Techno World

New Interface for the Digital Network Age

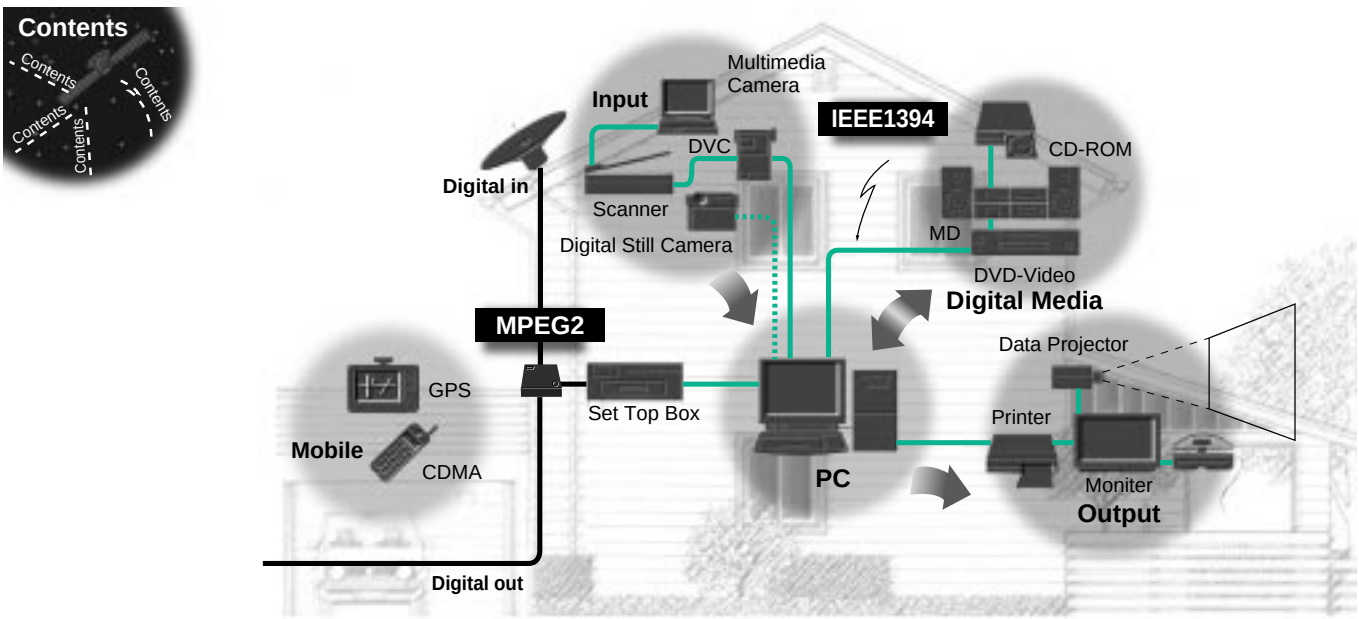
IEEE 1394 High-Speed Serial Bus Standard LSI

- **Conforms to the IEEE 1394-1995 standard**
- **High-speed data transfers (100/200/ 400 Mbps)**
- **Serial bus**
- **Tree structure (Can connect up to 63 units)**
- **Bidirectional communication**
- **Hot plug**

Sony quickly recognized the advantages of the IEEE 1394 standard that include high data transfer rates, scalability, real-time data processing, simple connections, and low cost. Thus Sony was one of the first companies to begin developing LSI products to support this standard. Following the DVC LSI developed last year, Sony has added three types of LSI to this product line, LSIs for personal computers, LSIs for D-STB and D-VHS, and LSIs for hard disk drives, CD-ROM, and DVD-ROM. These products greatly expand the range for connecting audio and video equipment to personal computers.

IEEE 1394 Standard

The IEEE 1394 standard defines a serial interface that can respond to the needs of the multimedia age and can directly connect personal computers and their peripherals to digital audio and video equipment such as digital video cassette recorders (DVC) and set top boxes (STB). (See figures 1 and 2.) IEEE 1394 was originally developed by Apple Computer and other companies as a computer interface to replace SCSI. As such, its features include bidirectionality, high data transfer rates, isochronous data transfers, a miniature and flexible cable, hot plug ability (the ability to connect or disconnect equipment with the power on), and the ability to connect devices that require audio, video, and control signals over a single cable. In 1995, Sony, having quickly realized the importance of these features, released the DCR-VX1000 DVC camcorder, the first commercial product to feature an IEEE 1394 interface. While the IEEE 1394 interface has now been formulated as the IEEE 1394-1995 standard, it is hoped that this standard will become both the basis of home networking and a replacement for the PCI and IDE busses in personal computers. Currently, there are several working groups actively discussing extensions to IEEE 1394, including the IEEE 1394a and IEEE 1394b working groups. Sony is taking an active leadership role in these standards activities and is committed to creating LSI and end products based on this standard as soon as possible.



■ Figure 1 Home Networking Concepts

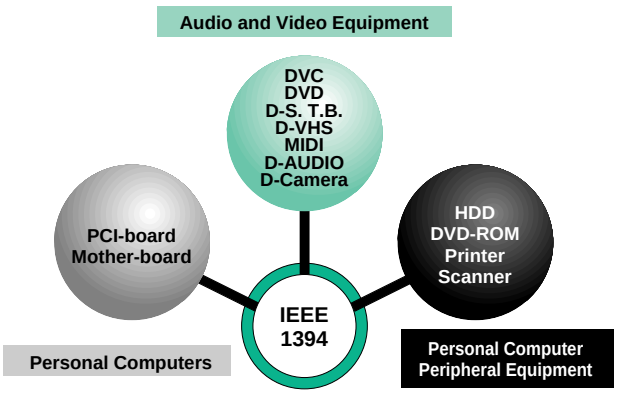
IEEE 1394 Cable: Simple and Easy to Use

To make high-speed serial interfaces even easier to use, the IEEE 1394 standard adopts an extremely simple cable and a flexible structure. This means that the wide connectors and multi-conductor cables that are now the standard in personal computer interfaces are no longer required. (See figures 3-1 and 3-2.)

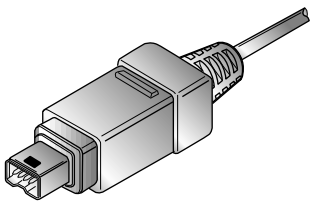
The cable used for IEEE 1394 data transfer is a shielded double twisted pair cable and is driven by low-amplitude differential signals. Data to be transferred is converted into two signals: the data itself and a strobe signal that supplements the data. (See figure 4.) A clock signal is generated by taking the logical exclusive OR of those signals. (See figure 5.) This means that there is no need to provide the high-speed PLL circuits required at both the transmit/receive sides of the communication channel in other interfaces. This allows systems to be constructed inexpensively. Additionally, since the IEEE 1394 interface includes a power line in the cable, power can be directly supplied to low-power devices through the cable.

PCI Bus LINK Layer LSI: CXD1947Q

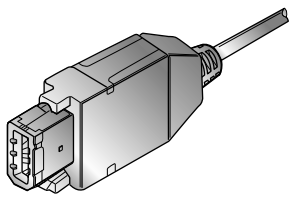
The CXD1947Q LINK layer LSI conforms to the IEEE 1394-1995 serial bus standard. Since it includes a built-in PCI bus bridge, it can be directly connected to the PCI bus. Furthermore, it includes a six-channel DMA circuit for high-performance data transfers. Systems that support the IEEE 1394 standard can be easily implemented by using the CXD1947Q and the CXD1944R LSIs.



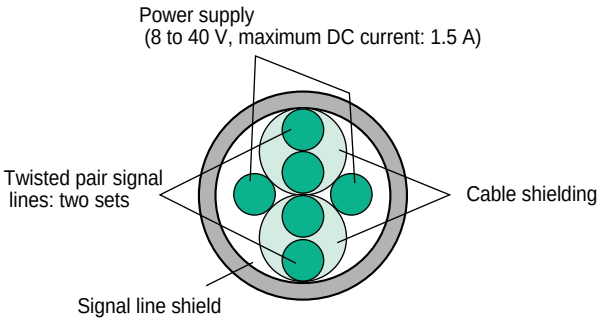
■ Figure 2 Deployment of IEEE 1394 Applications



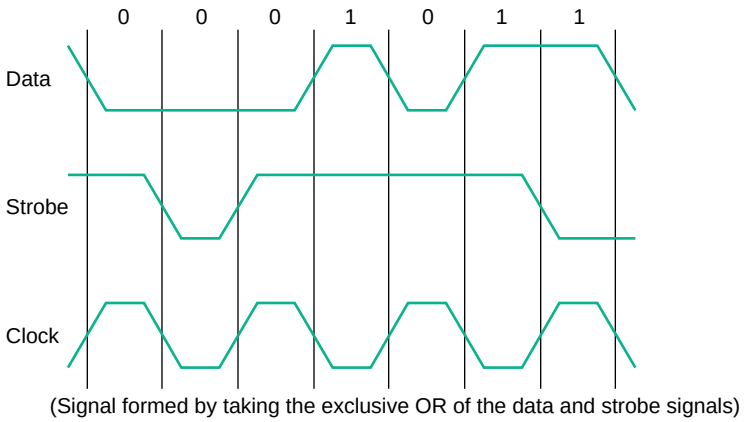
■ Figure 3-1 IEEE 1394 Four-Pin Cable



■ Figure 3-2 IEEE 1394 Six-Pin Cable



■ Figure 4 IEEE 1394 Six-Pin Cable



(Signal formed by taking the exclusive OR of the data and strobe signals)

■ Figure 5 DS-Link Coding Scheme

DVB and DSS LINK Layer LSI: CXD1948R

The CXD1948R LINK layer LSI conforms to the IEEE 1394-1995 standard and supports the AV protocol. This LSI adds a time stamp to each packet during transmission, and automatically adds CIP headers. It can also automatically recover the time stamps during reception. It supports data transfer rates of 100 and 200 Mbps and supports the DVB (188 bytes) and DSS (130/140 bytes) transport streams.

While it provides both a host interface (asynchronous) and a TPS interface (isochronous), it also includes an insert FIFO to allow isochronous transfers from the host interface.

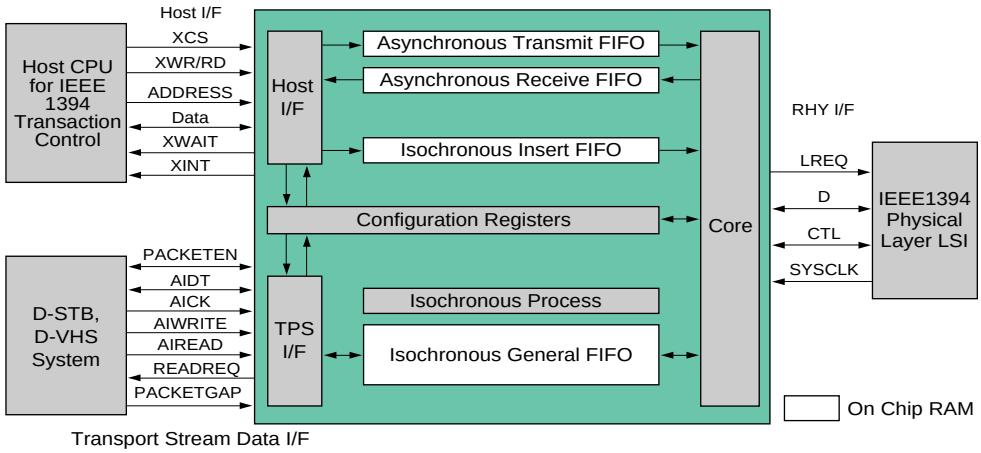
SBP-2 Link/Transaction Layer LSI: CXD3220R

The CXD3220R LINK/transaction layer LSI conforms to the SBP-2 (serial bus protocol 2) standard. This LSI can be used when connecting any type of storage device, including not only hard disk drives, but also DVD-ROM, CD-ROM, and tape streaming drives, to an IEEE 1394 digital interface. The CXD3220R includes an ADP (asynchronous data page) circuit to automatically generate SBP-2 packets and implements in hardware the transaction layer, which had been implemented in software up to now. This device supports data transfer rates of 100 and 200 Mbps, and includes large-capacity FIFOs on chip; a 2-KB FIFO for data transfers, a 96-byte FIFO for asynchronous transfers, and a 156-byte FIFO for reception.

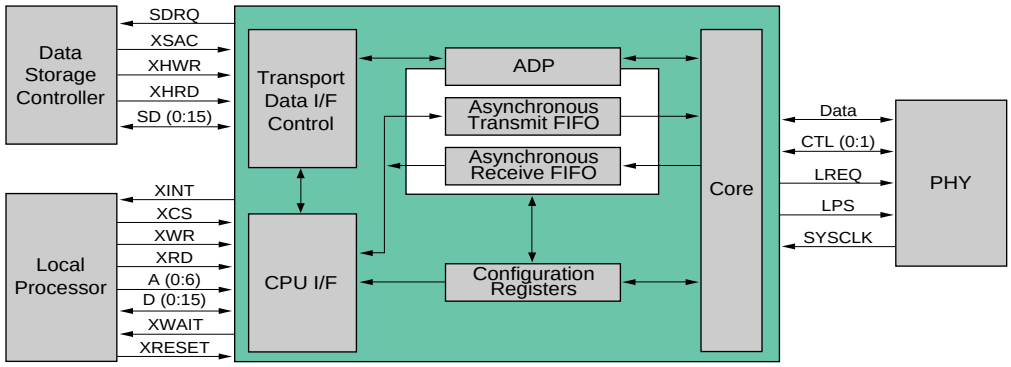
The CXD3220R provides both 8-bit and 16-bit interfaces for both CPU and transport data. Thus the CXD3220R is an optimal LSI for native 1394 drives, which many computer manufacturers support as serial SCSI.

Future Developments

Audio and video equipment, such as DVD players, MD players, digital set top boxes, and CD players, will become more tightly integrated with computers and thus become easier to use. For example, this equipment can now form systems simply by connecting devices to each other with a single cable. Then a wide range of operations become possible just by operating a controller such as a personal computer: for example,



■ **Figure 6 CXD1948R Block Diagram**



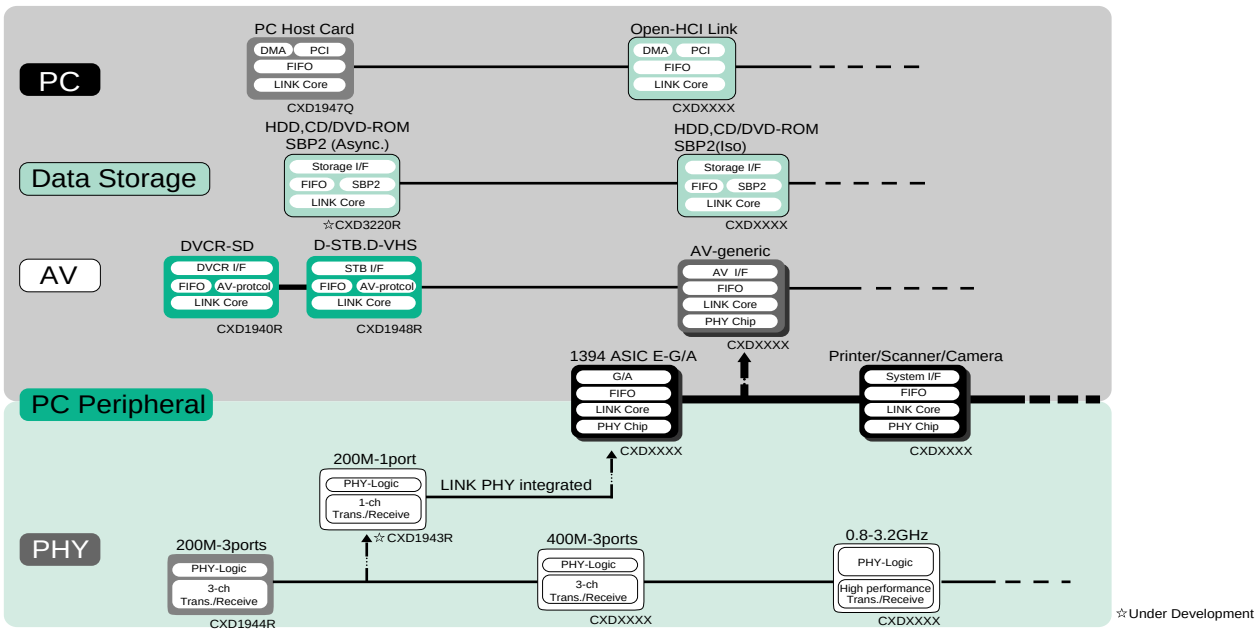
■ **Figure 7 CXD3220R Block Diagram**

recording from a CD player to an MD drive, or recording digitally broadcast video through a set top box. Of course, it will also be possible to exchange data between audio and video equipment without the intervention of a personal computer. The idea of editing video in the living room using the hard disk in the personal computer in the study is no longer merely a dream.

The IEEE 1394 standard, which is receiving much attention not only from the audio and video equipment industry but also from the personal computer industry as well, will surely become the network standard that supports the digital contents age of the near future.

Sony is committed to supporting the concept of the 1394 home network. Sony will support developments aimed at practical application of this standard through larger capacity, higher speed, lower power, and even more compact products, starting with the development of IEEE 1394 compliant LSIs that support an even wider range of applications, and including integration of this technology with a wide range of system chip sets and support for data transfer rates of 400 Mbps and higher.

■ Figure 8 Development Trends in IEEE 1394 LSIs



■ Table 1 IEEE 1394 LSI Product Line

	LINK Layer LSI				PHY Layer LSI	
Product name	CXD1940R	CXD1947Q	CXD1948R	CXD3220R (Under development)	CXD1944R	CXD1943R (Under development)
Application	DVC	PC	D-STB, D-VHS	HDD, CD/ DVD-ROM	1394 Cable Transceiver/ Receiver	
Applicable standards	Conforming to the IEEE 1394-1995 standard					
Features	• DVD-SD support • Automatic addition and detection of CIP headers • Large-capacity FIFOs	• PCI interface (5-V ports) • 6-channel DMA Asynchronous TX and RX Iso TX (×2) Iso RX (×2) • Large-capacity FIFOs	• DVB DSS support (MPEG-TS) • Automatic addition and detection of CIP headers • Support for packet splitting/joining • Support for packet insertion • Large-capacity FIFOs	• Conforms to the SBP-2 standard. • High data transfer rates provided by the adoption of an ADP circuit. • Transaction layer support • Large-capacity FIFOs	• Three ports • Unused ports automatically switched to low-power mode • Short bus reset support	• One port • Unused ports automatically switched to low-power mode • Short bus reset support
Transfer rate (Mbps)	100	100/200				
Supply voltage (V)	3.3 ± 0.3					