JUDGE_____ FINAL ADJUSTED SCORE_____

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ROGER G. AIKEN - U OF MINNESOTA 00325

ELECTRONIC COMMUNICATION Booklet Number _____

By 2008 McLuhanism ("the medium is the message") may have completely enveloped us unawares. A plethora of currently emerging and completely new information processing and distributing devices and systems will have invaded our society in all its aspects. At home, at the office and even at the cabin electronic gadgetry will surround us to wake us, brief us, provide the day's menu, facilitate our shopping, banking and education, entertain us and finally lull us back to sleep again.

Three already existing technologies will bring these events to fruition. They are 1. Fiber optics coupled with laser diode light sources, 2. Semiconductor integrated circuits and 3. Communication satellites.

With the perfection of the single frequency stabilized semiconductor laser diode light-source it will be possible to utilize single mode instead of multimode optical fiber technology to greatly enhance information carrying capacity and distance between repeaters. It is predicted that by 2008 it will be possible to transmit 10 Gb/s between repeaters spaced no less than 100 miles apart, at wavelengths in the 1.5 - 1.6 μm range where optical attenuation is a minimum.

Semiconductor I.Cs continue to shrink in size and power consumption enhancing packing density and speed of operation. I predict that by 2008 90% of all I.Cs will comprise either CMOS or GaAs FET technology. The former is superior to NMOS or bipolar in terms of low power consumption, reliability and cost for computer RAMs (10 Mb capacity by 2008) and the latter material is 5-10 times faster than silicon in addition to having a wider operating temperature range and higher radiation tolerance. It will be used for I.C's in computer CPUs, satellite electronics and defense systems.

In 2008 long distance communication will be facilitated by fiber optic cables, both trans-continental and trans-oceanic,

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ELECTRONIC COMMUNICATION (continued)

for high speed, high capacity information flow, and by communication satellites. The latter will provide wide area integrated (voice, radio, video and data) coverage including remote areas. Newer satellites will have much larger numbers of channels per transponder, perhaps as many as 15,000 64 kb/s digital channels for voice. Solid state power amplifiers using GaAs FETs will make this possible since they are linear over a much wider range of frequencies that TWTs.

By 2008 information flow will be transmitted almost entirely by digital rather than analog networks. As telephone exchanges turn to ESS it becomes increasingly possible to multiplex voice, radio, video and data together for transmission over a single trunk line. Furthermore it is predicted that there will be considerable decentralization at the large business or institution level by using integrated LANs (Local Area Networks)

The LAN provides the vehicle for in depth office automation. By 2008 most businesses and industrial operations will have multiple work stations with mainframe computer access for word processing, information storage and retrieval, electronic mail, laboratory, production line and hospital parameter control and building management operations.

Perhaps the most astounding and far reaching changes will come to our homes. Not only will teletext and videotex have penetrated deeply but with the breakup of A.T&T, integration of many home communication technologies will occur. I predict that by 2008 about 25% of homes in the U.S. will have their own integrated information systems providing 2way voice, video and data capability in a single unit with peripherals. The executive or university professor need not be hindered by a winter blizzard. He will be able to run his business or lecture his class from the comfort of his fireside chair, then turn for a game of "Donkey Kong" at coffee break.

Finally I predict a revolutionary new breakthrough in the field of E.S.P. Communication. New work in Information Theory coupled with advances in our understanding of the human brain will make this form of interpersonal communication widely possible! 8

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ENERGY Booklet Number _____

Our 2008 energy picture will reflect greater changes resulting from changed mindsets than changes brought about by new technological advances or breakthroughs. Currently in the U.S. we use about 78×10^{15} Btu (78 Quads) of primary energy per year. I predict that by 2008 this consumption rate will be about the same – may in fact even be a little less.

Consider our current primary energy use and compare it with the 2008 prediction.

Primary Source	1983 Quads	1983 %	2008 Quads	2008 %
Imported Oil	15	19	4	5
Domestic Oil	21	27	14	18
Total Oil	36	46	18	23
Natural Gas.	20	25.5	19.5	25
Coal	16	20.5	17	22
Nuclear	3	4	3	4
Renewables.	3	4	20.5	26
Total.	78	100	78	100.

At first, one might suspect that zero energy growth (ZEG) implies a stagnant economy. This need not be so. Instead I predict a rising GNP/Energy consumption ratio. i.e that we will be using energy more efficiently or productively by 2008, in fact 50% more so. This rise will be a direct result of a new understanding and appreciation of the laws of thermodynamics, especially the much maligned and often misunderstood 2nd Law. This law tells us that we should be more concerned with the way we use energy than with where we get it from, with system task efficiencies, rather than device efficiencies and with living within our global energy income than in depleting our remaining reserves of capital source energy, principally fossil fuels.

By 2008 we shall have achieved an overall 2nd law available energy (exergy) efficiency improvement of 9% to about 13½ %.

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ENERGY (continued) This will have been achieved by—

- Widespread development and acceptance of co-generation and district heating
- Integrated industrial energy management, using heat recuperators, waste heat boilers and recycling waste materials for energy.
- Better matching in all energy use sectors of energy demand to source of appropriate quality. e.g. electricity for work, heat for thermal needs
- Better building management practices including demand and occupancy climate control and thermal insulation.

Electrical energy will assume greater importance in the transmission and distribution of energy from source to user. Contributing to its increased flow and transmission efficiency will be 1. HVDC transmission up to ± 1000 kV and 2. superconducting cables based on rapid advances in cryogenic engineering. Superconducting circuits will also be used in large AC generators and Fusion Reactors by 2008, when the latter will be a proven laboratory reality and prototype commercial plants based on the Tokamak principle will be on the drawing board

We shall see a resurgence of electric traction for both passengers and freight. The electrification of the nations railroads will be well advanced and the advent of the small P.R.T. vehicle for urban mass transit will have arrived in many of our cities. These, together with lighter and more efficient I.C engines in automobiles for intercity transport will have halved the country's country's consumption of petroleum.

Sulfur emissions leading to continued acid rain will constrain growth in coal use, and the public's continuing suspicions regarding the safety of reactors and the waste storage problem — further growth in nuclear.

Slack in decreased petroleum usage will be taken up primarily by renewable primary sources. Direct solar thermal, photovoltaics, wind, biomass, expanded hydro and geothermal. Secondary or storage sources will be an integral part of these e.g. pumped hydro and air systems, reversible fuel cells and hydrogen generation.

By 2008 we shall be close to energy self-sufficiency, a wise and prudent response to the changing availability of our 10 energy sources and the security of our people

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SOCIETAL IMPACT Booklet Number _____

The societal impacts of the predictions I have made in the fields of Electronic Communication and Energy will be superficially quite different, yet there are some subtle interactions between the two. The former will impact not only on the way we live individually and corporately, but also on the way we think, behave and views the rest of the world. The danger exists not only for privacy invasion but also for mind and thought pattern manipulation. Big Brother may indeed be more insidious than we think! The societal impacts of changing energy use technology and patterns will be more overt. At all stages we will have the opportunity to see and assess outcomes and make compromises if necessary. We already see this in societal reaction to the use of coal and nuclear (uranium) as primary sources.

The technology advances in electronic communication at the device and component level have little direct impact on the man in the street. It is at the systems level that the impacts will be felt; in fact it is usually a desired change or impact which motivates a technological development in this field. Thus high speed, high capacity long distance communication will dramatically shrink the perceived size of our globe and hopefully bring us into close contact with not only with friends, relatives and business colleagues remote from our home and work places, but also with people of other cultures and life styles, making us more understanding and tolerant of them. But the pressures of private enterprize and consumer demand could also drive the impact the other way. We must be on guard.

At the workplace the advent of integrated LANs will undoubtedly have many positive benefits. By using them as the vehicle for office automation many current work practices will be eliminated or eased e.g. unnecessary hard copy filing, rapid correction and editing of documents, rapid

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SOCIETAL IMPACT (continued)

information retrieval and dissemination, and on the production line continuous and automatic process control and monitoring. The work place should become a more humane and/or exciting place to be.

In the home there lies the greatest danger for manipulation and mind control. There are certain to be court cases involving privacy invasion, and unscrupulous mind/thought manipulation as home information systems evolve, particularly with 2 way systems.

The societal impacts associated with changed energy use will be far reaching. Decreased petroleum consumption will decrease our reliance on foreign crude even as domestic production continues to fall. By 2008 we could very well be in a position to curtail our shipments from the Gulf completely. With less automobile use the problems of photochemical smog should abate but continuing coal combustion at large electric power stations particularly those in the East using high sulfur fuel will force utilities to make major modifications to ease the acid rain problem. New boilers will utilize fluidized bed combustion and MHD topping cycles will increase thermodynamic efficiencies to reduce emissions and reduce fuel requirements.

The impact of renewable energy use will be very positive. Once installed, solar, wind, biomass, hydro and geothermal systems are cheap to run and maintain and most are almost pollution free. Furthermore the small distributed units are easily observed and understood in the local setting and give their owners a sense of pride.

Many new energy systems especially those feeding power into utility grids will require sophisticated information processing and control. Here and in building management systems the expenditure of minute amounts of energy to operate the decision making circuits results in very sizeable savings in energy use. Even though Information Theory tells us that $0.693kT$ joules of energy are required per bit of information flow, this 10^{20} leaves us ample scope for conservation!