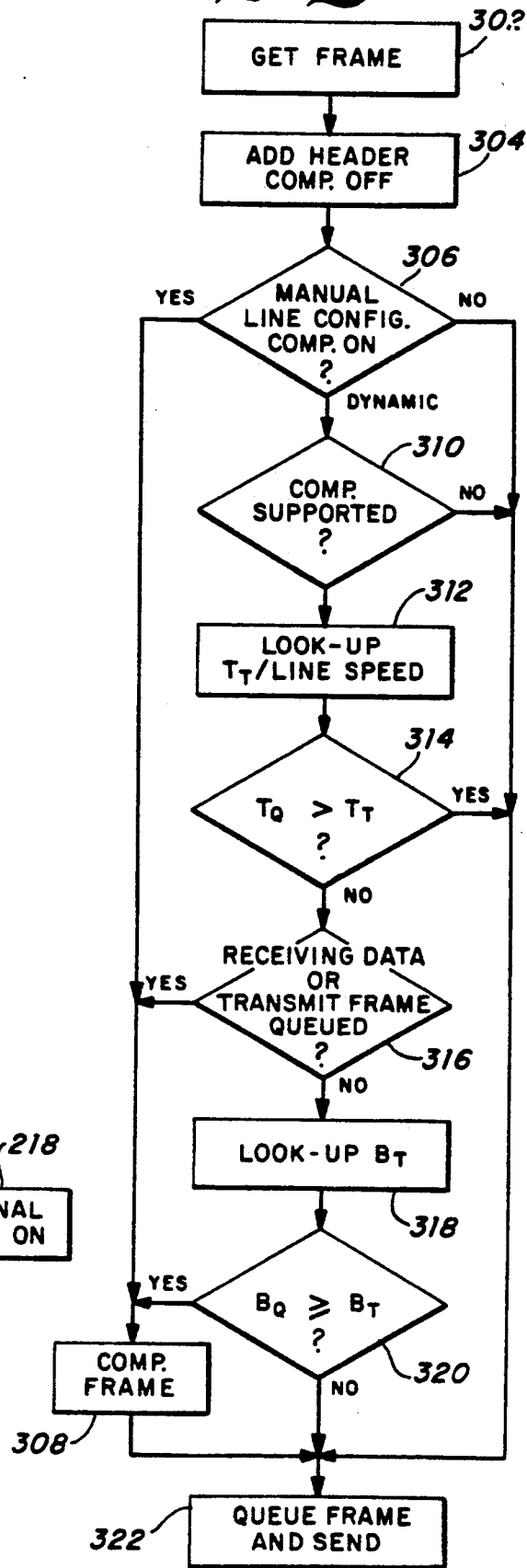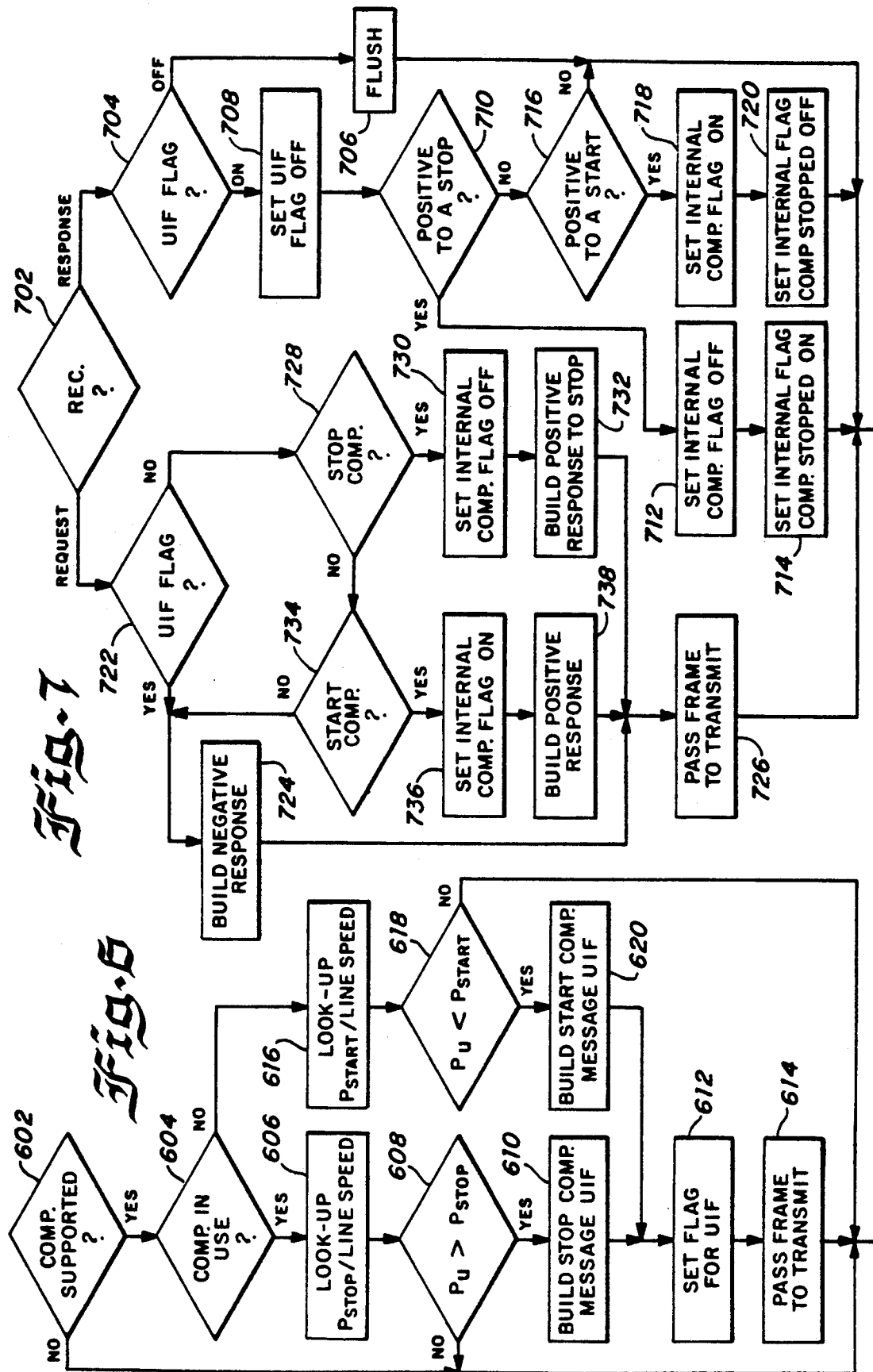
322 → QUEUE FRAME AND SEND

Fig. 7

Fig. 6

SYSTEM FOR SELECTIVELY COMPRESSING DATA FRAMES BASED UPON A CURRENT PROCESSOR WORK LOAD IDENTIFYING WHETHER THE PROCESSOR IS TOO BUSY TO PERFORM THE COMPRESSION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to data communications using data compression, and more particularly to a method and a computer system for dynamic management of data compression.

2. Description of the Prior Art

Data compression has been increasingly used because it provides improved communications performance by reducing the amount of transmitted data and/or reduces the cost of data communications. Data compression is used on various known communications controllers.

Various compression algorithms have been employed for data compression. Examples of data compression algorithms are disclosed in U.S. Pat. Nos. 4,386,416, 4,663,490, 4,663,660 and 4,684,923.

U.S. Pat. No. 4,631,598 discloses an image processing system including a video converter board that transmits data to a spatial compressor board which compresses data electronically in the x-direction or the direction of the linear array. Data compression in the y-direction is accomplished by motor speed control movement of the document. A scanner controller provides data compression for the end user to match the data handling capabilities of the end user system. The image processing system uses automatic thresholding techniques with respect to grey scale and edge detection threshold parameters.

U.S. Pat. No. 4,598,411 discloses a data compression system for compressing data transmitted between a data source and an ultimate utilization device. Data is compressed "on-the-fly" in that the data is compressed as it is transmitted, instead of compressing and storing the compressed data in memory before it is transmitted.

Japanese patent No. 59189751 issued Oct. 27, 1984 to Nakayama et al., discloses a data transmission control system including a central processing unit (CPU) and a communication controller (CCU). Image data is sent to the CCU by the control of the CPU. The CCU transfers received data to an attachment corresponding to a line through which data should be transmitted. In the attachment, a start part of the image data is read to determine whether or not the data is compressed. If the data from the CPU is not compressed, the CCU compresses the data before it is transmitted. Otherwise, if the data from the CPU is compressed, the CCU will bypass the compression step and transmit the data in its existing compressed form.

One significant disadvantage of the above and many of the known data compression methods is that degraded performance can result. Data compression adds to the processing overhead and can result in inefficiency in the processor system. When the processor utilization is high, data compression further increases the processor utilization resulting in degraded performance. Another problem is that data compression may not result in any actual data transmission savings. The time spent either attempting to or providing the data compression can cause a delay in the actual transmission of the data and degraded performance. For example, when using a high speed communication line and the communications hardware is idle, the time spent compressing data causes an overall delay for the start of data transmission.

U.S. Pat. No. 4,905,171 issued Feb. 27, 1990 to Harvey G. Kiel et al. and assigned to the present assignee, discloses a workstation controller (WSC) performance monitor for locating performance bottlenecks. Performance measurements are taken and processor utilization and communications line utilization are calculated. Processor utilization is calculated using an idle loop for generating an idle loop count and using the following equation:

$$\text{processor utilization} = \frac{(\text{elapsed time of test/idle loop time}) - \text{idle loop count}}{\text{elapsed time of test/idle loop time}}$$

where the idle loop count equals the number of times an idle loop was executed, the elapsed time of the test equals a predetermined time period for retrieving measurements, and the idle loop time is a constant equal to the time required to execute the idle loop once.

SUMMARY OF THE INVENTION

Important objects of the present invention are to provide an improved method and computer system for dynamically controlling the use of data compression for data communications; to provide such a data compression control method and computer system for comparing an identified processor utilization value to a predetermined threshold value and for compressing a data communication frame when the processor utilization value is less than or equal to the predetermined threshold value; to provide such a data compression control method and computer system for comparing an identified processor utilization value to a predetermined threshold value and for compressing the data communication frame using a first compression algorithm responsive to an identified processor utilization value greater than the threshold value; and for compressing the data communication frame using a second compression algorithm responsive to an identified processor utilization value less than or equal to the threshold value; to provide such a data compression control method and computer system for providing a compression selection flag representative of data compression being selected or not selected and for transmitting the compression selection flag to a receiving other system, the compression selection flag being used by the other system for either selecting or not selecting data compression; and to provide such a data compression control method and system for identifying a state of communication hardware and for compressing a data communication frame when the communication hardware is busy and for transmitting a data communication frame not compressed when the communication hardware is idle.

In brief, the objects and advantages of the present invention are achieved by a method and a computer system having a processor for selectively compressing a data communication frame for data transfer between the computer system and at least one other system. A processor utilization value is periodically identified for the processor. A predetermined stored threshold value is identified and compared with the identified processor utilization value. Responsive to an identified processor utilization value greater than the identified predetermined threshold value, the data communication frame is

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