JUDGE________________ FINAL ADJUSTED SCORE________

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DAVID D. LEWIS - MICHIGAN STATE UNIV.

**ELECTRONIC COMMUNICATION** Booklet Number 00688

Optical fiber use will be the most active area in communications technology for the next 25 years. By 2008 any type of information will be transmittable over a fiber network that will have substantially replaced the copper wire telephone system. Durability, strength, and efficiency of both fibers and associated semiconductor lasers will near theoretical limits as their cost drops greatly with mass production. Spinoffs from enhancement research will include fiber-based sensors that take advantage of changes in transmitted light due to external stimuli. (A microphone based on the human ear, with fiber cilia, for example.) Very thin fibers in 2- and 3-dimensional arrays may replace both CRTs and conventional video cameras.

Of course, all of the above applications will require not only fibers, but control and processing hardware as well. In the near run, digital optical signals will be converted to digital electrical ones for switching in the information network. Integrated optoelectronic devices combining electronic circuits and optical transducers will come into widespread use within 10 years, easing interconnection and conversion problems. Various contraptions of mirrors and prisms will offer electronic techniques no competition, but some form of purely optical switching, probably using liquid crystals, will appear in the laboratory, if not in the marketplace, by 2008. Processing of signals, except for simple transformations that can be done by the fibers themselves, will still require conversion to electrons. Practical integrated circuits for moving photons appear many decades away, though simple amplifiers operating without converting light to electrons will come sooner.

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ELECTRONIC COMMUNICATION (continued)

Fiber will not cause the airwaves to be abandoned. Demand for vehicular communications will be satisfied without spectral crowding by use of cellular mobile radio to cut transmitter power and digital modulation to use channels efficiently. The right combination of demand, technology, and spectrum for portable communicators for everyone does not seem near; a better bet is that commuter planes, buses, and trains will offer hookups for portable terminals. These terminals, with cousins in the home and office, will have flat TV screens and will allow reception and transmission of video, audio, text, and data, allowing access to news, entertainment, transactions, messages, etc

Broadcast technologies such as high resolution TV and AM stereo will be hampered by political inaction and conflict, but microprocessors will allow manufacturers to produce receivers which not only enhance reception but can be programmed to whatever standards are agreed upon. Cheap home dishes for satellite direct broadcast TV will be developed, but competition from cable, and Third World demands for geosynchronous satellite slots, may bury that technology. Orbital crowding will also force development of systems for sophisticated tracking and satellite-to-satellite transmission so that nongeosynchronous satellites can be used for long distance communications. As more countries develop broadband networks, satellite communication will be displaced by transoceanic fiber optic cables.

Finally, on a more mundane level, printers will be developed to print out only those parts of a newspaper or magazine that a consumer wants, in an easily readable form at home or at a coin-operated device.

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**COMPUTERS** Booklet Number 00688

The Japanese 5th generation computer project will greatly influence the direction of computer science for at least a decade. Much work will be done on large scale use of parallel processing and on predicate logic based languages and knowledge bases. Electron beam fabrication of very large scale integrated (VLSI) chips will displace optical methods, allowing mass production of multiple processor chips. Artificial intelligence methods will be increasingly used in general purpose programming.

The Japanese project, and those inspired by it, will have both successes and failures in the early 1990s. Multiprocessor supercomputers will give spectacular results in areas where many similar calculations are required: computer vision, graphics, statistical forecasting, etc. Many commercial expert systems will be produced, but the more ambitious goals of natural speech recognition and generalized knowledge bases will not be realized.

Artificial intelligence (AI) researchers will turn to designing computer architectures to suit particular algorithms. Cognitive psychology will contribute ideas on how humans reason, resulting in new methods for building knowledge bases. The mathematics of nonstandard, "fuzzy", logic will be found to be a useful model for reasoning, spurring new interest in analog computers. Findings from neurophysiology will be used in attempts to mimic the human brain by building computers with many types of micropro-cessors operating in parallel, with special computer languages being used to express problems in a fashion appropriate to such an architecture. Similarly, advanced telecommunications will allow specialized computers

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connected in networks to attack different parts of complex problems, especially when real time solutions are not needed. (Automated transformation of textbooks into knowledge bases may be done in this fashion.)

New types of hardware will be investigated. The use of fiber optics in telecommunications will spur interest in integrated optoelectronics; VLSI chips with built-in lasers will allow fast fiber optic chip-to-chip connections. Optical logic, however, won't make it past the lab curiosity stage due to difficulties with miniaturization. Order of magnitude increases in circuit density will be fewer and farther between. Even crude 3-dimensional chips will be decades in coming; they may have to be built atom by atom (or ion by ion). Organic circuitry built by genetically tailored bacteria is a long shot possibility by 2008, as is the use of mutated brain cells (with the associated ethical dilemmas).

Optical memory devices will become increasingly important for storing permanent data, as well as in graphics and animation, as general advances in optical technology allow rapid access and processing of stored images. Interactive videodisc systems will be widely used in conjunction with expert systems for entertainment, education, and advising. Magnetic memories will remain important where erasability and rewritability is required; rewritable optical memories will be developed, but will have much lower density than both permanent optical memories and erasable magnetic ones. The development of either 3-dimensional or biological logic circuits would also allow memories to put <u>all</u> the above to shame.

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SOCIETAL IMPACT Booklet Number 00688

Advances in electronic communications and computer science in the next 25 years will bring an almost unimaginable growth in out ability to control and generate information...for a price. Existing class differences in wealth and education will be exacerbated as the ability to access and use information become more important. The "right to information" will be a new rallying cry. Demands to provide low cost access to the growing communications net will be acceded to by government, but educational differences will be less easily remedied, so that access may be used only for entertainment.

Individuals will have the power to copy and transmit all forms of information, sharply limiting the profits to be made from records, videotapes, software, etc. Such intellectual properties may be sold to programming companies that will provide a package of information products for a flat fee. Note that pornography, cultism, financial frauds, and interactive gambling are all possible products, causing regulatory battles to be commonplace. Some programming companies will provide all news, advertising, entertainment, computer dating, etc. from a particular religious or political viewpoint, increasing factionalization of society and growth of narrow interest groups.

Corporations and interest groups will also eagerly gather and merge data on individuals, despite public disapproval and government restrictions. Advertisers and interest groups will use computer generated psychological profiles to tailor appeals to each individual. People will development a healthy skepticism, of course, but the total amount of political activity will grow.

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**SOCIETAL IMPACT (continued)**

Communications will not end personal contact, however. Those organizations that try to cut costs by using at-home workers will suffer productivity losses from psychological problems and lack of creative interaction between workers. Executives will find reasons to make business trips despite teleconferencing, both for pleasure and for off-the-record conversation. Members of the general public will have the increasing ability to develop friendships and romances throughout a country via videophone. Computerized translation systems will eventually allow relatively easy conversation between speakers of different languages. (Before running off to marry a video romance, it will be wise to check whether he or she has been using image enhancement software.)

Factory automation will continue to slowly displace low-skill workers. Clerical and service employment will also begin to drop as programs with increasing natural language capabilities are introduced. (Consumers may be given the choice between tailoring their speaking and requests to a computer's capabilities or waiting endlessly to speak to a lone human. Other organizations will offer "all-human" service...for a higher price.) Employment will increase dramatically in information specialities such as programming, consulting, teaching, and the new discipline of knowledge engineering. The greatest problem facing society will be developing the educational methods to train a majority of people to effectively work with information. The omnipresence of information in 2008 will do us no good if our people do not have the intellectual training to use it.