EMERGING TRENDS IN HOME NETWORKING

Dan Sweeney
Intel Home Networking Organization

THE HOME NETWORK

There is a growing phenomenon in the home computing environment that Intel believes will dramatically alter the home of the future. It is the multiple-PC home. Based on 1998 Dataquest* research, Intel estimates that the number of multiple-PC homes by the end of 1998 will be approximately 18 million. This number represents about 37% of the 49 million U.S. homes with PCs (GRAPH 1). Dataquest estimates that in the year 2003, 28 million households will have at least two PCs. And, Forrester Research recently predicts
that home networking will generate annual sales in excess of $1 billion by 2002 (GRAPH 2).

Intel believes that home networking will dramatically impact the way technology is used in the home. This paper explores the multiple-PC home trend, Intel's vision of the optimal features of a home networking solution, and the implications of home networking for today and the not-so-distant future.

A PRECIDENT OF MORE THAN ONE...

There was a time when the idea of one television set per home was considered a luxury. Today, according to a December, 1997 Odyssey* study, approximately 76% of all U.S. households have two or more televisions. It can be argued that the PC is following the same pattern. Consider three factors that contributed significantly to multiple TV
set ownership within the home:

- Purchase of a newer, bigger, better television
- Purchase of an additional television to reduce conflicts in the house over TV use
- Purchase of an additional television for use in a second or third room (kitchen, bedroom, etc.)

Replace the word "television" with "PC" in each of the above statements and they fit the multiple-PC phenomenon. After all, rapid advancements in PC technology result in "newer, bigger and better" every holiday season. PCs undoubtedly take the potential for conflict one step further than television.

Unlike TV viewing, which can be a multi-person experience, personal computer use is distinctively personal. In most cases it is impossible for users to share.

During Intel-sponsored focus group research, one respondent lamented that, because his teenage daughter has replaced the telephone with the Internet for long distance communication with her boyfriend, he had to purchase another computer for his use. Finally, it's not a leap to hypothesize that as PC use increases, more home users are likely to demand the convenience of accessing the computers' capabilities from the home office, the kitchen, the bedroom, or wherever they happen to be.

TODAY'S MULTIPLE PC HOME

What does today's multiple-PC home look like? Perhaps less "techy" than might be imagined. Notably, among the hundreds of two-PC household decision-makers that Intel interviewed, few consider themselves early adopters of technology. In fact, in focus group discussions, most indicated a modest level of PC knowledge. What they communicated was that they find the PC a useful, integral part of life - *for more than one member of the household.* Intel also learned the following about these consumers:

- 85% have two or more adult users in the home and 50% have at least one child user
- The *primary* users are typically adults between the ages of 25 and 54
- Multiple-PC homes don't appear to be a trend of only the highly affluent. Annual household income ranged widely from $20,000 to over $100,000, with the most prevalent income cluster being in the $20,000 - $70,000 range

The only *significant* difference between these households and one-PC households is the tendency to be connected to the Internet. According to research Intel conducted in May of 1998, 86% of multiple-PC homes have Internet access compared to 47% reported for single-PC homes in a January, 1998, Odyssey study. Notably, this access is used by nearly everyone in the home. Ninety-eight percent of adults and sixty-nine percent of children who use a PC in these households report being on the Internet at least once per month (GRAPH 3). More than half of this group reported that *someone* is on the Internet in their home at least 10 hours per week (GRAPH 4).

Another significant piece of information is that multiple-PC household members spend a lot of time on their computers.

The majority of primary users (typically adults) spend about 19 hours per week on the PC – mostly engaged in work applications and on-line access.

Secondary users (more likely to be adults than children) spend about nine hours per week split between work applications and entertainment. The tertiary user (typically a child) uses the PC about six hours per week for educational or entertainment purposes. In many households there are four, five, and even more users competing for PC time. Critically, most of this PC use occurs in the evening when everyone in the family is home. That can result in conflict for valuable resources such as printers and Internet access - which leads to the need for home networking.

GETTING THE MOST FROM YOUR PCs

If you buy a PC for everyone in the house, all PC-related conflicts are over, right? Well, maybe. In a number of Intel-sponsored focus group discussions across the U.S., one issue was apparent. Home consumers don't consider the PC a stand-alone device any more than businesses do. To get the most value from their computers, home users need to be able to access PC resources (like printers and Internet access) from any PC they are working on. For most home consumers Intel spoke with, multiple PCs in their homes only partially addresses their needs. To get full use of their PCs, these consumers have turned to a variety of methods.

A very small percentage of U.S. multiple-PC homes have actually installed a traditional office network (GRAPH 5). Other consumers have purchased additional printers and/or Internet access accounts and phone lines for their additional PCs. Those who haven't made such purchases (the majority) are grudgingly living with makeshift solutions, like running floppy disks from the non-printer-connected PC to the printer-connected PC, and simply waiting for the Internet-connected PC to be available before accessing their favorite website. While most felt they could live with such compromises, when presented with an easy home networking option, the majority indicated they would jump at the chance to take it.

The Idea of Home Networking

Intel asked consumers how appealing a product providing the following benefits would be:

- ***Printer sharing*** - enabling all PCs in the home to access the best printer in the house

- ***Simultaneous Internet access from a single phone line*** – enabling all PCs in the home to access the Internet at the same time through one Internet account
- ***File sharing*** - enabling all PCs in the home to access and share files
- ***Multi-player gaming*** – enabling all PCs in the home to participate in multi-player games

The response clearly indicates a strong consumer need. More than 50% of consumers surveyed indicated that they would find such a product highly appealing (rating appeal 8-10 on a scale of 1-10) (GRAPH 6). Nearly 70% indicated that such a product would be at least somewhat appealing (6-10 rating). Critically, among those indicating a lower appeal level, one of the biggest concerns was whether they would be able to install and operate it. (See next section.)

Those who found the concept of home networking appealing were then asked which benefits (of those presented) would be most important to them. Although printer sharing and Internet/Modem sharing were perceived as the greatest potential benefits of home networking, file sharing and multi-player gaming were also appealing. In-depth discussions with consumers have indicated that the total package of networking, not one single benefit, is what they find most interesting (GRAPH 7).

BUT FEW ARE NETWORKED TODAY

Nearly 18 million consumers have more than one PC in their home. At least half of these have indicated they would be very interested in a solution that would give them the major benefits of a home network. Why aren't multiple-PC consumers flocking to retailers for the currently existing network-in-a-box solutions? Two reasons:

First, consumers perceive a network as difficult to install and maintain. GRAPH 8 shows that 50% of multiple-PC household decision-makers use a networked PC at work. Among those who don't use a LAN (local area network), focus groups indicate that they are very familiar with someone who does. These people are not strangers to the idea of sharing data and PC resources on an office network. But, familiarity has bred contempt. Throughout Intel's investigation of the multiple-PC home, few discussion topics were as lively or emotional as those surrounding consumers' impressions of office networking:

> *"The network is always going down."*
> *"It takes a whole department to run the network."*
> *"Networking is a hassle."*

All of these are similar to the types of responses heard across the U.S. from consumers who have (or plan to soon have) at least two PCs in their homes - a fairly PC-literate group. Few argued the overall benefits of networking, but all perceived the cost of those benefits (in hassle and frustration) to be very high. Almost none felt compelled to pay that high a price to install a *traditional* network in their home.

The second reason multiple-PC owners aren't rushing to install home networks is very practical. Most don't want to drill holes in their walls to install network wiring. The option of stringing loose wire from room to room across the carpets or hardwood floors leaves something to be desired from an interior design standpoint.

ENTER HOMELINE-BASED HOME NETWORKING

Existing telephone wiring is an excellent medium for networking PCs within the home without adding new wires. The average multiple-PC household has 4-5 telephone jacks, and most are near existing PCs. Phonelines also provide a secure environment for data transmission (GRAPH 9, 10).

THE OPTIMAL HOME NETWORK

Following are key criteria based on input that Intel has gathered from thousands of consumers :

Home Networking Criteria

- ***Easy to use*** - Given the current perception of networking as "difficult," Intel believes that consumers will adopt a home networking solution when it is extraordinarily simple for the typical multiple-PC owner to install and run. Intel's consumer line of products will be extraordinarily simple from both an installation and operation standpoint.
- ***No new wires*** - A successful home networking solution won't require the installation of any new wiring. It will work within today's typical home with no structural, cabling or other modifications. Intel's home networking products will offer fast, reliable connectivity between home PCs through ordinary phone wiring already in homes.
- ***Accessible from anywhere in the home*** - As noted earlier in this paper, computing is increasingly likely to take place in multiple rooms of the home. An optimal networking solution will allow PCs to be easily added or moved wherever people most want them to be.

As noted earlier in this paper, most homes have multiple phone jacks located in rooms that most frequently contain PCs (kitchen, master bedroom, den, other bedroom).

- ***Low price*** - Priced comparably with popular peripherals such as printers, digital cameras and scanners, research indicates that a home networking solution would thrive. Intel's consumer home networking line will be affordable – offering consumers the opportunity to get more out of their PCs with less investment in extra peripherals or Internet access.
- ***Fast*** - A key necessity for a home network will be high bandwidth. The emerging solutions to bring data to the home (e.g. cable modems, UADSL, satellite) are promising multi-megabit rates. As consumers adopt these speedy Internet connections *outside* the home, fast (at least one megabit per second) solutions will be required *inside* the home to avoid bottlenecks. Intel's home networks will offer 1 mbps data speeds. This is fast enough for today's printing, file transfer and Internet sharing applications. After all, 1 mbps is over 18X faster than a 56 kbps (kilobit-per-second) modem.
- ***Works with popular networking protocols and high bandwidth Internet access (DSL and cable modems)*** - The optimal home network would be fully interoperable with existing applications and protocols such as TCP/IP, the Internet's standard protocol. It would also allow consumers to connect to DSL or a cable modem. Intel's consumer line of products will meet both of these requirements.
- ***Becomes an industry standard*** – Strong industry standards, like those being pursued by the Home Phoneline Networking Alliance, will foster third party development, consumer acceptance, and growth of the overall home net-working category. Standards will also assure consumers of interoperability between products. Intel's consumer product line will be full compliant with the standard being proposed by the Home Phoneline Networking Alliance.

Tomorrow's Connected Home

How does Intel project that the multiple-PC, networked home is going to change PC usage in households of the future? Short-term, it will make PC use more convenient for the multiple-PC household. Users could access files, printers, modems, and more from the network without regard to whether the accessed device was physically connected to the PC in front of them or a PC

located somewhere else in the house. A home network would make it possible for all non-printer-connected-PCs in the home to share one high-quality color printer without the hassle of copying files to disk (an increasing challenge given that many of today's files require more than one floppy) and interrupting work on the printer-connected PC. It would also make it possible for one PC user to send e-mail over the Internet while another user accessed the Internet for stock quotes or homework research (with only one phone line, one modem, and one Internet connection).

Additionally, connected home PCs would provide the benefit of file sharing. A file from a laptop in the living room could easily be sent to the home office PC as a means of backup - or vice versa. For those "fun and games" PC users in the family, a home network would allow multiple-player gaming from all the connected PCs in the home. Imagine a whole house full of teenage Quake* players! But, the way a home network will change households in the very near-future pales in comparison to the way it will change homes in the not-so-distant future. The space-age home of sci-fi movies is on the brink of becoming reality. Consider the following scenario in which phoneline and radio frequency home networking devices work together:

It's a typical Monday morning. You wake up a half-hour before the rest of your household to make coffee and absorb the morning news. "Local Weather. Audio and Visual", you say as you toss an English Muffin into the toaster.

The eight by six inch communication pad affixed to your refrigerator immediately displays a local weather map with high and low temperatures for the day. At the same time the pad plays a 60-second audio clip from an Internet broadcast. Both actions are nearly instantaneous because the device is connected via radio frequency to every PC on the network in your home. Your den PC is constantly accessing the Internet and caching the four key areas you're interested in (weather, traffic, top news stories and stock prices), so the data is available anywhere, anytime in your home - on command. When your muffin and coffee are ready, you detach the communication pad from the fridge and use it to read stories from all of the major news organizations as you eat.

At 6:30AM, it's time to wake your daughter. "Wake-up and music. Katy's room", you say as you pour yourself another cup of coffee. Upstairs, the PC in your daughter's room receives the command over the home network. Immediately it's monitor displays a video image of you "Rise and Shine, Katy. Breakfast in twenty minutes".

From downstairs you hear the music that your daughter directed her PC to play for wake-up -- courtesy of the Spice Girls.*

A few seconds later you hear your daughter on the home network inter-com system (each room has an unobtrusive microphone/ speaker device connected to the network for easy communication between family members, or PCs and electronic devices using voice recognition soft-ware). "Don't forget that you need to drop me off at school today", she reminds.

Oops. You had forgotten. "Den PC, update work and family calendar. Print to kitchen." The commands are transmitted to the Den PC via the home network. Then the den PC accesses the calendar from your work-office PC twelve miles away, combines it with the calendar your family keeps at home and prints out a copy for you on the kitchen printer. Unfortunately, you scheduled an 8:00AM meeting for this morning, which will leave no time for messing with traffic.

"Monitor best route to work from Katy's school", you say. Then you begin the mad rush to get everyone in the house out the door on time.

At 7:30AM, after dropping off your daughter, you connect the communication pad that you brought with you into your cell phone and dial home. The call is answered by the answering machine connected to the home network. Voice-printing immediately identifies you to the system and your request to have the latest "best route to work" transmitted to you in your car is fulfilled. Your den PC has been monitoring traffic conditions via the Internet continuously since your request earlier that morning. The data is sent pad and you quickly agree with the PC recommendation that the best route avoids a major accident on Interstate 5.

At 7:55AM you arrive at the office for the meeting with your manager. Before you even have time to take your coat off, your boss' assistant calls. Meeting will be delayed a half-hour. Your manager is stuck in traffic. Oh well, you think as you pull the communication pad out of your bag. At least now you can finish catching up on the news.

This example illustrates the ease and convenience of home computing to operate security systems, access the Internet, communicate with family members, printers and more, all through a home network, connecting several PCs in different locations in your home. But the additional benefits that home networking will make possible are limitless. Given the aggressive drive to bring bigger and better technology benefits to the home from outside, there is little doubt that innovators will search for ways to bring technology benefits *throughout* the home once a widespread

infrastructure exists. The optimal home network described in this paper would provide that infrastructure.

INTEL'S ROLE IN HOME NETWORKING

Intel Corporation is committed to increasing the value of PCs in the home. The research outlined in this paper indicates that a telephone-based home network is a logical next step to achieving this goal for multiple-PC consumers. Research also indicates that the number of these consumers is likely to grow dramatically over the next few years. Our role is to meet the home networking needs of consumers through high quality, easy-to-use products, and to meet the needs of the PC and consumer electronics industries by providing the home networking silicon enabling them to provide networking functionality in a wide range of consumer products.

For more information regarding Intel's consumer product line visit http://www.intel.com/home/network

For information regarding Intel's 21145 Phoneline/Ethernet LAN controller see document HNO102, "Intel 21145 Phoneline/Ethernet LAN Controller Product Brief: Single-chip solution for home and office networking" on the web at http://developer.intel.com/design/network/new21/21145.htm

**ABOUT INTEL-SPONSORED RESEARCH IN THIS PAPER

Following is an overview of the key Intel-sponsored research cited in this paper:

- May, 1998 survey of 300 multiple-PC (or single-PC with plans to buy a second within twelve months) homes. Survey conducted by Market Strategies, Inc.
- February, 1997 survey of 400 multiple- PC (or single-PC with plans to buy a second within twelve months) homes. Survey conducted by Market Strategies, Inc.
- 1997 Focus group research of multiple-PC owners.
- August, 1996 survey of 210 multiple-PC (or single-PC with plans to buy a second within eighteen months) homes. Survey conducted by Market Strategies, Inc.
- Numerous informal interviews of multiple home PC owners. This paper can be viewed online at http://www.intel.com/anypoint line and at http://www.intel.com/business/anypoint