

# Home-Networked Storage: The Heart of Your

by Patrick Khoo

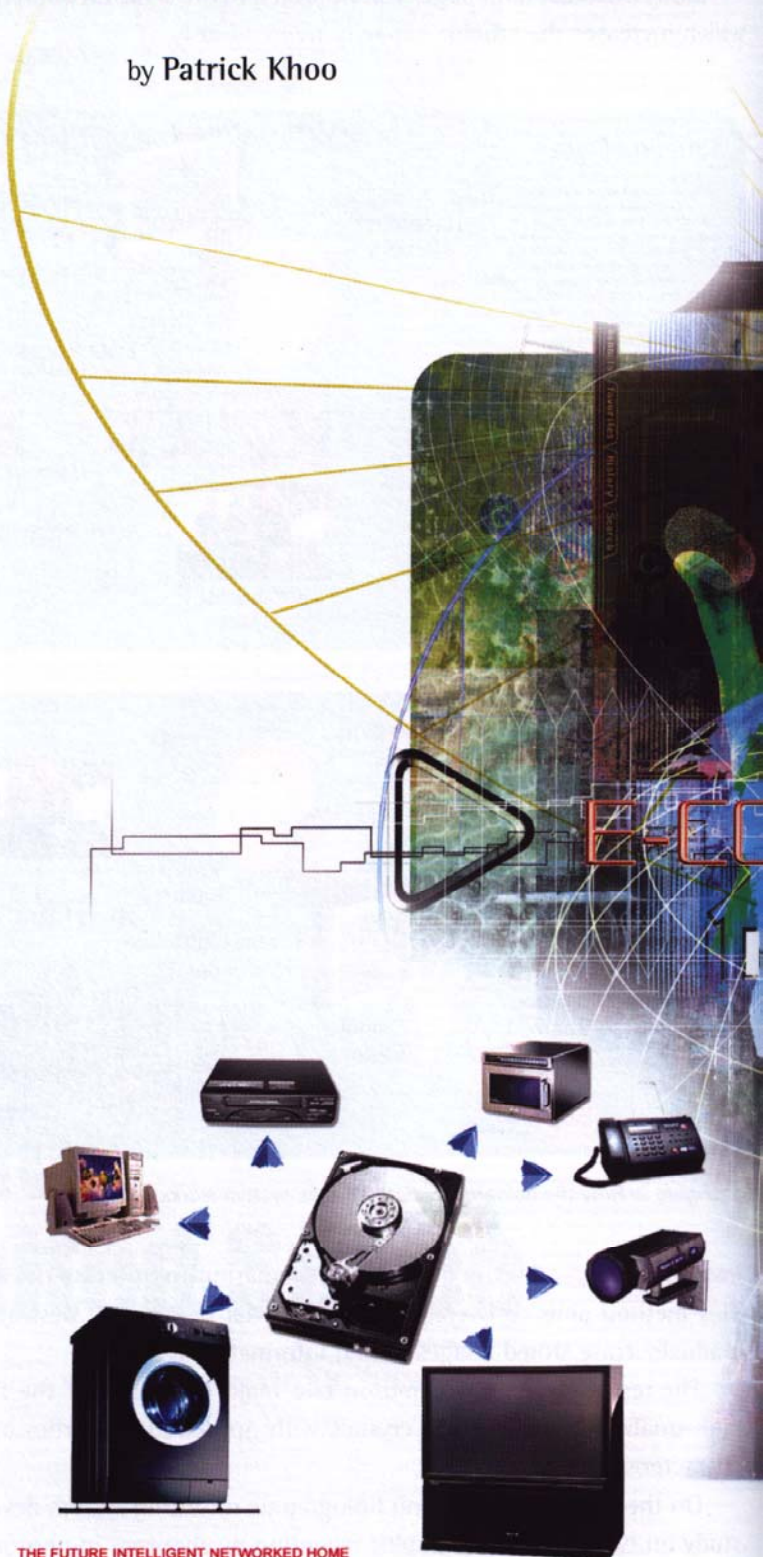
**Y**ou have just had an exhausting day, and the heat outside is getting to you. Before you hit the road, you send a message home on your handheld PC to tell your air-conditioning unit to cool down the house in anticipation of your arrival. A check with your refrigerator shows that you have run low on your favourite soya milk and some other food items that you will need for the week. You also learn that the food orders have already been placed with your friendly neighbourhood grocer via the Internet, and delivery will be made as soon as you get home.

All the elements of this scenario already exist, made possible by the rapid progress in many technical fields, such as connectivity, semiconductors, processing power, voice recognition, image manipulation and networking protocols. Many companies are involved in the development of the connected home as well, including industry leaders like Sony, Matsushita, Intel, Cisco, IBM and Microsoft. Analysts already predict that the residential gateway market segment will grow to about US\$2.4 billion by 2003. Although this number may currently seem small, it can only increase as more and more homes become connected.

Singapore has seen much development in this area. Organisations like the Agency for Science, Technology and Research (A\*STAR), the Economic Development Board (EDB) and the Infocomm Development Authority (IDA) have placed tremendous emphasis on the development of the connected home. One programme that the IDA works on is the Broadband Homes Working Group and Residential Gateway Task Force to promote broadband home connectivity and to develop required technologies like residential gateways.

Even the Housing Development Board (HDB) has conducted studies and trials on building-connected HDB units, together with the IDA and commercial companies like Cisco. Several showcase HDB units are undergoing renovation for this purpose. Private property developers have not been left behind either. Several recent new private apartments offer buyers the option of wireless web pads built into their homes.

One reason for Singapore's fast becoming a key player in the development of the connected home is the easy availability of broadband connectivity via cable and other services. The deployment and trial of connected homes is also easier in Singapore owing to advanced town planning on the part of the HDB and the close working relationship among multinational corporations



THE FUTURE INTELLIGENT NETWORKED HOME

Figure 1: Storage – the missing component in the connected home.







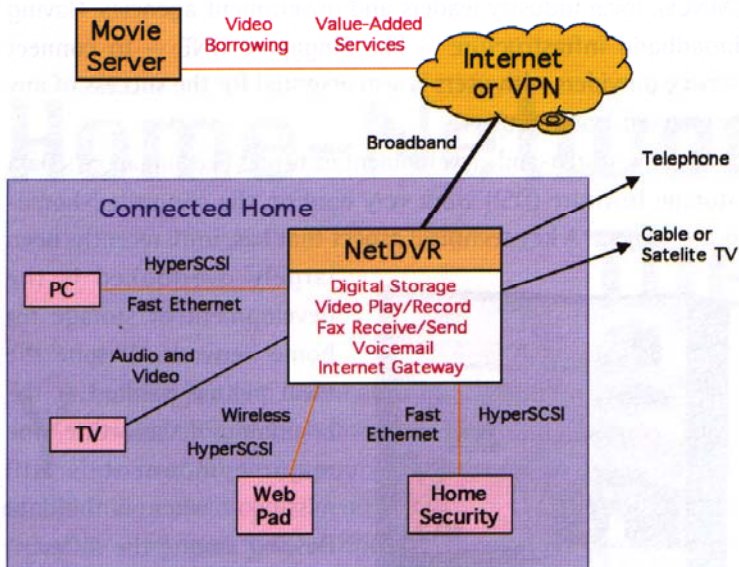


Figure 3: HyperSCSI in the connected home.

Information already provides a large and integral component of current home gateways, audio/video devices and the like. It may be quite tempting to assume that such information is less than it is, and simple non-volatile flash memory storage alone will suffice to accommodate it. However, existing storage technologies are unlikely to satisfy the needs of the home user fully, and other home network storage solutions will be necessary.

Recognising this condition, DSI has been working on storage technologies that will be used in future implementations of the connected home. Such technologies include ultra-quiet disk drives, high-density storage devices, secure and high-speed data-transport protocols for network storage, and even prototypes for the demonstration of connected homes. Some of these efforts address major concerns expressed by both users and manufacturers regarding the development of connected homes. The institute has undertaken many of these efforts and initiatives in cooperation with a number of MNCs, government agencies, and even local small- and medium-sized enterprises.

### High-Speed Data Transport

For example, one DSI success has been the development of a new data transport protocol that is both high-speed and secure. This protocol, called HyperSCSI, has been used to access hard disks, zip disks, and even compact disc writers. And most recently, in December 2001, the Institute of Electrical and Electronic Engineering formally granted recognition to DSI for HyperSCSI, thus opening the way for the protocol to be run across any Ethernet networks throughout the world. This achievement means that residential gateways, DVD jukeboxes, PCs and PDAs can now access and share storage devices anywhere in the home, securely and over standard equipment and technologies (Figure 3). And with its small footprint, secure functions and efficient operation, it is particularly well suited for storage in home networks when compared to other data transport technologies.

Another interesting development at DSI is the Network Digital Video Recorder (NetDVR), a DVD player that is network-capable (Figure 4). Apart from normal DVD playback, DSI engineers have routinely demonstrated the capability of this player to play back movies directly from its DVD drive across the home network without the normal overhead of conventional methods such as video streaming. This simplicity allows the development of thin-client web pads that can play back movies from anywhere in the home. But beyond just playback, one can even use a digital camcorder to record directly onto a CD recorder from anywhere in the home, thus allowing one to convert home movies directly into CDs over the home network.

The NetDVR has also been used to demonstrate the concept of media borrowing by DSI. This development involves the digital borrowing of a movie or a music file over the broadband network for playback in the connected home. Once borrowed, the user



Figure 4: DVD playback from DSI's NetDVR prototype.

can play the movie or music as many times as he or she wishes, and the data will "self-destruct" when the borrowing period expires. Should users wish to do so, they can pay an additional fee electronically, and the NetDVR can be instructed to write the movie or music file onto a CD for the user to keep. Apart from the obvious commercial implementation of digital media rental stores, this innovation means that the Singapore National Library will be able to allow people to borrow not just books but also digital videos and e-books in the future.

With all these rapid developments, researchers have positioned the connected home to ensure tremendous success in the future. Through the close cooperation and combined efforts of government agencies, MNCs and research institutes, Singapore has found itself in a very good position to become a catalyst for the development of the connected home. **i**

For more information on the development of storage for the connected home and other projects at DSI, contact Patrick Khoo at [patrick@dsi.nus.edu.sg](mailto:patrick@dsi.nus.edu.sg) or check out <http://nst.dsi.nus.edu.sg/mcsa/>.