1990s. By the dawn of the new century, the Internet was functioning as a true global utility–though still very uneven in its geographic and socioeconomic penetration.

Physically, the Internet consists of servers (computers that store and pump out digital information), clients (intelligent devices that consume information), telecommunication links, and switches that route packets of digital information from their sources to their intended destinations. The long-distance and building-to-building links that hold it together are extraordinarily heterogeneous; they may be formed from any mixture of high-speed fiber backbones, repurposed telephone or cable television copper wiring, terrestrial wireless links, geosynchronous satellite links, and low-earth-orbit satellite links. From an interior designer's perspective, the most critical link is that linking a building's internal network to a point-of-presence (POP) on a high-speed backbone; this will largely determine the speed and reliability of the building's linkage to the external digital world, and hence the functions that can effectively be supported. Telephone dial-up access is slow and discontinuous but the only thing available in many contexts, cable modem access makes use of the cable television system to provide faster, continuous access, DSL does the same with telephone wiring, and dedicated lines or satellite links provide very high-quality service at commensurate cost.

In general, it is useful to think of our burgeoning digital environment as a large collection of nested networks linked to each other, at well-defined points, by electronic "bridges." At the lowest level are the very fast, miniaturized circuits of digital electronic devices. These are connected to the somewhat slower networks that integrate the smart elements of our immediate surroundings–perhaps bodynets linking implanted, wearable, and handheld devices, plus the internal networks of automobiles, and the local-area networks of buildings. These, in turn, are linked into utilities at neighborhood, city, and regional scale. And finally, the high-speed backbone of the Internet ties everything together at a global scale. To the extent that there are significant differences in speed and reliability between small-scale and large-scale networks, there are clear advantages to storing software and data locally, near to where they will be used. To the extent that these differences are disappearing, though, so are the advantages of this local availability. We are entering an era in which local software and data resources will be far less important factors in the functionality of smart spaces than ready access to the distributed resources of the global network.

INTELLIGENT SUPPLY AND CONSUMPTION

As the utilities that supply a building become smarter in their operation, and as a building's systems and appliances become more intelligent consumers of resources, the relationship of supply and demand becomes more sophisticated. For example, an advanced electrical supply system might vary its prices dynamically according to current demand, and provide for buildings to "run the meter backwards" by pumping electricity from solar collectors or fuel cells back into the grid. In this context, a smart dishwasher might wait until prices were low before switching itself on, or even choose a moment when it could run on locally produced power rather than power supplied by the grid.

Devices that consume information can be programmed to "shop" the Internet automatically for content they require at advantageous prices. Thus Napster, the controversial Internet music distribution system, looks for specified recordings and downloads them from wherever they are most conveniently available. Similar software can be employed to find and download video. If sites charge for downloads, then this sort of software can be set to look for the least expensive sources.

The same principle can be extended to refrigerators, pantries, and household appliances such as clothes washers. In the future, many of these devices will monitor their own contents electronically and automatically order new supplies, as needed, over the Internet.

THE NEW FUNCTIONS OF INTELLIGENT INTERIORS

In general, the effect of embedded digital intelligence, together with Internet connection, will be to make interior spaces more flexible and versatile. In the home, for example, electronic delivery of digital audio and video files can turn any room equipped with suitable displays and digital audio playback devices into a versatile entertainment site–extending a trend that began with radio, the gramophone, and television. The same applies to hotel rooms, dormitory rooms, automobile seats, and airplane seats. Instead of a shelf