US006687766B1

(12) **United States Patent**
Casper et al.

(10) **Patent No.: US 6,687,766 B1**
(45) **Date of Patent: Feb. 3, 2004**

(54) **METHOD AND APPARATUS FOR A FIBRE CHANNEL CONTROL UNIT TO EXECUTE SEARCH COMMANDS LOCALLY**

(75) Inventors: **Daniel F. Casper**, Poughkeepsie, NY (US); **Robert J. Dugan**, Hyde Park, NY (US); **John R. Flanagan**, Poughkeepsie, NY (US); **Catherine C. Huang**, Poughkeepsie, NY (US); **Louis W. Ricci**, Hyde Park, NY (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/481,715**

(22) Filed: **Jan. 12, 2000**

Related U.S. Application Data

(62) Division of application No. 09/172,695, filed on Oct. 14, 1998, now Pat. No. 6,185,631.

(51) **Int. Cl.**[7] **G06F 13/14**

(52) **U.S. Cl.** **710/20**; 710/21; 710/29; 714/720

(58) **Field of Search** 710/20, 21, 29; 714/720

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,029,950	A *	6/1977	Haga	235/151.11
4,901,232	A *	2/1990	Harrington et al.	364/200
5,084,877	A	1/1992	Netravali et al.	371/32
5,218,680	A	6/1993	Farrell et al.	395/325
5,260,933	A	11/1993	Rouse	370/14
5,442,637	A	8/1995	Nguyen	361/5.5
5,528,605	A	6/1996	Ywoskus	371/33
5,566,304	A	10/1996	Regal	395/285
5,577,172	A	11/1996	Vatland	395/114
5,764,392	A	6/1998	Van As et al.	359/124
5,768,530	A	6/1998	Sandorfi	395/200.63
5,872,911	A	2/1999	Berg	395/183.19
5,938,735	A	8/1999	Malik	709/238
5,959,995	A	9/1999	Wicki et al.	370/400
6,167,459	A	12/2000	Beardsley et al.	710/3
6,170,023	B1	1/2001	Beardsley et al.	710/36
6,205,498	B1	3/2001	Habusha	710/29
6,467,056	B1 *	10/2002	Satou et al.	714/720

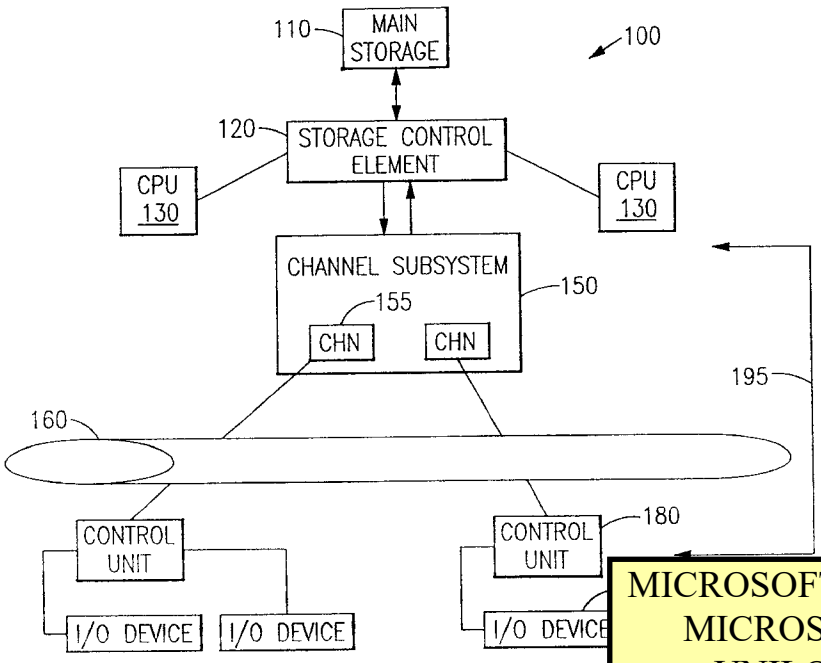
* cited by examiner

Primary Examiner—Jeffrey Gaffin
Assistant Examiner—Abdelmoniem Elamin
(74) *Attorney, Agent, or Firm*—John E. Campbell; Marc A. Ehrlich; Floyd A. Gonzalez

(57) **ABSTRACT**

The present invention provides a method for fibre channel control units to execute commands locally when a channel sends a repeat execute indicator in conjunction with certain other field settings, wherein the control unit will repeat and chain control words until certain predefined conditions occur.

24 Claims, 2 Drawing Sheets



US006687766B1

(12) **United States Patent**
Casper et al.

(10) **Patent No.: US 6,687,766 B1**
(45) **Date of Patent: Feb. 3, 2004**

(54) **METHOD AND APPARATUS FOR A FIBRE CHANNEL CONTROL UNIT TO EXECUTE SEARCH COMMANDS LOCALLY**

(75) Inventors: **Daniel F. Casper**, Poughkeepsie, NY (US); **Robert J. Dugan**, Hyde Park, NY (US); **John R. Flanagan**, Poughkeepsie, NY (US); **Catherine C. Huang**, Poughkeepsie, NY (US); **Louis W. Ricci**, Hyde Park, NY (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/481,715**

(22) Filed: **Jan. 12, 2000**

Related U.S. Application Data

(62) Division of application No. 09/172,695, filed on Oct. 14, 1998, now Pat. No. 6,185,631.

(51) **Int. Cl.**[7] **G06F 13/14**
(52) **U.S. Cl.** **710/20**; 710/21; 710/29; 714/720
(58) **Field of Search** 710/20, 21, 29; 714/720

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,029,950	A *	6/1977	Haga	235/151.11
4,901,232	A *	2/1990	Harrington et al.	364/200
5,084,877	A	1/1992	Netravali et al.	371/32
5,218,680	A	6/1993	Farrell et al.	395/325
5,260,933	A	11/1993	Rouse	370/14
5,442,637	A	8/1995	Nguyen	361/5.5
5,528,605	A	6/1996	Ywoskus	371/33
5,566,304	A	10/1996	Regal	395/285
5,577,172	A	11/1996	Vatland	395/114
5,764,392	A	6/1998	Van As et al.	359/124
5,768,530	A	6/1998	Sandorfi	395/200.63
5,872,911	A	2/1999	Berg	395/183.19
5,938,735	A	8/1999	Malik	709/238
5,959,995	A	9/1999	Wicki et al.	370/400
6,167,459	A	12/2000	Beardsley et al.	710/3
6,170,023	B1	1/2001	Beardsley et al.	710/36
6,205,498	B1	3/2001	Habusha	710/29
6,467,056	B1 *	10/2002	Satou et al.	714/720

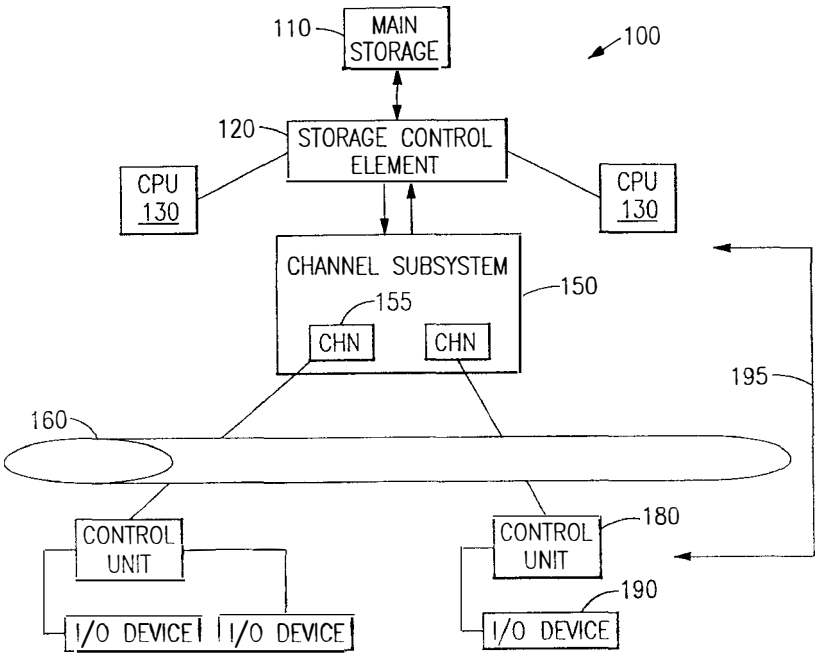
* cited by examiner

Primary Examiner—Jeffrey Gaffin
Assistant Examiner—Abdelmoniem Elamin
(74) *Attorney, Agent, or Firm*—John E. Campbell; Marc A. Ehrlich; Floyd A. Gonzalez

(57) **ABSTRACT**

The present invention provides a method for fibre channel control units to execute commands locally when a channel sends a repeat execute indicator in conjunction with certain other field settings, wherein the control unit will repeat and chain control words until certain predefined conditions occur.

24 Claims, 2 Drawing Sheets



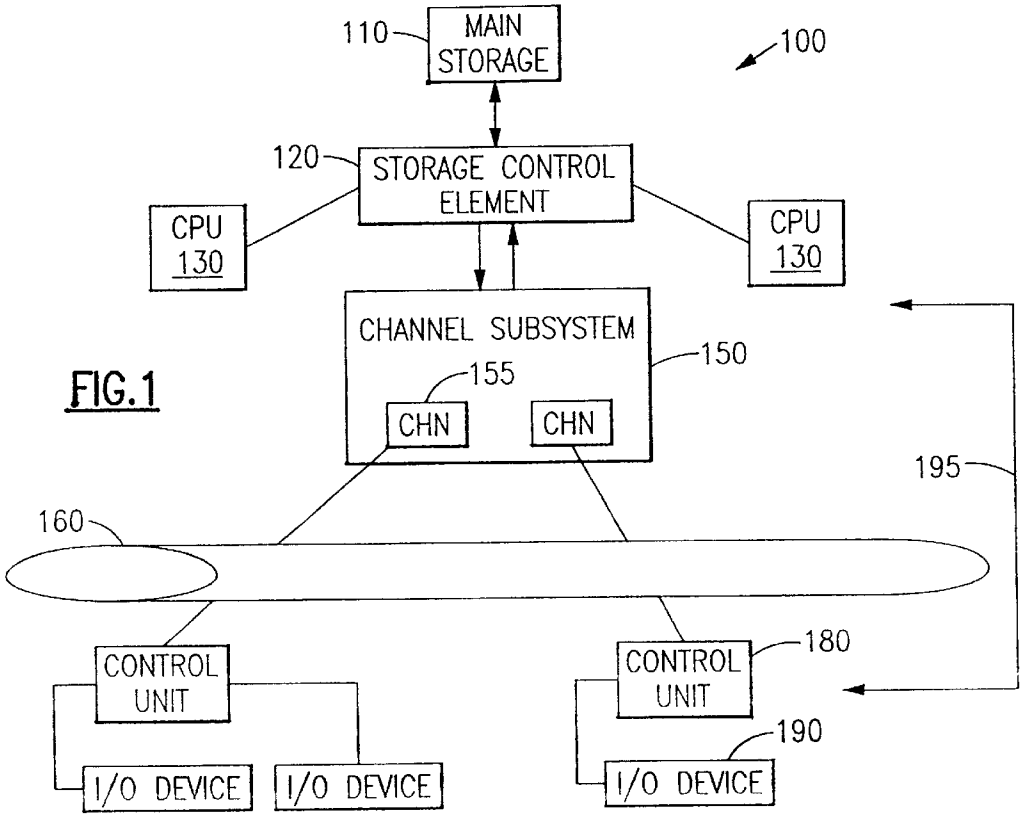


FIG.1

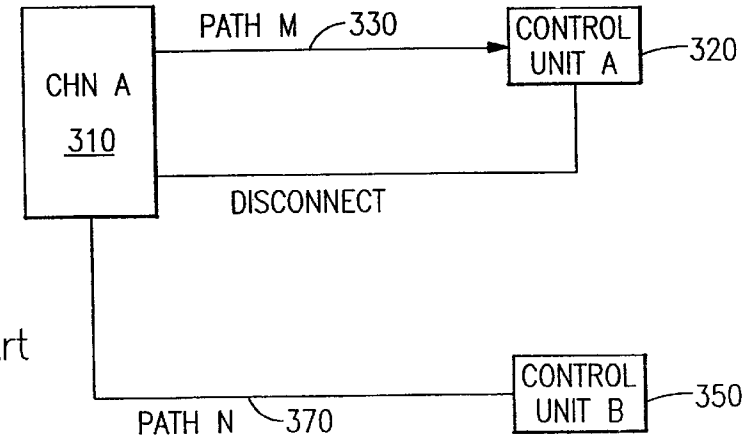


FIG.3
Prior Art

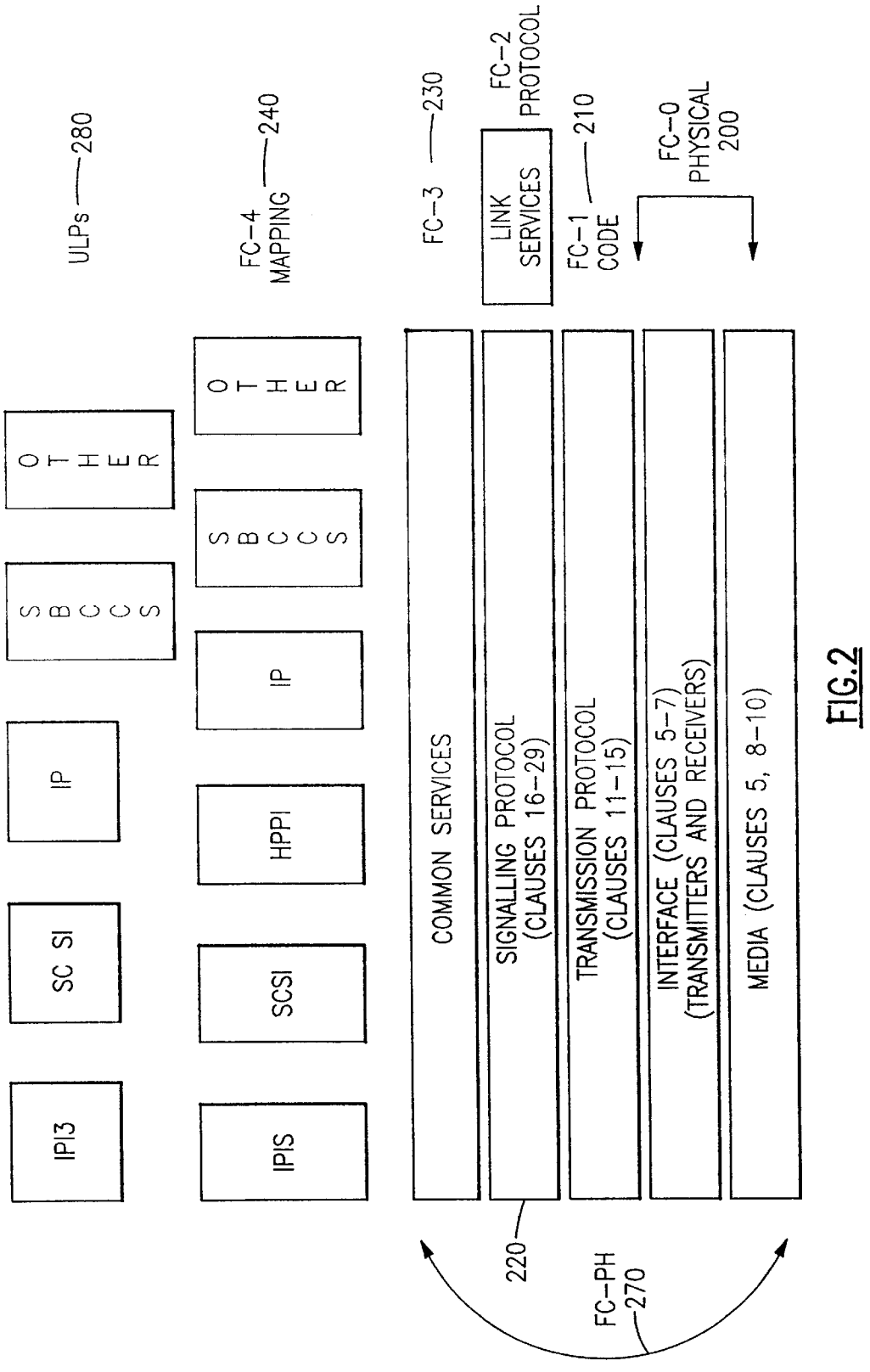


FIG.2

METHOD AND APPARATUS FOR A FIBRE CHANNEL CONTROL UNIT TO EXECUTE SEARCH COMMANDS LOCALLY

This is a divisional application of Ser. No. 09/172,695 filed on Oct. 14, 1998 now U.S. Pat. No. 6,185,631.

FIELD OF INVENTION

This invention relates to concept of transferring information in a computer program product for use with a computer system having a main storage device in processing communication with a plurality of input/output devices.

BACKGROUND OF THE INVENTION

In a network computing environment, multitudes of commands and requests for retrieval and storage of data are processed every second. To properly address the complexity of routing these commands and requests, a number of different resolutions have been implemented. In some data processing architectures, such as International Business Machines Enterprise System Architecture/390 (Enterprise System Architecture/390 is a registered trademark of International Business Machines Corporation), a channel subsystem is utilized to pass information between the main storage and input/output (I/O) devices. The channel subsystem includes one or more channel paths, each including one or more channels and one or more control units. Recently developed technologies such as the International Business Machines ESCON switch (ESCON is a registered trademark of International Business Machines Corporation), connect the I/O devices to the main memory through the control units using legacy channels to support the data transfer there between.

But as the technology improves, the performance of new system processors will require many more legacy channels than are presently in use to support the resulting increase of information transfer in the data processing systems. Current architectural constraints make the addition of such legacy channels an expensive proposition. A further challenge is to provide the link data rate required to support the data rates of new I/O devices such as DASDs and Tapes. In this case, simply adding more legacy channels does not adequately address the problem. A new architecture is needed that can scale up to the higher link speeds needed for normal transaction processing. Therefore, any new proposed architecture, must include a capacity to accommodate higher bandwidth channel links such as Fibre Channel links while providing better data rates and higher link speeds.

This application is being filed at the same time as related application, Ser. Nos. 09/172,488, 09/172,696, and 09/172,462.

This application incorporates by reference the following patents and publications:

1) Fibre Channel Single Byte-2(FC-SB-2) Architecture (AR-6865-00-POK)

2) Fibre Channel (FC-PH) REV 4.3 ANSI X3.230-199x

3) U.S. Pat. No. 5,526,484 to Casper et. al.

SUMMARY OF THE INVENTION

The present invention provides for a computer program product for use with a computer system having a main storage device in processing communication with an information transfer interface mechanism capable of coupling to a plurality of input/output devices. The computer program device comprises of a data storage element included in the main storage device having a computer usable medium with computer readable program means for receiving and retrieving data and computer readable code means for concurrently receiving multiple packets of data from said interface mechanism. It also includes computer readable code means for concurrently storing multiple packets of data concurrently in said data storage element as well as computer readable code means for storage and retrieval of multiple packets of data concurrently between said interface mechanism and said data storage element. In one embodiment of the present invention the interface mechanism can include a control unit and channels and in yet another embodiment a fabric is in processing communication with the control unit and the channels. The computer product can also comprise computer readable code for transferring information using time division multiplexing. It can also comprise computer readable code for interleaving multiple starts each to a separate device on one channel by using multiplexing capability.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of practice, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. **1** is an illustration a network computing environment utilizing one embodiment of the present invention;

FIG. **2** is an illustration of different Fibre Channel hierarchies; and

FIG. **3** is an illustration of prior art systems demonstrating communication paths.

DETAILED DESCRIPTION OF THE INVENTION

In a network computing system environment **100** having a data processing system architecture such as the one depicted in FIG. **1**, information is passed between a program storage device or a main storage such as the one shown at **110**, and one or more input/output devices (hereinafter I/O devices) **190**, using channel subsystems **150**. Through a fabric that can include one or more optical fiber and switches **160**, channel paths are established, comprising channels **155** and one or more control units shown at **180**. These channel paths are the communication links established between the I/O devices **190** and the main storage for processing and exchange of information. The channel subsystem, control units and the fiber are all part of an information transfer interface mechanism **195** which enables the main storage remain in processing communication with the input/output devices. The information transfer interface mechanism can include other or different components. The fabric can be to simply replaced by one or more switches. In one embodiment of the present invention, the interface mechanism does not even include the fabric or any switches.

The main storage **110** stores data and programs which are input from I/O devices **190**. Main storage is directly addressable and provides for high speed processing of data by central processing units and one or more I/O channel subsystem devices. One example of a main storage is a customer's storage area and a system area (not shown). I/O devices **190** receive information or store information in main storage. Some examples of I/O devices include magnetic-tape units, direct-access storage devices (DASD), displays,

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.