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This is the text (with graphics) of a presentation made by Anthony G. Oettinger at the National Security Agency, Ft. Meade, Maryland on January 10, 1990.

Its form does not fall neatly into any categories: It has not undergone review (although pieces of it have) and is therefore not a Program report. It has not had enough editing and production to make it an incidental paper.

Nonetheless we think it may be of interest, and we include it in this mailing.

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FOIL 1: *Title*

NATIONAL POLITICS AND THE TELECOMMUNICATIONS WORLD

Anthony G. Oettinger

ABSTRACT

Sketches forces and trends related to the continuing deployment of electro-optical digital technologies in the multi-national environment of the turn of the 1990s, where -- compared to the turn of the 1980s -- both market competition and government interventions have increased, where telecommunications supplier market power has fragmented across a chaotic telecommunications-computer-industrial electronics/consumer electronics market, where large business users hold the best cards, and where the shape of post-POTS (plain old telephone service) mass markets is at most a faint glimmer. Explores associated threats and opportunities.

Contents

List of Foils

I. Stakeholders and Stakes; Forces and Trends

FOIL 2: *Affiliates*

I am honored that you invited me to speak here. As you can see on the foil, NSA is among our sponsors, a group of diverse public and private, often competing, domestic and foreign entities who, collectively, help keep us both reasonably competent and reasonably impartial. For those of you who are curious, there is more about how we operate in the Appendix to the written version of my talk. I need not bore you with that here.

They asked me to speak on *National Politics and the Telecommunications World*. So I puzzled about what might such a talk encompass? The next seven foils suggest the scope of what I might dwell on if only I had world enough and time.[1]

FOIL 3: *Forces & Trends*

First, I am not going to predict anything. I'll be happy if I leave you with a more accurate sense than you came in with of where we are. The only sure thing about the future is that it is rooted in the past and in the present.

It can also help to know what forces might carry us into the future along what trends. I will only sample the forces and trends under the headings of this foil. I shall explore as much as time permits how some selected forces and trends might mean to our professional lives.

FOIL 4: *Forces & Trends: Hints of Detail*

Politics: In electoral politics, for instance, farmer's votes -- or rather the decrease in their importance over the last few decades -- help to account for both the similarities and the differences in the politics of telecommunications regulation in different countries, in the forums of the

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[1] The materials in this section are drawn in part from unpublished drawings by John McLaughlin and from John LeGates and John McLaughlin, *Forces, Trends and Glitches in the World of Compunications*. Cambridge, MA: Harvard Program on Information Resources Policy, P-89-2, 1989.

United Nations and in bilateral relationships.

Economics: The excess of United States imports over United States exports is a major economic concern in many areas, including telecommunications, where the United States for a time enjoyed undisputed leadership.

Demographics: The post-World-War-II baby boom, which has dominated demographics for a few decades, is giving way to a sharp dip in the number of 20-to-30-year olds, with implications that are already visible not only in the soft real estate market in the United States but also in shortages of entry level personnel in the military as well as numerous other sectors. Retrenchments in the work force, shifts to more capital intensive modes of production instead of more labor intensive modes of production, and migration of production to places where labor is more available are all linked to this trend.

Social: The continuing increase in the number of working mothers, one of the results of labor shortages as well as of militant feminism, makes itself felt all across the social fabric as questions of day care for children and for elders. In our realm of information resources, the continuing increase in the number of working mothers makes itself felt, for example, through the growing importance of information technologies in enabling economic fast food operations and in stimulating the sales of such consumer products as telephone answering machines.

Technologies: Specific to our area of special interest is the continuing trend toward more for less across the board in information technologies.

FOIL 5: *Structures and Stakeholders*

Forces and trends are of no interest in a vacuum. What matters is how they affect various stakeholders. These stakeholders do not exist in a vacuum either. They are linked together in diverse structures imposed on "the real world" by diverse outlooks from diverse standpoints. The foil illustrates the

telecommunications industry's structure as it might be seen by a major corporate or government customer.

FOIL 6: *Stakes*

The stakes are the usual ones. What matters is the details, which vary stakeholder by stakeholder, and which I shall sample for you further on.

FOIL 7: *Battlefields*

The battlefields are the usual ones. For a few decades, the telecommunications world had the luxury of dwelling almost exclusively in the sanctuary of the relatively benign and insular world of dedicated domestic administrative agencies, namely, in the United States, the Federal Communications Commission (FCC) and the similar bodies of each of the fifty states, the territories and the District of Columbia. Internationally, the International Telecommunications Union (ITU) was a congenial and, on the whole, technically oriented club for the major suppliers of telecommunications services, namely the pre-divestiture American Telephone and Telegraph Company (AT&T) and the Post, Telegraph and Telephone administrations (PTTs) of most other countries. Today, there are many more players in unstable and ever shifting alliances.

FOIL 8: *Options*

Balances that seemed frozen -- for better or worse -- under the old ways through decades of what, in retrospect, looks like a period of unusual stability, are all swinging with renewed vigor along the dimensions framed by the options in the foil, dimensions as relevant to government agencies as they are to private sector entities.

FOIL 9: *Implications*

Why anybody might care, of course, has to do with the implications of all this.

II. How Did We Get To Where We Are?

Ten years ago, at the turn of the 1980s, there was relatively little perception among telecommunications practitioners that most of the forces and trends that I have sketched, except for technology trends, mattered to their professional lives as contrasted to their lives as citizens, as consumers, or in some other capacity.

Therefore a talk on national politics and the telecommunications world could have been a very short one, in the vein of a talk that the astronomer Harlow Shapley gave at Harvard aeons ago, when Mac Bundy had not yet gone to John F. Kennedy's White House but was still the Dean of the Faculty. Mac introduced Harlow who, he said, was going to talk on *Galaxies and their Human Worth*. Harlow got up, went to the podium, took a breath, looked around at the audience and said: "Ladies and gentlemen, galaxies have no human worth." He then went on to talk about whatever was on his mind.

Ten years ago, at the turn of the 1980s, the Bell System was still whole in the United States and PTTs (Post, Telegraph and Telephone administrations) were still tall in their saddles in most of the rest of the world. Aficionados clucked about the politicization of the ITU (International Telecommunications Union) and of the WARC (World Administrative Radio Conference) but the United States still pretty much had its way. Although the FCC's (Federal Communications Commission) Common Carrier Bureau had been actively stirring the telephone pot since the late 1960s, the Commissioners themselves were mostly just leering at pornography or otherwise embroiled in much sexier broadcasting matters, as were the committees of the Congress of the United States.

In summary, as of the turn of the 1980s, the United States national order of telecommunications was at the summit of realizing the dreams expounded by the former Bell System's patron saint, Theodore Vail, when he argued for a nationwide telephone monopoly in the first two decades of the twentieth century. The storm clouds of competition had already gathered but, so far, they had rained just an occasional light mist on the parade of the

monopolies. From the standpoint of the traditional telecommunications industries, the computer industry was still perceived as a whole 'nother world and consumer electronics was something for amusement, not for serious communication.

In reality, even at the turn of the 1980s, the telecommunications monopolies already were in the precarious position of Wile E. Coyote in the Road Runner cartoons: having run past the edge of the cliff and still running level only because they hadn't yet bothered to look down. At the same time France, as one instance of the world outside the United States, was still in the state before the subsidized and partly illusory Minitel miracle, a state about which one could joke that half the people were waiting for telephones while the other half were waiting for dial tone.

At the turn of the 1980s there was no, or at least mighty little, high national politics of the telecommunications world. There was, of course, plenty of the usual low politics of infighting among all the usual suspects, by then a growing band encompassing not only the Bell System and the thousand or so golden-oldie independent phone companies, but also upstarts MCI and Telenet, to name but two of the OCCs (Other Common Carriers; the term subsumes IXCs (Interexchange Carriers) and VANs (Value-Added Networks)). Closer to NSA (National Security Agency), by 1979 two years had passed since President Jimmy Carter had issued his presidential directive PD-24, which ushered in the uneasy sharing of responsibility for protecting United States telecommunications between NSA and what was then the National Bureau of Standards (NBS) and now is called the National Institute of Standards and Technology (NIST) of the Department of Commerce.[2]

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[2] The subject keeps being revisited as in President Reagan's National Security Decision Directive (NSDD) 145 and the sarcastically numbered House bill HR 145, which Reagan signed into law as Public Law 100-235 on January 8, 1988. Also in a memorandum of understanding about the implementation of this law, signed by the Director of NIST, Raymond G. Kammer, and the Director of NSA, W. O. Studeman, in March of 1989.

III. Where Are We Now?

As we enter the 1990s, the traditional telephone world has shattered, mostly in the United States, but also throughout most of the world, albeit to varying degrees and according to scripts tailored to national circumstances. The usual low politics of infighting among all the usual suspects continues to be a growth industry -- worldwide. Because this low politics more and more often spills over into other arenas, like trade and alliance politics, as we enter the 1990s there are more and more attempts, with occasional success, to project the telecommunications world into the world of high national and international politics.

A. A Quick World Tour

In France, for example, *Competition* has become a long-running play that stars republican pluralism and diversity in order to entertain both the whole country and the European Economic Community, but all the same is a play written, directed and paid for at the Champs Elysées with a classical centralist panache that the Sun King or Napoleon could envy.

In Germany, the radical letter of the law that went into effect in August 1989 blows a whirlwind of pro-competitive prose over the former postal-and-telephone Bundespost monopoly. But the letter of that law is also vented through such giant loopholes that, in actuality, just a *Mailufterl* breeze of political caution is likely to waft just the rather traditionalist spirit of that law over the newly styled but otherwise rather traditional Deutsche Bundespost Telekom entity responsible for telecommunications under that new law.[3]

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[3] A separate public enterprise called "Deutsche Bundespost Postal Service" handles the mail. Yet another, named "Deutsche Bundespost Postal Bank" handles the financial services traditional in European PTTs. But the linkages that the government may establish among these provide extensive enough flexibility to move anywhere from the status quo to radical new competitive behavior. For details of expectations, see: Federal Minister of Post and Telecommunications. *Reform of the postal and telecommunications system in the Federal Republic of Germany*: Concept of the Federal Government

In Japan, the wild samurai saber rattlings for the privatization and the divestiture of Nippon Telegraph and Telephone Corporation (NTT) are tamed into a tea ceremony first by the Labor Democratic Party's dependence on rural voters partial to monopoly cross-subsidies and, second, by the 1989 gain of control of the Diet's upper chamber by the Japan Labor Party, a party then supported by NTT's labor unions.

The Brits muddle through in their style to a position between the cousins and the continent: very limited and circumscribed competition arranged among gentlemen and the Iron Lady to provide a tightrope for them to walk over the crosscurrents of the usual demands of large customers and the unusually backward state of plain old telephone services within the United Kingdom.

In the United States, regulated competition holds sway, the regime that the last imperial chairman of the Bell System, John deButts, excoriated as the worst of all possible worlds. The competition is increasingly bitter. At the same time, the intervention of government in traditional telecommunications is as active as ever in traditional federal and state administrative agencies and more extensive beyond those agencies even though rhetoric still trumpets deregulation.

B. Abundance, Fragmentation and Diversity: The Basic Realities of the Turn of the Decade

More important in the 1990s than the continuing -- and Byzantine as ever -- low politics of maneuvering within the remnants of the traditional telephone industry are four major realities:

FOIL 10: *Technology Improvements Create Business Opportunities*

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for the Restructuring of the telecommunications market. Heidelberg: R. v. Decker's Verlag, G. Schenk, 1988. The essential of the enacted legislation conform to these expectations.

First, electro-optical digital technologies are still getting ever more abundant, as they have been getting in the last few decades. Compared to each preceding generation, each new generation of electro-optical digital technologies yields better products and services: products and services that are of higher quality and of greater reliability than the products and services that came before and that are also faster, smaller and cheaper.[4]

Second, telecommunications supplier market power has fragmented not only within the traditional telecommunications industry but also across the computer industry, the consumer electronics industry, and other traditional industries as well.

Third, diverse large business users from every imaginable branch of commerce and industry continue to hold the best cards in both the low and the high politics of computers-and-communications.

Fourth, the mass of individual consumers as power brokers is said to be hovering in the wings, ready to swoop to center stage. No one knows, however, whether the cue will come out of show biz, out of a break out of hordes of Group 4 FAX (facsimile) machines, top down from some CAD/CAM (Computer-Aided-Design/Computer-Aided-Manufacturing) or financial application, bottom up from Nintendo games or not at all in our lifetimes.

In summary:

more abundant applications of electro-optical digital technologies in more fragmented and diverse markets served by increasingly diverse

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[4] For instance, as the foil hints at, Japanese TVs swept the United States market because they were better than American makes, namely so reliable as to require esentially no maintenance. Hence they could be distributed through department stores and through other general merchandisers, while the distribution of American-made TV sets was locked into the network of the deservedly much caricatured and vehemently distrusted TV repair shops.

competitors.

more upsets of many balances, among them the balance between the security of information and the usefulness of information.

More and more, fragmentation and diversity are also the hallmarks of the national security aspects of telecommunications, if for no other reason than that they are the hallmarks of national security in general. The turn of the 1990s in Eastern Europe and in Panama portends even greater diversification, but not necessarily attenuation, of military threats we subsume under National Security, capital "N", capital "S", than what we have already experienced since Mikhail Gorbachev first spoke of perestroika and glasnost. Those events ranged from the tumbling of the Berlin Wall, which the New Yorker magazine summed up by paraphrasing Julius Caesar into "They came, they saw, they did a little shopping"[5] to the bloodier events in Panama and in Romania.

The increasingly fragmented and diversified distribution of economic power throughout the world, combined with the fragmented and diversified character of the drug threat make fragmentation and diversification the hallmarks also of national security, lower case "n", lower case "s". Besides combined operations among our allies and joint operations among our military services, we now are seeing more and more demand for operations that glom LEAs (Law Enforcement Agencies) of the most varied sorts together with assorted military agencies. Perhaps we shall come to refer to such operations as "glommed operations", or even as "Joint, UNified and Combined" and try to avoid them. Perhaps we shall systematize them and make them the norm.

Before developing these themes and their implications, I should like to recap for you some essential traits of the way technology, economics, politics and other aspects of reality intertwined in the heyday of the latest monopolistic alternation of telecommunications regimes in evolving what we perceive as today's reality.

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[5] New Yorker, *The Talk of the Town*, November 27, 1989, p.39.

For that recap, I shall use as my example the evolution of an essential ingredient of what the traditional telecommunications companies say they are serving up at the turn of the 90s as fuel for the world's future, namely ISDN (Integrated Services Digital Network).[6] That recap of the past will give us a backdrop against which to contrast the current regime and the forces and trends that shall transform that regime into the future.

[6]The acronym also has been said to stand for "Integrated Services Digital Network" and for numerous other variants expressing different attitudes and goals from the reverent and the hopeful to the sarcastic and the skeptical, like "Innovations Subscribers Don't Need".

IV. How Discretion Worked in the Good Old Days: The Birth of T1, Mother of ISDN

A. The Scientists' Tale

One of the most fundamental of the new perceptions of information that scientists have expressed over the last 50 years or so, is the perception that voice, data, pictures and any other kind of vehicle for information can all be represented with complete faithfulness in digital form. That means expression as a sequence of 0's and 1's, namely expression as the bit streams or the byte streams by now familiar, at least by hearsay, to nearly every educated person throughout the world.

Claude Shannon's work at the Massachusetts Institute of Technology and at Bell Laboratories from the late 30's to the mid 50s is one of the key contributions to the emergence of this perception.[7]

When you look at bit streams, you can't necessarily tell whether they stand for voice, or data, or whatever other kind of information. For many purposes, therefore, distinctions among voice, data, pictures and so on become entirely optional.

It was this observation which led me, some twenty years ago, to suggest the term "compunications" for the common digital underpinnings of computer and communication sciences and technologies. In this I followed the example of that great American patriot, William O. Baker, who as early as the Kennedy/Johnson administrations had succeeded in infusing into presidential documents queries about "the true meaning" of the convergence of computer and communications technologies.[8]

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[7] Shannon's work built on earlier findings of Hartley and of Nyquist.

[8] See, for instance, President Nixon's Executive Order 11556 (35 FR 14193) of September 9, 1970, "Assigning Telecommunications Functions", which listed the following among functions of the newly created Office of Telecommunications Policy: "k. 'Conduct studies and analyses to evaluate the impact of the convergence of computer and communications technologies, and

But even if universally accepted, it seemed to me, the perception of computer systems and of communication systems as indistinguishable information engines would tend to blur but would not necessarily actually blur the perceptions of the computer and communications industries as distinct. Likewise, the perception of voice, data and pictures as indistinguishable digital information formats would tend to blur but would not necessarily actually blur the perceptions of the voice, data and picture industries as distinct.

There are many reasons why the option, as scientists perceive it, of looking at the information world as digital is not always exercised even though better, smaller, faster, cheaper electro-optical digital technologies provide strong incentives to do so. One important reason is inherent in the very concept of an option, which is there to exercise or not by some kind of decision.

B. The Engineers' Options

Like many scientific truths, Claude Shannon's universally valid theoretical findings open up a wide range of possibilities. They do not give a unique way of digitizing voice, data and pictures. There are lots of ways of exercising the resulting discretion. And there are many influences on how that discretion is exercised.

The specifics of the following historical sketch are meant to illustrate the specific influences that led to the choices that were actually made.

FOIL 11: *TI and the Exercise of Discretion*

The digitizing scheme in actual use in the late 1980s in the North American telecommunications network was shaped by the perceptions of engineers

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recommend needed actions to the President and to the departments and agencies." The language is similar to language used in a memorandum by McGeorge Bundy, national security adviser under the Kennedy/Johnson administrations.

working for the Bell System at least two decades before its divestiture in 1984. This scheme, of which the T1 carrier system is an important part, differs from those adopted by telecommunications organizations elsewhere in the world and from those adopted by computer manufacturers in North America as well as elsewhere in the world

The exercise of discretion came out as follows: a single pair of copper wires, formerly capable of carrying only one conversation at a time was made capable of carrying 24 simultaneous conversations or voice channels by transmitting a digital bit stream at the curious rate of 1,544,000 bit positions per second, i.e. 1.544 million baud or 1.544 megabaud.[9]

The rationale for this outcome typifies the admixture of discretion with truths of various kinds characteristic -- to a degree that varies with the organization, the era and other factors -- of engineering decisions.

The rationale rests on Shannon's finding that just sending a finite number of samples of an utterance instead of the entire utterance is good enough to reconstitute the original utterance absolutely exactly at the other end. Each sample is then digitized, meaning that how loud the sample is, is represented by a loudness number.

As a matter of discretion tempered by empirical truths about how finely people can tell apart levels of loudness, 128 levels of loudness was chosen as the basis for digitizing the samples.

The decision to make it 128 rather than 127 or 129 doubtlessly had more to do with the mathematical truth that it takes exactly 7 bit positions to represent 128 possibilities than with any difference in what our ears can hear with 127, 128, or 129 levels of loudness.

Making it 129 levels would have taken 8 bit positions. This would theoretically sound better but it would also cost more money.

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[9] In Europe, the most nearly comparable rate is 2.048 megabaud.

Using only 127 levels would waste some of the capacity of 7 bits and "waste not, want not" is a tenet of the engineer's ethic.

So here we have a clear instance of discretion tempered by both engineering and financial perceptions of truth within the environment of the North American telephone industry. In the decade or so after World War II when all this discretion was being exercised, the Bell System order of things in the telecommunications world was at its pinnacle. It defined its own environment with apparently inalterable authority and stability. Within that environment standards were unquestioned as the tool of choice for achieving compatibility. Complexity was at most technical complexity, and whatever balances had to be struck were at most balances among claims competing within the sanctuary of the Bell System and resolvable, when necessary, by appeals to authority no higher than whatever not-so-benevolent despot[10] reigned at New York City's 195 Broadway, then the Bell System's headquarters.

Let me note parenthetically that in 1956, even as this discretion was being exercised, a Final Judgment was entered in a United States government antitrust suit against the Bell System. This Final Judgment locked the Bell System out of the computer industry. The 1982 Consent Decree that divested AT&T of the Bell Operating Companies was, technically, a Modification of that 1956 Final Judgment. Parenthetically, you can tell a lawyer from a layman by whether or not he or she winces at the oxymoron in "Modification of Final Judgment" (MFJ).

The desire to have a good chance of catching certain types of transmission errors led to adding one bit position to the sample, for a total of 8 bit positions per sample. Each additional position would catch more errors but would cost more money, so here is another performance/cost tradeoff.

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[10] Von Auw gives a vivid account of the often strained relationship between the the Bell System's technical people and its top corporate management. Von Auw, Alvin. *Heritage and Destiny*: Reflections of the Bell System in Transition. New York: Praeger, 1983.

Bandwidth is a measure of how good a telephone channel is at transmitting voice. The wider the bandwidth, the higher the fi. The standard telephone channel was designed for 3Khz bandwidth. Adopting the equivalent of 4Khz as the basis for digital transmission gives a noticeable improvement in quality comparable to the transition from AM radio to FM radio.

When that adoption was made, it had to be on faith and not on proof that the right balance would be struck between quality that the market would appreciate and cost that the market would tolerate. That the decision was made for future quality (or for wasteful indulgence in adventurism) has more to do with the political truth of the then monopoly status of the Bell System than with hard and fast technical truth or free-market finance.

This piling together of empirical, engineering, financial, marketing and political truths could then trigger the scientific truth embodied in Shannon's theory. To wit, taking precisely 8000 samples per second would enable digital voice transmission exactly as faithful to the original as traditional transmission over a 4Khz channel.

With one more whopping application of discretion, the rest becomes pure analytical truth, the application of arithmetic to reach a foreordained conclusion.

It was Bell System practice to bundle together 24 voice-grade copper-wire-pair circuits for the next level of cabling or trunking. This truth came out of the history of what was practical and economical in the pole-climbing or man-hole-fishing world of pre-electronic cable-making times. Habit or an operational need for consistency and for easy fit of the old to the new carried the number 24 forward into the electro-optical digital telecommunications world.

So, 1 sample takes 8 bit positions or 8 bits. 1 sample for each of 24 circuits takes 24 x 8 = 192 bit positions. Adding to that a synchronizing bit position for essentially engineering reasons makes it 193 bit positions per

sample. With 8000 samples needed per second and 193 bit positions needed per sample we finally reach the outcome that 8000 samples per second times 193 bit positions per sample = 1,544,000 bit positions per second, i.e. 1.544 million baud or 1.544 megabaud.

FOIL 12: *1 T1 Channel = ISDN's B-Channel*

Let us also note that for 1 channel: 8000 samples per second x 8 bit positions per sample = 64,000 bit positions per second. This is precisely the size of the B-channel proclaimed as the core of the ISDN wave-of-the-future of the late 1980's.

C. A Tale of Two Cities: Computers and Communications

But recall the coincidence that I highlighted for you on p. 14 between the environment that gave birth to the T1 standard and the environment that gave birth to the 1956 antitrust consent decree, a consent decree that walled off the communications industry from the computer industry for almost three decades.

Some consequences of this walling off are apparent today. Both alongside of and superimposed on the telecommunications industry's single-minded and -- from the user's standpoint -- outside-inward diffusing T1 standard, there grew up the computer industry's multiply-spawned and -- from the user's standpoint -- inside-outward diffusing standards for LANs (Local-Area Networks).

And what is hooked up to networks at the turn of the 1990s is no longer just the POTs (plain old telephones) once owned exclusively by the traditional telcos, nor even just the main frames, work stations, PCs or dumb terminals made by the computer industry, but also CPE (Customer Premises Equipment) -- namely the FAX machines and the clock-radio-answering-machine-telephones and all the other gadgets made by the consumer or industrial electronics industries.

As user- or third-party-owned LANs expand outward from users to become MANs (Metropolitan Area Networks) and WANs (Wide Area Networks) while traditional-telco-owned T1 expands inward toward users as part of "private" networks, compatibility issues once fought out within the Bell System family or -- at most -- within the extended ITU family of monopoly PTTs are nowadays fought out by more diverse stakeholders, more acrimoniously, in more varied forums than in the glory days of the telco monopolies.

Standards now appear more clearly as what they have always been: one among many useful tools for achieving compatibility. The fragmented and diverse supplier industry structure of the 1990s, catering to the unquenchable demands of diverse user business communities, will willy-nilly rely more than in the past on other major tools for compatibility: interfaces, gateways and the like. Politically, there is little alternative, especially since, technically, the better, smaller, faster, cheaper electro-optical digital technologies are making the implementation of interfaces and gateways more attractive than the implementation of any but the most crucial standards.

It has always been so, even when the Bell System's and the Defense Department's rhetoric argued for perpetuation of the unitary telecommunications industry structure and for that industry's standards, essentially on the grounds that the world would come apart otherwise.

But, behind the rhetoric of systems analysis and of "The System is the Solution" with its intimations of the infallible superiority of top-down design by master minds, there always was the reality of the Bell System's true but expensive genius: its capacity to harness together technical (and institutional) cats and dogs of the most varied breeds and generations and make them pull as one team.

D. Beyond Compunications[11]: A Growing Zoo

What has changed since divestiture, but not because of it, is that there

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[11] For definition, see p. 11.

are ever more cats and more dogs and also zebras and mice and gorillas. In place of the veneer of orchestration that the Bell System and, one might add, the Defense Department, wore as their Emperor's Clothes, there is now visible a chaotic democratic process of political and marketplace accommodations, a process made relatively easier and more affordable by better, faster, smaller, cheaper, namely abundant electro-optical digital technology.

Folks accustomed to relative scarcity find it hard to adjust to relative abundance.

Let me illustrate this with a true story about the birth of modern computers. When I was an undergraduate in the late 1940s, I spent a couple of summers working at IBM's Watson Laboratory, then in Manhattan down the street from Columbia University. Way up my chain of bosses was a man named John McPherson, who had some responsibility for IBM's engineering. He also happened to be the son-in-law of IBM's founder, Thomas Watson. During that period, my mentor at Harvard was Howard Aiken who had, in 1944, unveiled what he called the Harvard Mark I computer and what IBM called the IBM Automatic Sequence Controlled Calculator.

Aiken built his machine with help from IBM, help he had negotiated with Thomas Watson some time after 1937. John McPherson told me he had been present at a meeting where Aiken presented his ideas to Watson. He said that he had counseled his father-in-law against supporting Aiken. I asked him why so. "Because", John told me, "my engineer's soul rebelled against the crazy idea of building a machine 90 per cent of which would be idle 90 per cent of the time". In contrast to McPherson's outlook, think about the pads of paper each of us owns, the books on our shelves, the telephones in our offices, the cars we drive, all of them unused most of the time: once things get convenient enough and cheap enough, the effectiveness of abundance (erstwhile wastefulness) overwhelms the efficiency of high load factor (latter-day miserliness).

What Group 3 FAX machines and the STU III secure telephone have in common is their evolutionary adaptation. Both apply the best available

electro-optical digital technology of their time to the design of terminal devices so smart in their specialized sphere that they are capable of grafting themselves onto and functioning through world network transmission standards adopted in pre-history that way antedates the T1 standard. In so doing, each fenced its political battle ground into a manageable arena.

Before I keep going ahead with this example, let me share the following prediction with you:

> "The probable simplification of the fac-simile [sic] system of Caselli, by which an exact copy of anything that can be drawn or written may be instantaneously made to appear at a distance of hundreds of miles from the original; and the countless other applications of electricity to the transmission of intelligence yet to be made, -- must sooner or later interfere most seriously with the transportation of letters by the slower means of post."[12]

The writer was the Postmaster-General of the United States, expressing himself in his annual report for 1872. So, by the late 1980s, after more than 100 years of repeated predictions of the imminent hegemony of FAX over the mail and other alternative transmission modes, after repeated failures including, most recently, failures to provide for compatibility acceptable to

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[12] *Annual Report of the Postmaster-General of the United States*. The Fiscal Year Ended June 30, 1872. Washington: Government Printing Office, 1872, p.30. The next paragraph vents the PMG's feelings on another matter with a contemporary ring to it: "Meanwhile, the immediate defects and abuses of the telegraph call loudly for reform. The system has grown up with and by the side of railroads, and has naturally directed itself to profitable and easily accessible districts. It has followed the march of civilization, and not, like the post office, led the van. It has waited for certain remuneration before advancing, without attempting to educate the people through its use to an appreciation of its advantages. On the contrary, its spirit has been too often illiberal and unprogressive. A glance at the telegraph map of the country shows large districts totally unprovided with telegraphic facilities, and many important places with post offices in their business centers dependent upon the outlying railroad stations for the means of telegraphing. the tariffs are exorbitant, unequal, and complex, supplemented in some cases by enormous charges for local delivery, and regulated entirely by the pleasure of the companies".

users and affordable by them, the FAX community, mostly the Japanese, managed to agree to graft terminal compatibility to the transparent lowest-common -- indeed nearly universal -- telecommunications denominator, namely the 3 - 4 khz analog voice POTS channel.

The STU III system likewise relies on terminals with a degree of smarts that would have been prohibitively expensive in the pre-LSI (Large Scale Integrated circuits) era. Compatibility decisions were fought out in the family, as it were, within the sheltered environment of a still-monopolistic Defense Department initiative supported by a small number of private companies, and again taking as given the universal availability and transparency of the POTS channel.

At the other extreme of broad-band high bit-rate data transmission, the computer industry's LANs and MANs have cut some Gordian knots that tie up progress by proliferating -- within essentially unregulated markets -- revolutionary and proprietary transmission systems that serve limited and mostly closed environments separated from one another by opaque partitions pierced, only when necessary, by front-ends, gateways or interfaces by still other names.

The filling in of the bleak middle between these lively extremes, now populated mostly by abortions like France's Minitel and numerous other failed teletext experiments in the United States, Europe and Japan, is among the stuff of controversies for the years ahead over the nature and timing of the diffusion, if any, of broadband services to mass markets within the framework of the traditional telecommunications industry.

ISDN of the 2B+D variety, as envisaged by the world's traditional telcos as of the turn of the 1990s, may be an idea that has no time in history. Group 3 FAX and STU III make do with much less than 2B+D ISDN. Television and top-of-the-line computer-to-computer communications have long since outgrown it. Or perhaps Group 4 FAX and 2B+D ISDN will bootstrap one another into life. Or perhaps 2B+D will bring abundance in the form of multiple phone lines or, more accurately, the equivalent of multiple phone lines, to homes as

well as to offices. For that to happen in the United States, regulations would have to change to enable phone companies to pass at least some of the ensuing revenues to their stockholders. And that's no small political order.

What about other approaches to broadband digital distribution? The broadband services reaching mass markets in the late 1980s do so through relatively new but already well entrenched media such as the cable companies with their coaxial cables and the video stores with their brown paper bags -- of practically unlimited bandwidth -- in which people cart home videotapes from every shopping area from Main Street America to the back roads of India. High capacity optical spines are already criss-crossing America. Various approaches to terminals with higher image definition than prevalent in the TV terminals of the late 1980s are contending for expansion into ever larger markets. The only certainty in all this is that controversy among suppliers will continue into the foreseeable future in every available political forum and every open market place.

V. Working Out Issues of the 1990s

Controversies over the nature and timing of the diffusion, if any, of broadband services to mass markets within the framework of the traditional telecommunications industry occur within the context of all information resources. Information resources as a whole cover much more territory than the traditional telecommunications industry, even including such upstart neighbors as the cable TV industry and the videotape distributors.

A. Telecommunications in the Context of Information Resources

FOIL 13: *The Basic Resources (Triangle)*

By information resources, I mean anything that has to do with the gathering, storing, transmitting, manipulating, displaying, or consuming of information or anything else that has to do with the production or use of information by any means whatsoever from chisel marks in stone to light in glass fibers. Information resources in that all-encompassing sense stand beside our other basic resources: energy and materials. Three assertions express the essential character of all three resources:

Without materials nothing exists.

Without energy nothing happens.

Without information nothing makes sense.

Clearly, these assertions express only necessary characteristics. Even with information nothing may make sense, but getting into what kind of information is sufficient for what is more appropriate to a talk about intelligence, command and control than to a talk about national politics and the telecommunications world. So, enough said about that.

FOIL 14: *The Harvard Information Business Map*

The Harvard Information Business Map helps to place the traditional telecommunications industry within the context of information resources,

visualized here as seen when dispensed by information businesses that sell their products and services to end users.[13]

Judgments about two factors determine the vertical and horizontal positions where information businesses are displayed on the map. Vertical position depends on the degree of continuing interaction of the buyer with the provider.

Pure services, where continuing interaction is of the essence, are at the top. Examples include government first class mail services and medical services of the diagnostic as distinct from the meat-cutting kind. The latter are material services rather than information services at all. Pure products which, once purchased, require no further interactions between the buyer and the provider, are at the bottom. Blank paper and books are both products.

Horizontal position depends on the extent of information value added by the provider. Government mail services, which normally deal with no more than address information are at the formal, left end of the horizontal axis. So is blank paper at the formal, left hand side. Diagnostic medical services and books, both of which are prized precisely for the information value they add, are at the right-hand, substantive end of the horizontal axis.

The circles denote the once clear-cut spheres of five more or less traditional industries whose boundaries have grown cloudy and whose futures have become intertwined with that of the traditional telephone common carrier industries. For instance, FCC actions over the last two decades opened up the market for what the telco monopolies once fought as foreign attachments when not rented from a telephone company but, instead, purchased outright from a consumer electronics (or industrial electronics) provider. What is now called customer premises equipment (CPE) includes plain old telephones (the legendary

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[13] For more detail about the Harvard Information Business Map, see McLaughlin, John F., with Anne Louise Antonoff. *Mapping the Information Business*. Cambridge, MA: Harvard Program on Information Resources Policy, P-86-9, 1986.

POTs) and private branch exchanges (PBXs), namely switches made with computers or computers acting like switches.

The gray area in which the five circles sit denotes what once was touted as the office-of-the-future. From the customers' standpoint the office of the future had more or less arrived by the end of the 1980s. From the standpoint of suppliers at the turn of the 1990s, the gray area is actually red with the blood both of AT&T honchos taking forced early retirement and of Crazy Eddy salesmen bailing out of that bankrupt former high roller of consumer electronics as the office-of-the-future area continues to roil and shake itself out.

B. Provider Stakes: Some Specifics

1. The Mysteries of Regulated Competition

FOIL 15: *The Post-Divestiture Traditional LEC Network*

In one respect, little has changed at the turn of the 1990s by comparison with the turn of the 1980s. Most of the traditional United States telecommunications network still looks like this foil, which is pretty much the way it looked at the turn of the 1980s. Except for the POTs and POPs (Points of Termination or Points of Presence) where local exchange carriers (LECs) like Bell Atlantic, Pacific Telesis or one of the thousand or so non-Bell carriers interconnect with Interexchange Carriers (IXCs) like AT&T, MCI or SPRINT, apparently little has changed. Even less than might appear has changed, since many of the POPs are still switches once wholly owned by AT&T but now shared between AT&T and the divested Bell LECs.

But more than might appear has also changed. Whole new optical and microwave spines built by AT&T, MCI, SPRINT and several carrier's carriers from whom the latter two lease facilities have come on the scene among points providing highly concentrated traffic. The LECs have replaced many of the switches that were in place before divestiture with more modern digital switches; more and more, these switches are interconnected by optical fiber where once cable and microwave were exclusive; and, increasingly, lots of

competitors are building fiber optic plant hoping to link up among themselves locations with highly concentrated traffic. Even lowly copper pairs have been jazzed up as T1 carriers.

Perhaps more important in the long run than the evolution of the traditional carriers is the largely invisible, largely unmeasured and perhaps unmeasurable proliferation, already alluded to on pp. 16 and 20, of LANs, MANs and WANs either built for or by users or at least controlled by them even when pieced together with some facilities leased from traditional carriers.

FOIL 16: *Criteria for Evaluating Alternative Costing Methods*

Still, so long as most of the measured money and traffic and plant still remain with the traditional carriers, as seems to be the case at the turn of the 1990s, the traditional games still get played, indeed more so. A key traditional game still played and played more so, is the game which translates political and policy muscle into prices as seen by customers and into revenues and market shares as seen by providers. This game has at its core the more or less regulated definition of the costs to which more or less regulated prices and revenues are tied -- more or less -- by the regulators, competitors and customers of the traditional telecommunications carriers.[14]

To the stakeholders involved, this game deals with the essence of financial success or failure. To the casual onlooker, however, the game looks about as fascinating as cleaning up Alaskan beaches by picking up oily sand grain by grain. I will spare you the details but flow over you some facets of their aggregation, like the list of 16 criteria on this foil. Of course the sixteenth is OTHER! The first fifteen, each of which is demonstrably dear to

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[14] For background and detail see:

Weinhaus, Carol L. and Oettinger, Anthony G. *Behind the Telephone Debates*, Ablex Publishing Corp., Norwood, NJ, 1988.

Silberberg, Jay L. *Alternative Telecommunications Costing Methods. Fundamentals and Discretion: A Fixed Allocator Separations Model*. Cambridge, MA: Harvard Program on Information Resources Policy, P-89-6, 1989.

Oettinger, Anthony G. *The Formula is Everything: Costing and Pricing in the Telecommunications Industry*. Cambridge, MA: Harvard Program on Information Resources Policy, P-88-2, 1988.

a live stakeholder, cover just about every stakeholder I have mentioned so far and every force and trend I have listed in earlier foils.

FOIL 17: *FCC Costing Rules*

This foil lists costing rules promulgated by the FCC. These set forth what costs are to be recovered from services regulated by the FCC, like interstate long distance calls, and what costs are left to be recovered from services regulated by the 50 states, the territories and the District of Columbia. Ultimately, within the overall framework of better, faster, smaller, cheaper technology, the details of the prices most customers pay and the definitions of the services they pay for have as much if not more to do with the battles over costs before the regulatory agencies, the courts and the legislatures than with scientific and technological factors such as those I mentioned in connection with T1 carrier and ISDN beginning on p. 11.

Although the details vary with each country's political and economic circumstances, similar games are played in every country, games that have a significant role in determining the relative market shares of the visible and the invisible network providers whom I sketched beginning on p. 25.

FOIL 18: *1980 Interstate Cost-Revenue Structure:Local Exchange Carriers*

This foil sketches the federal rules, effective at the turn of the 1980s, for determining what portion of LEC plant costs belong to what federal cost pool fed by what stream of federally regulated revenues. Hanging off to the right near the top of the diagram is a box that stands for what is left over from total LEC costs when federally regulated costs have been taken out. That leftover is called the "residual state costs".

If reality reflects rhetoric, one would expect the rules of the game to get simpler as deregulation progresses.

FOIL 19: *1985 Interstate Cost-Revenue Structure:Local Exchange Carriers*

Here is a picture of reality, vintage 1985. Deregulation has continued since then; so, clearly, has simplification -- at least in an Orwellian perversion of the word.

FOIL 20: *1985 Intrastate Cost-Revenue Structure:Local Exchange Carriers*

To complement the interstate, federally regulated picture, here -- for 1985 -- is a reasonably typical picture of detail about the disposition of the residual intrastate, state regulated residual cost.

FOIL 21: *Interstate Cost Per Minute:Fixed Allocator Costs*

We should emphasize the obvious inference to be drawn from the several preceding pictures: as far as the traditional telecommunications industry is concerned, what has taken place in the United States is not deregulation at all, but a changing pattern of greater and more varied government intervention, mostly drawn by the affected industries on themselves and on their competitors in the name of providing "level playing fields".

This foil illustrates how glaringly non-obvious the meaning of "level playing field" might be. It shows the wide variation, across the fifty states, of the size of just one among numerous cost elements woven into the larger patterns that I have just shown you on the preceding foils. Those advantaged by this pattern see it as a level playing field. Those disadvantaged by it see it as tilted. The essentials of the game are mostly the same all over the world. The details vary country by country according to each country's political and economic circumstances. But, the whole world over, life for both suppliers and customers has gotten more complicated since the good old days of the club. The old telecommunications club was full of excellent tree surgeons, very few of whom would know a forest if they felled one. The 1990s need to tip the balances between tree types and foresters toward the foresters.

FOIL 22: *Population Density of the States*

Let me illustrate the significance of that point with an example.[15] One of the demographic factors which varies across the states of the United States is the population density. On this foil, the white areas have less than 50

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[15] For further detail, see Note 1.

people per square mile; the cross-hatched areas have between 50 and 100 people per square mile; and the shaded areas have more than 100 inhabitants per square mile.

Please focus on Colorado, in the territory of the USWest Regional Holding Company. Like all of USWest's franchise territory, except the State of Washington, Colorado has a very sparse population. This suggests that political, technological and economic factors associated with traditional notions of what is rural influence decision making in Colorado. But, following that suggestion makes the behavior of USWest and of Colorado politicians seem fuzzy and unintelligible.

FOIL 23: *Population Concentration of the States*

Focusing instead on population concentration sharpens the image considerably. In this foil, white denotes less than 50 per cent urban population; cross-hatching denotes urban population making up between 50 and 60 per cent of the whole population; and shaded areas have more than 60 per cent of their people living in cities. From a telecommunications standpoint, Colorado is a strip running 10 miles or so north and south of Denver, plus some other isolated points of high traffic concentration like the Colorado Springs/Cheyenne Mountain area. Nowadays concentration, not density, is the key geo-demographic factor in the economics and the politics of telecommunications. That means you count congressmen, not senators, when you want to assess power in the United States Congress. Before the migrations from the farms to the cities or, within the last three decades, before the confirmation of "one person, one vote" by the Supreme Court in *Baker v. Carr*[16], you counted senators, not congressmen.

The tortured shape of the costing practices that I illustrated in the foils beginning on p. 26 reflects the tortuousness of a transition that is still ongoing. No one can understand all the subtleties of such things from any distance. That is why "rent-a-local" is such an essential ingredient of successful commercial and military tactics.

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[16] *Baker v. Carr*, 369 U. S. 186, 1962.

As I suggested in my brief sketches of the French, German and Japanese practices beginning on p. 6, the generics of relationships among technology, economics, politics, demographics, and so on -- but not the details -- all have their counterparts abroad. The resulting policy patterns therefore have sharply differentiated individual features within broad family resemblances.

FOIL 24: *Differences Among Service Definitions in Computer Inquiries I, II, and III*

For almost twenty years now, the FCC has been questing for the Holy Grail of a bright line between the telecommunications and the computer industries, in the style of politicians' promises of wars to end all wars. So far this has given us Computer Inquiries I, II and III. I fully expect that this means One, Two, Three Infinity, in the style of George Gamow's marvelous little book of many years ago.[17] The details of the shifting boundaries on this foil need not detain us here.[18] What matters is the vivid testimony this foil gives of dynamic and not static boundaries, just within the United States.

FOIL 25: *Market Structures of the U.S.A., Japan, U.K.*

This foil compares the telecommunications and computer industry market boundaries in the United States, Japan and the United Kingdom in the mid 1980s. The individual differences within family resemblances is all I mean to convey with this busy diagram. One of my former students, now a partner in a prestigious Washington law firm has a sign over his desk that reads "Litigation is war". The busyness of this foil reflects the richness of detail churned up over the years by what amounts to urban guerilla warfare not

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[17] Gamow, George. *One, two, three infinity*. New York : Bantam Books, 1967. Original publication: New York, Viking Press, 1947.

[18] For further detail, see Shukunami, Tatsushiro. *The Race for Value-Added Services: Challenges and Opportunities in the U.S., Japan and the U.K.*. Cambridge, MA: Harvard Program on Information Resources Policy, P-88-1, 1988.

only in the courts, the ministries, and the legislatures of the industrialized and industrializing nations, but also under their tables and in their back alleys.

2. Whither Compatibility? Whither Research and Development?

FOIL 26: *Promotion of OSI (Open Systems Interconnect) Standards and Cooperative Relationships (1986)*

By the late 1980s the diagram of relationships among the computer-industry-based entities interested in Open Systems Interconnect (OSI) standards had come to resemble in its elegant simplicity the clean cut schemes for carving up LEC costs described starting on p. 26. Whether all this churning does anything useful for anybody is still cloudy at the turn of the 1990s.

The SONET standard for high-capacity optical transmission under discussion in traditional telco forums at the turn of the 1990s essentially covers pre-existing practices under one umbrella and calls that the standard.

At stake for users is getting compatibility among such various pieces as they might want to pull together into one coherent system. At stake for providers is market share or profits or whatever the fashionable yardstick of the day might be. So, providers tend to be for or against compatibility of their products or services with somebody else's products or services according which way they think they'll win. Transponders, modems, codexes, interfaces, gateways or matchmakers by any other names are getting better, faster, smaller, cheaper in keeping with the main trend of electro-optical digital technologies. So are smart terminals.

So, users make do with whatever standards happen to be handy or else they mate their essential cats and dogs with gadgets called "cadogs" or "docats". The exclusive ideal of the clean Olympian top down standard, at best a figment of the technocratic imagination in the heyday of Bell Laboratories or of IBM Research's preeminence, nowadays reverts to an honored

place among numerous other tools for achieving compatibility. Hence, for better or worse, idiosyncratic compunications islands are likely to keep proliferating so long as new applications and major revampings of old applications keep coming on line.

FOIL 27: *List of Critical Technologies and Their Objectives*

As of the turn of the 1990s, the end is not in sight. Research and development in compunications sciences and technologies is alive and well, albeit no longer as concentrated within the United States as it became in the decades immediately after World War II. The list of technologies on this foil, drawn from a United States Defense Department report to the Congress, is preponderantly a list of compunications technologies.

FOIL 28: *Countries with Significant national R&D Efforts (other than the US, Japan, USSR; or NATO, or Warsaw-Pact Bloc)*

It is therefore not surprising that the list of countries aspiring to master these critical technologies includes not only the usual suspects, but also the more serious among the newly industrializing nations. This is another sphere where scattering and diversity have, at least at the turn of the 1990s, supplanted concentration and umiformity.

C. User Stakes in the Protection of Information Resources

There was a time when the story of national politics and the telecommunications world was the story of just a few providers: AT&T in the United States and the PTTs elsewhere in the world. So far, we have looked at implications of the luxuriant proliferation of providers. But at the turn of the 1990s, the users are in the saddle, so the story is mainly their story.

Actually, that story is impossible to tell, because it has become the story of everything. The pervasiveness of the application of compunications technologies across the full scope of human endeavor was once a hackneyed and distant hope that researchers expressed to flacks at budget time, much like

molecular biologists express their hope for cancer cures to flacks at budget time at the turn of the 1990s. But, at the turn of the 1990s, the pervasiveness of compunications technologies is a *fait accompli* as far as breadth of applications.

Vast frontiers remain, but they are along the depth and the complexity of applications. As World War II drew to a close, Vannevar Bush, one of the leaders of the application of science and technology to the winning of that war, wrote a report to the President of the United States looking forward to the role of science in peace. He called it Science: The Endless Frontier.[19] Looking forward into the 1990s, a similar report might be titled Complexity: The Endless Frontier.

There is no time here even to begin that report. I begin to wind down, instead, by sampling a set of issues that affects enough different user stakeholders to merit being considered as generic, namely issues about the protection of business information.

1. Types of Legal Protection for Business Information

FOIL 29: *Types of Legal Protection for Business Information*

Protecting information is not a new idea.[20] But the growth in the importance of information resources relative to energy and materials means a growth in the importance of protecting them. And the continuing trend to better, faster, smaller, cheaper electro-optical digital technologies throws the limelight once again on numerous balancing acts which had gone to sleep offstage during a period of relative stability.

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[19] First issued in 1945, the report is reproduced in the series: Cohen, I. Bernard (Ed.). Three Centuries of American Science. New York: Ayer, 1980.

[20] For further detail, see Branscomb, Anne W. *Nurturing Creativity in a Competitive Global Economy: Intellectual Property and New Technologies.* Cambridge, MA: Harvard Program on Information Resources Policy, P-88-4, 1988.

Thus, most of the modalities of legal protection shown on this foil have long histories.

FOIL 30: *U.S. Difficulties in Addressing Legal Protection Problems for Business Information*

The factors listed on this foil are among those which have brought back into the limelight the modalities of legal protection shown on the preceding foil. Notice the mix of domestic, international and universal flavors of these difficulties ...

FOIL 31: *U.S. Difficulties in Addressing Legal Protection Problems (cont.)*

... of which there are more than were listed on the first foil. This is one way of approaching the problems of protecting information: through the eyes of one set of toolmakers and their tools, lawyers in this instance. The danger is obvious. To a kid who has a hammer, everything in the world looks like a nail.

2. Telephone-Transaction-Generated-Information

FOIL 32: *Types of Telephone-Transaction-Generated-Information*

Another way of approaching the problems of protecting information is by focusing on some types of information.[21] This foils illustrates what we mean by telephone-transaction-generated-information.

FOIL 33: *Parties with a State in Telephone-Transaction-Generated-Information*

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[21] For further detail, see McManus, Thomas E. *Telephone Transaction-Generated Information: Rights and Restrictions*. Cambridge, MA: Harvard Program on Information Resources Policy, 1989. Not released in final version.

Here we see some of the parties who care about telephone-transaction-generated-information. The issues at stake for these folks range from all sorts of commercial rights - and who has them, through rights of privacy of a caller, through rights of privacy of a callee, to personal safety.

3. Decisions, Decisions

FOIL 34: *Decision Matrix of Strategies Concerning Security Product Development*

In the same days that were the good old days for the traditional telephone companies, people in the government worried about how to go about supplying users with information security products the government thought they might need. This foil shows some of the alternatives around which controversy swirled inside the government.[22] For better or worse, by the turn of the 1990s the decisions on this score were no longer exclusively the government's, if ever they had been. Here, as in the general realm of telecommunications, users had jumped into the saddle.

Not that this changed the fundamental balancing acts, which are everlasting, like the balancing act that Bob Herres, the Vice Chairman of the Joint Chiefs of Staff at the turn of the 1990s, sketched in the following words which he spoke as Commander of the Air Force Communications Service at the turn of the 1980s:

> " . . . [I]t seems that we're in some sort of dilemma: on the one hand, we must maintain the security and integrity of our sensitive information, but on the other hand we must be able to respond quickly to rapidly changing situations, especially during times of crisis or war. And this means that we must process and

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[22] Jelen, George F. *Information Security: An Elusive Goal.* Cambridge, MA: Harvard Program on Information Resources Policy, (P-85-8), 1985.

distribute information rapidly."[23]

Herres went on:

"We cannot let security considerations throttle our operational responsiveness, but we also cannot jeopardize sources of intelligence information, war plans, actions, or sensitive information by having some unknown hole in our security which could be exploited by some individual or group, quite undetectably."

Whether it's a civilian or a soldier sitting on them, the horns of this dilemma remain as sharp at the turn of the 1990s as they were at the turn of the 1980s or, for that matter, at the dawn of both business and warfare.

Still equally fresh, whether applied to business or to warfare, are George Jelen's words about the 1980s:

"Thus, responsibility and authority for information security within the government have been in something of a muddled state, divided along COMSEC-COMPUSEC lines and along national security-civil lines as well.

...

There is considerable divergence of opinion regarding how best to proceed. A basic question is whether COMSEC and COMPUSEC should be pursued separately or together. A disagreement over strategy reinforces the argument over separation. COMSECers tend to feel more comfortable with government sponsorship and classified environments. Computer security practitioners, on the other hand, tend to favor industry development and open environments."[24]

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[23] Robert J. Herres, "Overview of Computer Security Requirements," text of a speech included as Appendix C in: J. Barton DeWolf and Paul A. Szulewski (ed.), *Final Report of the 1979 Summer Study on Air Force Computer Security*, the Charles Stark Draper Laboratories, Cambridge, MA, Report Number R-1326, October 1979, pp. 132-133. As cited in Jelen, p. I-2.

[24] Jelen, pp. i - ii.

Finally, verities that Jelen gleaned from observers in the late 1970s also remain as fresh as ever, even more so:

> "Networks span the spectrum from collections of heterogeneous, autonomous host computers to groups of hosts operating under a single authority and cooperating to provide a coherent, supra-computer interface. Correspondingly, the types of measures provided for network security vary over a wide range, depending on the network environment."[25]

> "Generally security is a system problem. That is, it is rare to find that a single security mechanism or procedure is used in isolation. Instead, several different elements working together usually compose a security system to protect something."[26]

In the fragmented world of the turn of the 1990s, users who don't care about security don't support centralized efforts to provide one system in any literal technical or institutional sense. Those who do care, look after themselves with smarter terminals hooked up to telecommunications networks which, smart or dumb on the inside, are treated as dumb and transparent. The now ubiquitous Group 3 FAX machines and the STU-III secure voice system are the trend, not the aberration.

Indeed, pluralism and democratization of information resources are here to stay and, here's that word again, pervasive. Consider the following words:

> "Thanks to the advances in mass media and means of transportation, the world seems to have become more visible and tangible. International

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[25] S. T. Kent, "Network Security: A Top-Down View Shows Problems," *Data Communications*, June 1978, p. 97. Cited in Jelen, p. I-4.

[26] R. Stockton Gaines and Norman L. Shapiro, "Some Security Principles and their Application to Computer Security," *Operating Systems Review*, Association for Computing Machinery, 12 (July 1978): 19. Cited in Jelen, p. I-4.

communication has become easier than ever before. Today, the preservation of any kind of closed society is hardly possible. This calls for a radical review of approaches to the totality of the problems of international cooperation as a major element of universal security."[27]

The words are those of Mikhail Gorbachev, spoken to the United Nations in New York, on December 7, 1988. Could he then have foreseen the events of December 1989?

4. Two and a Half Cheers for Democracy.

FOIL 35: *Types of Rogue Programs*

We who are blessed with democracy also know its imperfections and, while moved to give only two and a half cheers for democracy, we nonetheless bless it in the face of the alternatives. One unpleasant facet of the democratization of information resources that has caught the popular imagination in the late 1980s is the potential for mischief by Everyman. This foil illustrates the type of mischief, from the prankish to the criminal, that has escaped into the everyday world.[28]

FOIL 36: *Motivation of Intruders*

Motivations for mischief likewise exhibit the diversity and the range that seem to characterize both the decade we are leaving and the decade we are entering. ...

FOIL 37: *Perpetrators*

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[27] Unofficial Transcript, Address to the United Nations General Assembly by Mikhail Gorbachev, General Secretary of the Soviet Union, New York, NY. Wednesday December 7, 1988.

[28] For further detail, see Branscomb, Anne W. *Rogue Computer Programs - Viruses, Worms, Trojan Horses, and Time Bombs: Prank, Prowess, Protection or Prosecution?* Cambridge, MA: Harvard Program on Information Resources Policy, I-89-3, 1989.

... And so does the collection of perpetrators exhibit the diversity and the range that seem to characterize both the decade we are leaving and the decade we are entering.

FOIL 38: *The Herger Bill, H.R.55: The Computer Virus Eradication Act of 1989*

And, where there are measures, can countermeasures be far behind? So, in the 1990s, everyone is in the Act!

5. First Aid for the Family Jewels

FOIL 39: *Protecting Information Resources:The Decision Process*

Whatever Congress may propose or even dispose, one of the underpinnings of a working democracy is that God helps those who help themselves. But how are the mass of users, in business or in government, to know what to protect and how to protect it? There is no lack of hammers, pliers, paper mills, snake oil or other implements and their salespeople. There has been nothing by way of even a minimal checklist that a CEO or equivalent from the kitchen to the kitchen cabinet might use to figure out whether anything needs doing and, if so, what options might be handy.

My concluding remarks draw on the work of Daniel Knauf on precisely this subject. This foil outlines the key steps in the protection decision process.[29]

FOIL 40: *Protection Priority*

As this foil indicates, priority for protection depends on both the value of whatever information resource is being considered for protection and on the vulnerability of that information resource to whatever might harm it.

FOIL 41: *Value and Vulnerability of Information Resources*

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[29] For further detail, see Knauf, Daniel. *The Family Jewels: Corporate Policy on the Protection of Information Resources*. Cambridge, MA: Harvard Program on Information Resources Policy, a work about to be circulated for review.

This foil aims to convey that both value and the vulnerability of information resources -- hence the need for protection -- are context-dependent concepts. For instance, the degree of sensitivity of a company about knowledge of certain technical information by its competitors might determine the value of that information. How susceptible that technical information is to stealing by the competition or leaking by an employee might determine the vulnerability of that technical information.

FOIL 42: *Protection Need: Value and Vulnerability*

As this foil shows, value has many dimensions, whose importance varies, of course, with the beholder. Assessment of value is therefore inevitably a political act, with the politics ranging from the lowest of low politics in the kitchen to the highest of high politics in the kitchen cabinet.

FOIL 43: *Protection Need: Vulnerability to Threat By*

Vulnerability likewise has many dimensions, first of all under the heading of possible threats, as shown in this foil.

FOIL 44: *Protection Need: Vulnerability to Threat of (Susceptibility to)*

Other dimensions of vulnerability are under the heading of susceptibility. If I am not susceptible to public disclosure of certain personal information about me, I am invulnerable to your threat to divulge it. Or to use another example, I am less susceptible to damage to a well-backed up computer system than to damage to a unique system with no backup.

FOIL 45: *Protection Method: Adequacy and Cost*

Assuming that you've satisfied yourself of your need for protecting your information resources, there remains the task, illustrated by this foil, of finding an adequate and affordable method of protection. This then, is the point at which you are ready to consider the tools offered by all the specialists from lawyers to techies, or missing altogether from the panoply of the day.

Our tasks have just begun.

FOIL 46: *U.S. State Information Protection Legislation*

And,as this last foil shows, for better or worse, it's no longer lonesome out there.

FOIL 47: *U.S. State Information Protection Legislation: Topics*

All the states are dealing with the broad range of topics shown on this foil.

FOIL 48: *Ending Foil*

Appendix

VI.Affiliates list

March 1990

PROGRAM ON INFORMATION RESOURCES POLICY

Harvard University

Center for Information Policy Research

Affiliates

Action for Children's Television
American Newspaper Publishers Association
American Telephone & Telegraph Co.
Ameritech Publishing
Anderson, Benjamin, Read & Haney, Inc.
Apple Computer, Inc.
Arthur D. Little, Inc.
Auerbach Publishers Inc.
Bell Atlantic
Bell Canada
BellSouth Corporation
Boice Dunham Group Inc.
Bull, S.A. (France)
Centel Corporation
Chronicle Broadcasting Company
CMC Limited (India)
Communications Workers of America
Computer & Communications Industry Assoc.
Data America Corp.
Dialog Information Services, Inc.
Digital Equipment Corp.
Dow Jones & Co., Inc.
France Telecom
Gannett Co., Inc.
Gartner Group, Inc.
GTE Corporation
Hitachi Research Institute (Japan)
Honeywell, Inc.
IBM Corp.
Information Gatekeepers, Inc.
Information Industry Association
International Data Corp.
International Resource Development, Inc.
Invoco AB Gunnar Bergvall (Sweden)
I.T. Direction Ltd. (UK)
Knowledge Industry Publications, Inc.
Lee Enterprises, Inc.
John and Mary R. Markle Foundation
MCI Telecommunications, Inc.
Mead Data Central
MITRE Corp.
National Telephone Cooperative Assoc.
The New York Times Co.
NEC Corp. (Japan)
Nippon Telegraph & Telephone Corp. (Japan)
Northern Telecom Ltd. (Canada)
Nova Systems Inc.
NYNEX
OTC Limited (Australia)
Pacific Telesis Group
Public Agenda Foundation
Research Institute of Telecommunications and Economics (Japan)
RESEAU (Italy)
Rhode Island Public Utilities Commission
Rizzoli Corriere della Sera (Italy)
Saint Phalle International Group
Salomon Brothers
Scaife Family Charitable Trusts
SEAT S.P.A. (Italy)
Southern New England Telecommunications Corp.
State of California Public Utilities Commission
State of Minnesota Funding
TEKNIBANK S.p.A. (Italy)
Telecom Australia
Telecommunications Research Action Center (TRAC)
Tele/Scope Networks, Inc.
Third Class Mail Association
Times Mirror Co.
United States Government:
- Department of Commerce
  - National Telecommunications and Information Administration
- Department of Defense
  - National Defense University
- Department of Health and Human Services
  - National Library of Medicine
- Department of State
  - Office of Communications
- Federal Communications Commission
- General Services Administration
- National Aeronautics and Space Administration
- National Security Agency
- U.S. General Accounting Office
- United States Postal Rate Commission

United Telecommunications, Inc.
US West
Wolters Kluwer

VII. The Observer Observed: Why Believe Any of This?

How best to navigate the chaos and the controversy of rapid change? With charts, of course. Whose charts? The adversary's? Another military service's? A competing contractor's? Of course not. With charts made by competent and impartial observers of the changing information world. And where, pray tell, be there such competent and impartial observers of the changing information world? Of course at the Harvard Program on Information Resources Policy, yours truly, Anthony G. Oettinger, chairman, at your service.

In all seriousness, my colleagues at the Program and I set out, over 15 years ago, to create a climate that would favor research, both competent and impartial, on controversial matters of importance to stakeholders. Ideally, the findings of this research could be trusted by any stakeholder or by any bystander and could therefore aspire to being useful to any stakeholder or bystander.

Competence alone is no great problem. There are, fortunately, still lots of very competent people in the world. But competent people tend to be partial to what they are competent in. Why not? That's why they bothered to get good at whatever they are doing wherever and however they are doing it.

Impartiality alone is no great problem either. Just as all roads get you there if you don't care where you're going, so it's easy to be impartial when you don't know anything. With all the incompetence around us, impartiality is no big deal.

But combining competence and impartiality is a problem. So much of a problem that it is but rarely even tackled. It is not enough to hang out a shingle that proclaims, Snoopy like, that "The competent impartial adviser is in!". The only stakeholders who fail to look behind such a shingle are in the market merely for file stuffers. Even stakeholders who care about no more than covering their asses will look for something more substantial than shills' shingles to cover them with. And stakeholders truly concerned about

the competence and the impartiality of the advice they buy ask many questions. Among the first of these questions is "who owns you?".

My associates and I have tailored what still seems to be a unique process for addressing "who owns you?" and other questions that stakeholders who want competent and impartial advice ask about their advisers. We are eager to share our recipe with anyone interested.

The process has many components, each responsive to some question about impartiality or about competence. Since bills have to be paid, answering "nobody" to "who owns you?" only invites raised eyebrows as in the presence of fools or knaves. Thus "nobody" is an impractical or a deceitful answer to "Who owns you?". "Some" as an answer to "Who owns you?" is the very essence of partiality. Only being owned by everybody means being owned by nobody. Aspiring to that is getting as close to Olympian detachment as is practical in the fallible mortal world.

We have therefore deliberately sought our research money both in small doses and from the widest variety of sources that we can convince to contribute. We aim for competing industries and for competitors within industries. Where relevant, we go for the military as well as the civilian. We like both public and private contributors, both domestic and world-wide contributors, both small and large contributors, and so on.

The list in Section VI gives a snapshot of where the money came from in January 1990. The most astute of concerned stakeholders also ask us if there is any money that is <u>not</u> on that list and the answer to that is "no!".

Besides impartiality, small amounts of money flowing from many sources also help toward another quality that we prize: resistance of our research activities to the money droughts that take place when this or that source dries up from the ins and outs of fashions and of incumbencies. Our contributing stakeholders themselves have come to value this statistical stability. We can stay with them through their droughts, and we can provide a trusted communal memory that they would otherwise lack. History does not

repeat itself, but history sure helps ask questions that one might otherwise never think of asking.

And, since the money comes in annual contributions, it keeps up pressure on us to stay relevant to the collective of the stakeholders.

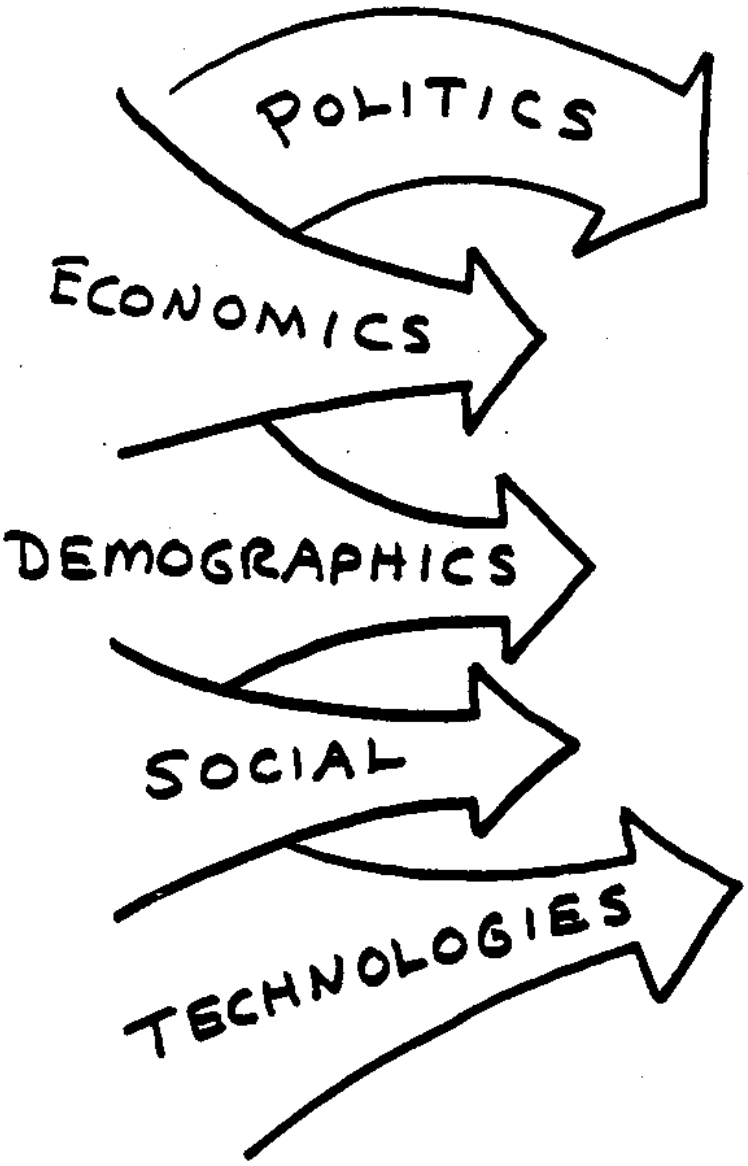
National Politics & Telecommunications

April, 1990

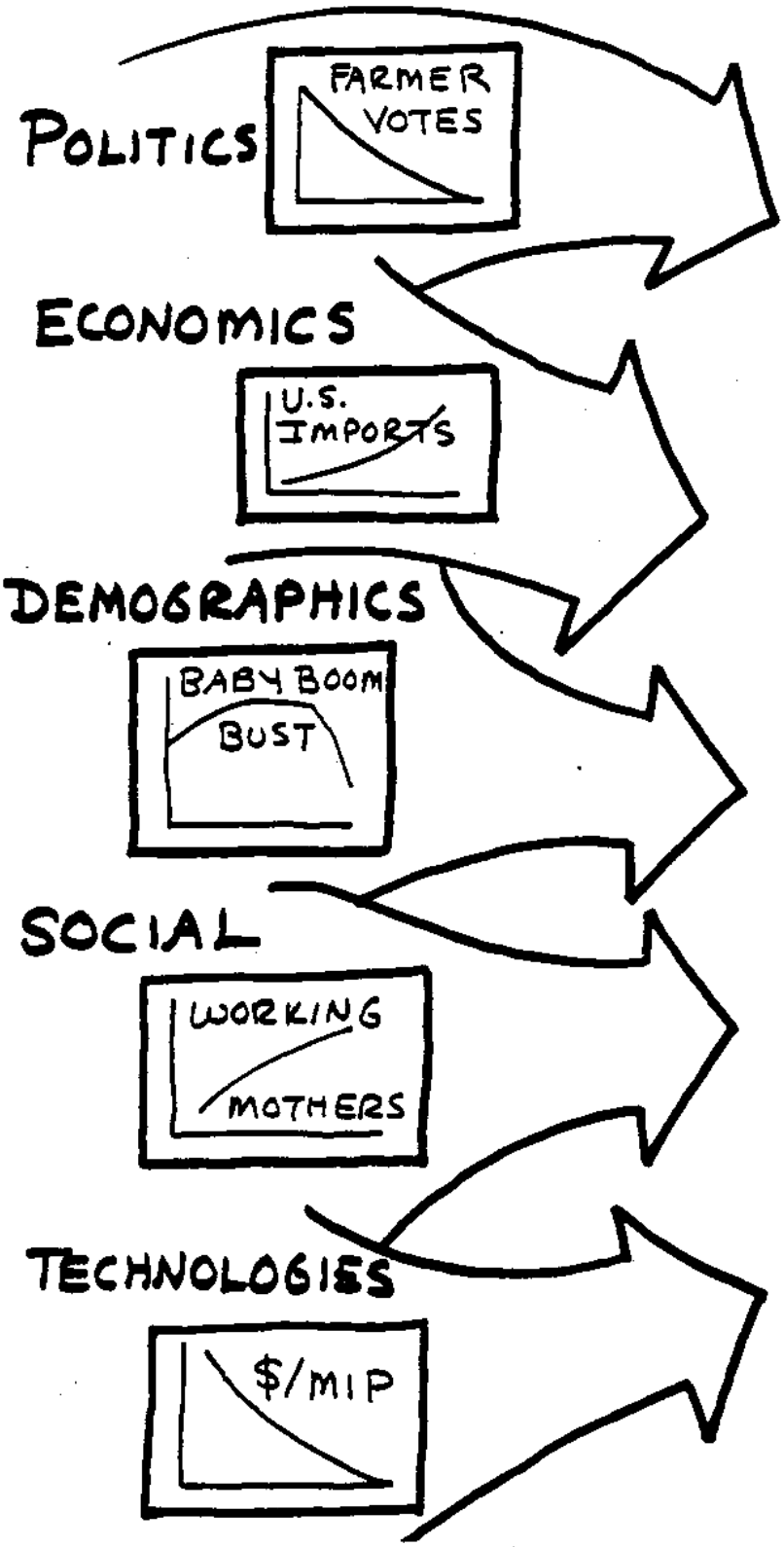
Anthony G. Oettinger

Chairman, Program on Information Resources Policy, Harvard University

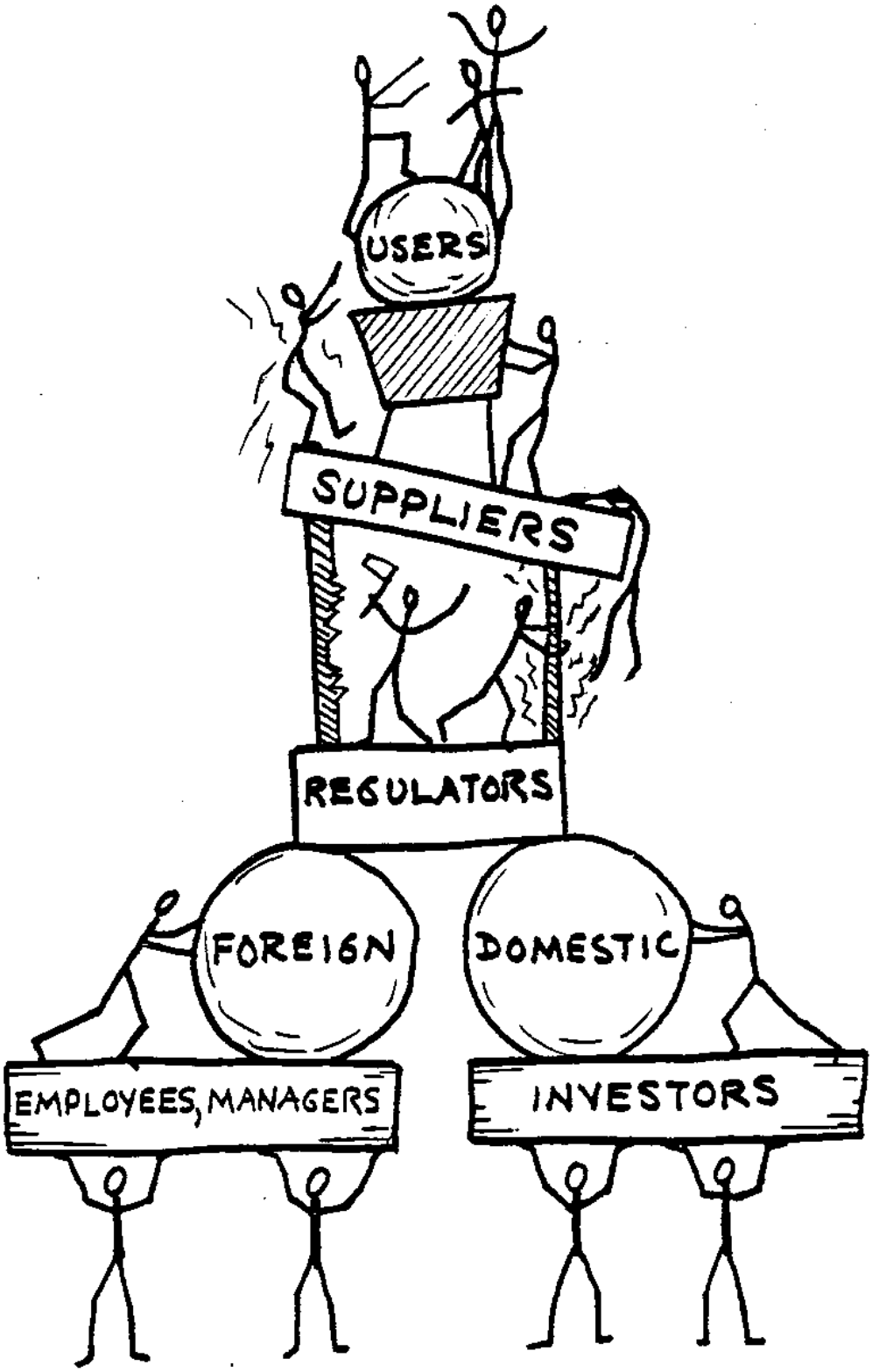
FORCES & TRENDS



FORCES & TRENDS: HINTS OF DETAIL



STRUCTURES AND STAKEHOLDERS

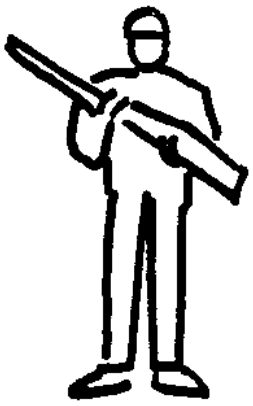


STAKES

MONEY

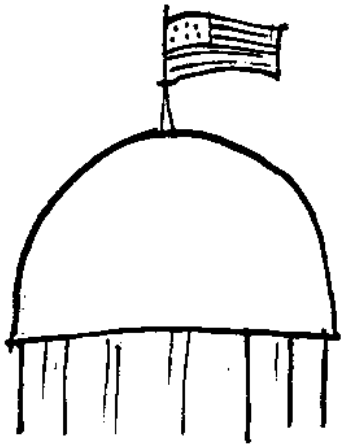
POWER

JUSTICE



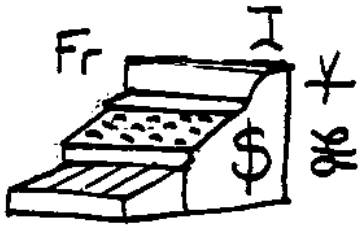
NATIONAL SECURITY

BATTLEFIELDS



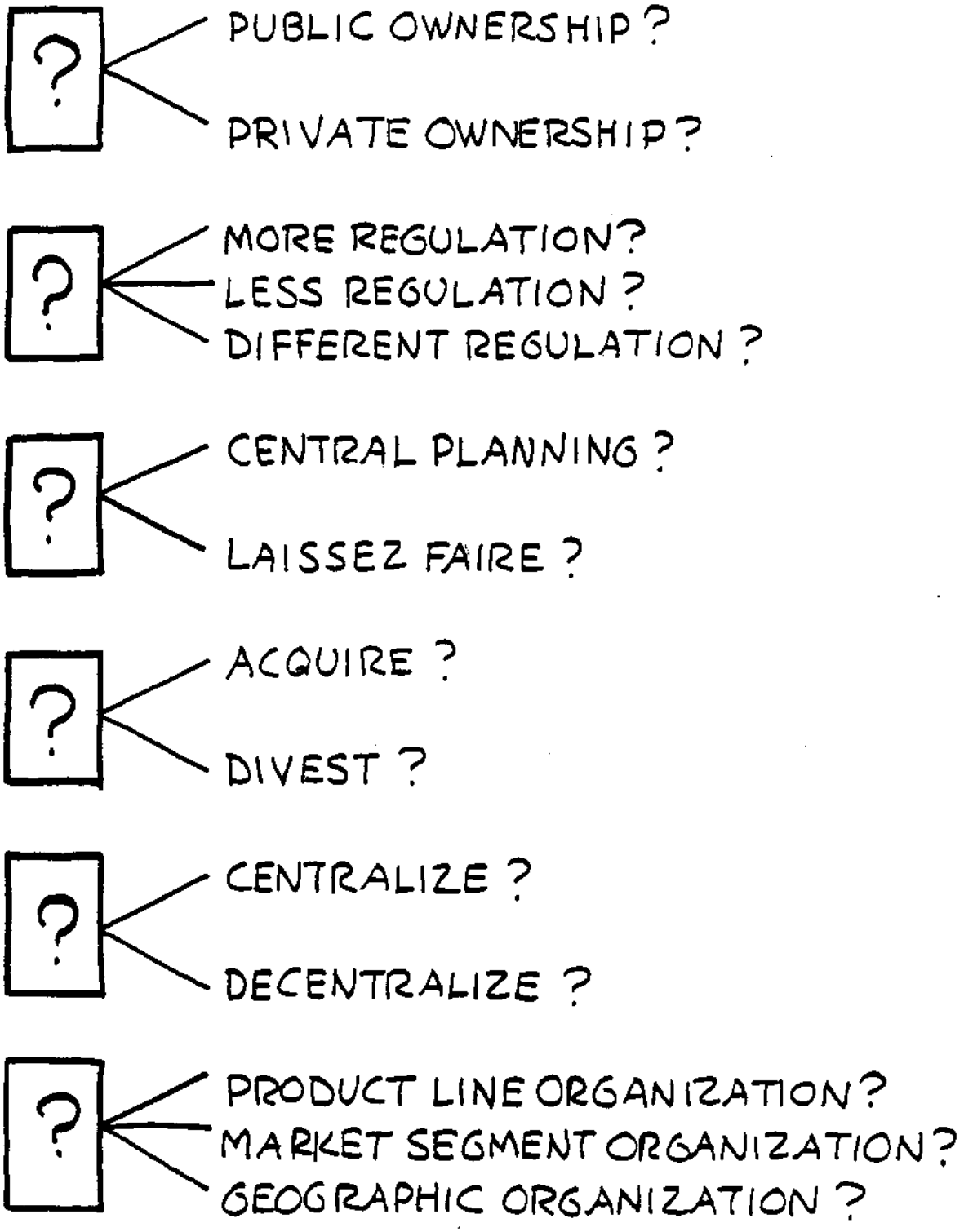
CONGRESS
PARLIAMENTS
STATE LEGISLATURES

DOMESTIC, FOREIGN
INTERNATIONAL REGULATION BODIES

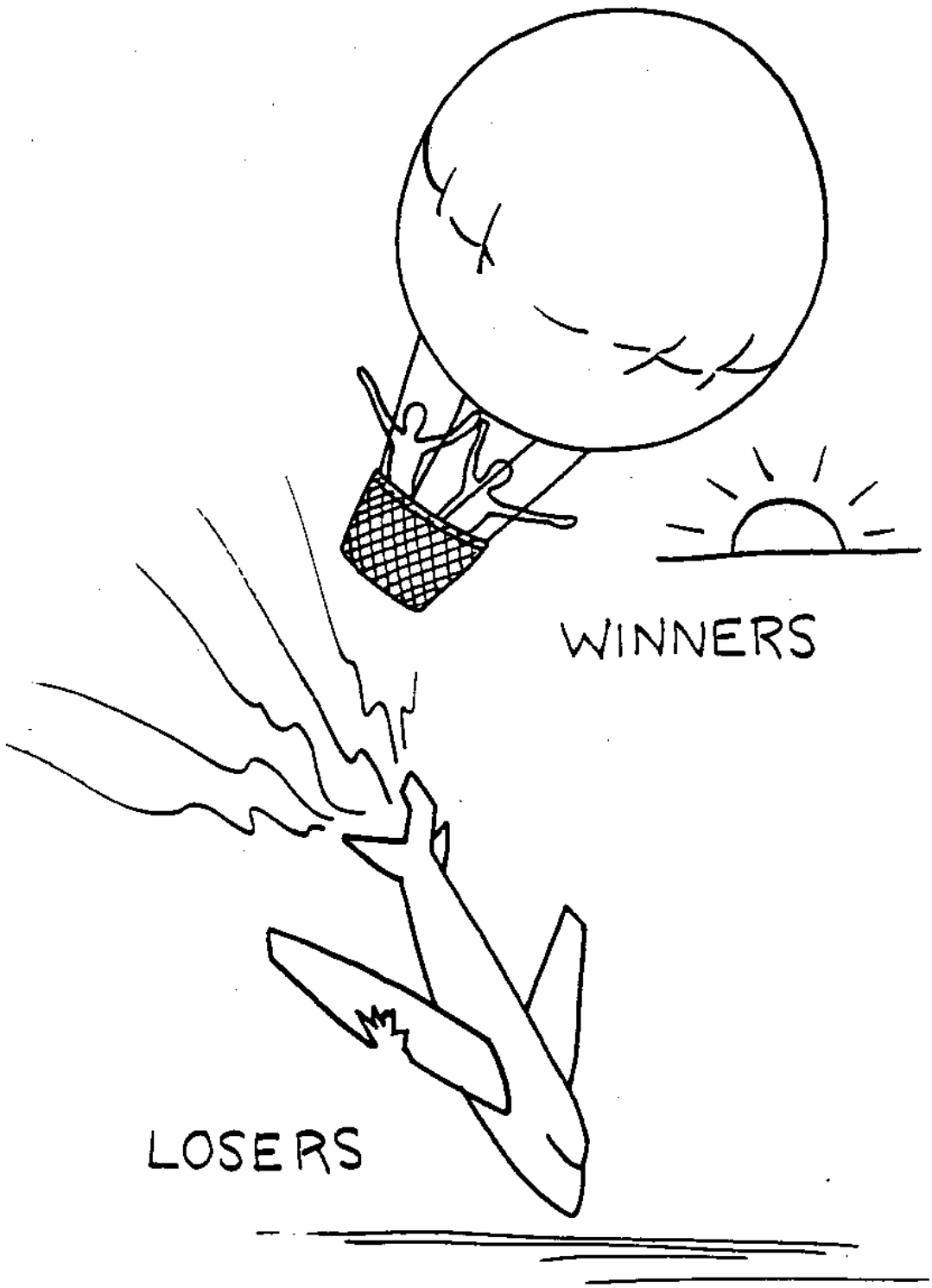


MARKETS

OPTIONS



IMPLICATIONS



T1 and the Exercise of Discretion

1 sample = 8 bits (bit positions)

24 circuits x 8 bits per circuit sample = 192 bits

192 bits + 1 synchronizing bit = 193 bits

8,000 samples needed per second x 193 bits per sample
= 1,544,000 bit positions per second
= 1.544 megabaud

1 T1 Channel = ISDN's B-Channel

18,000 samples per second

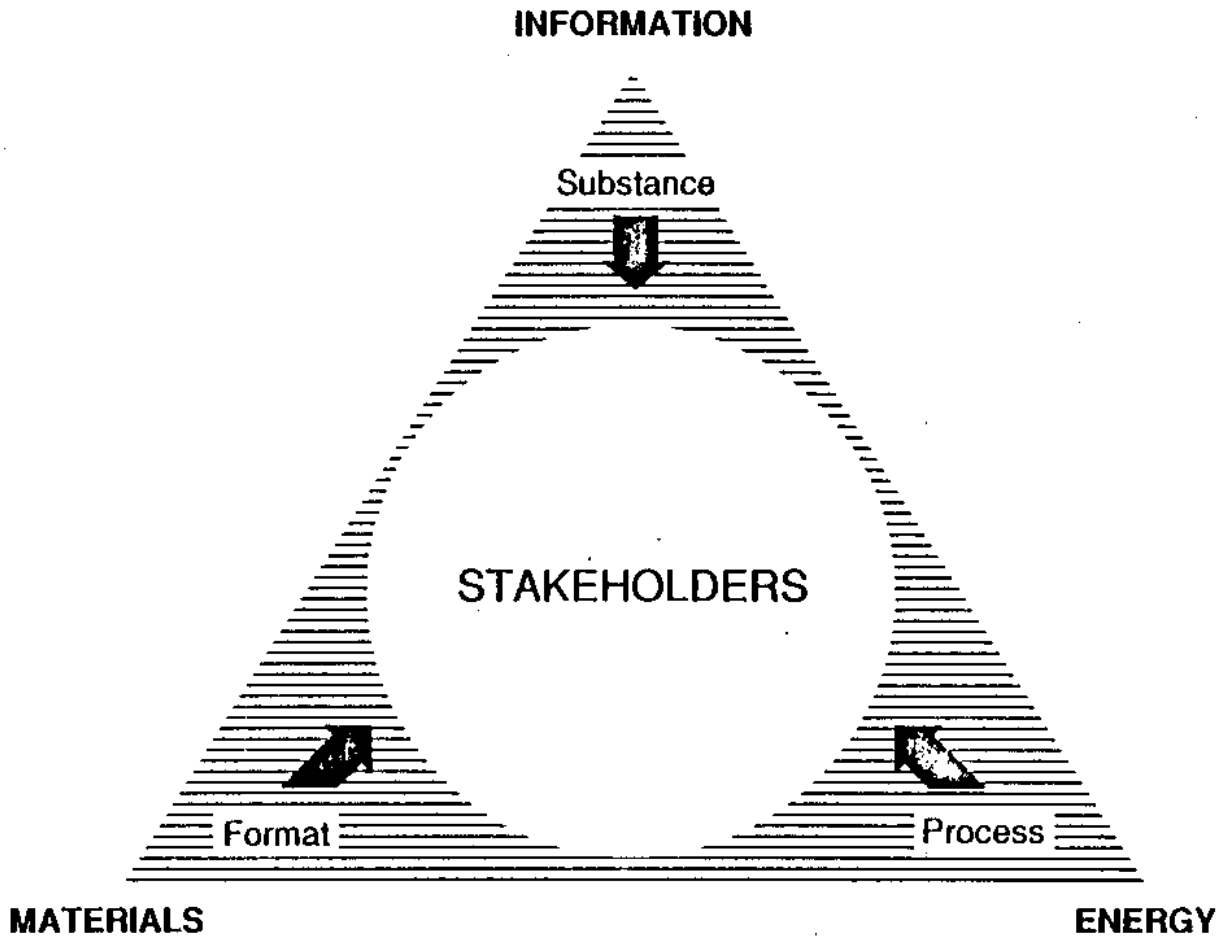
x

8 bit positions per sample

=

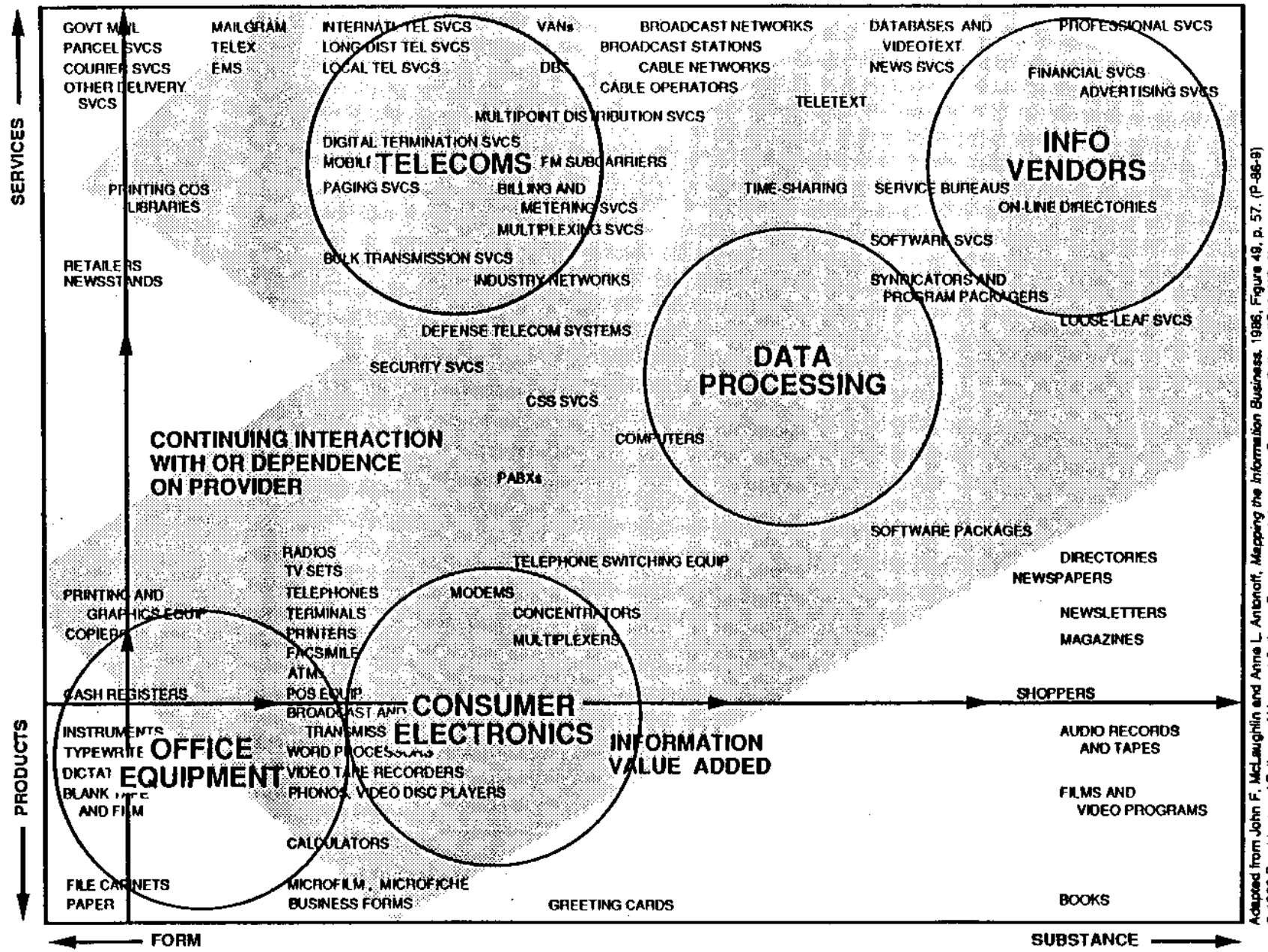
64,000 bit positions per second

The Basic Resources



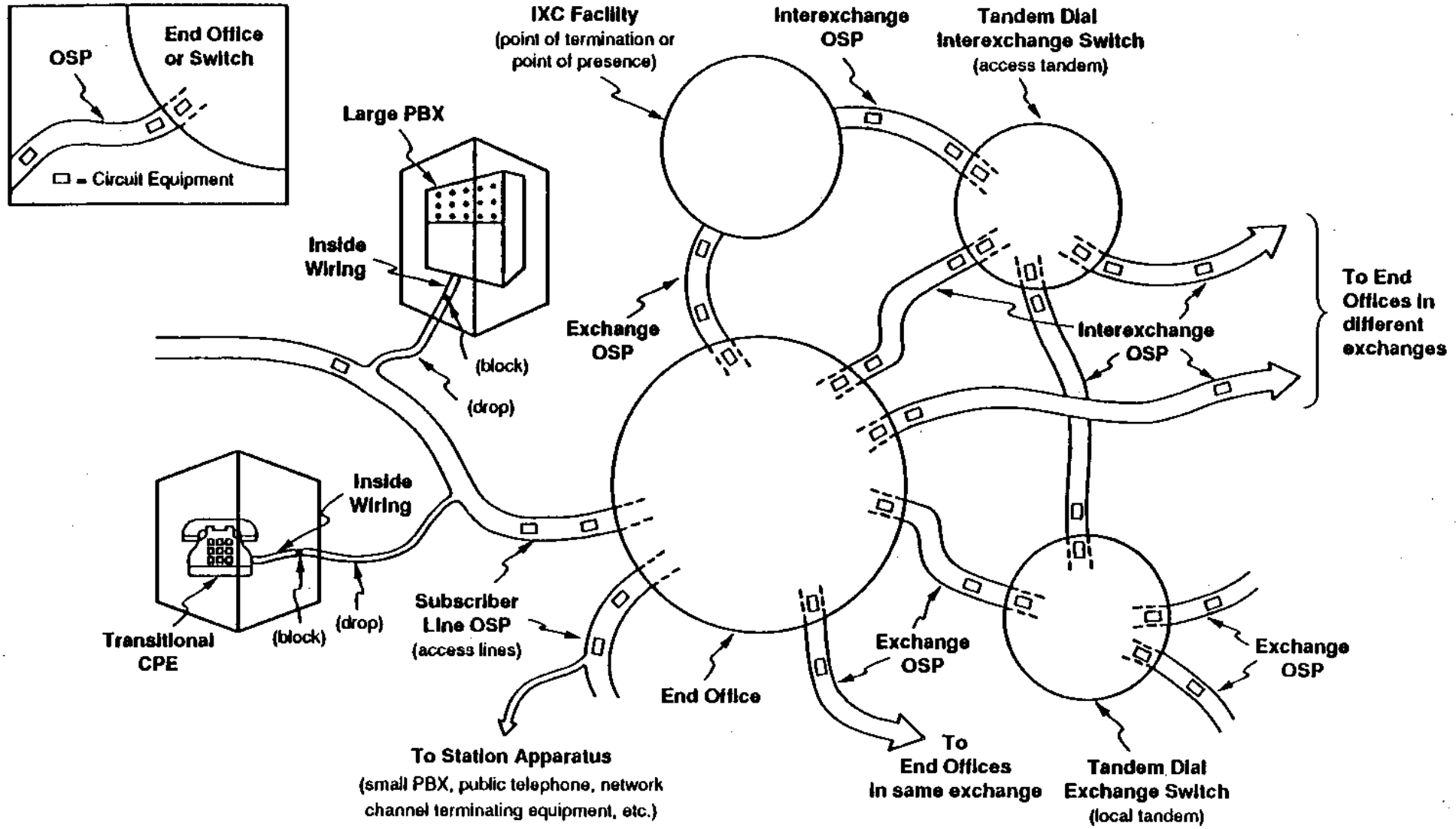
- Without materials nothing exists
- Without energy nothing happens
- Without information nothing makes sense

The Harvard Information Business Map



Adapted from John F. McLaughlin and Anne L. Antonoff, *Mapping the Information Business*, 1986, Figure 49, p. 57. (P-86-9)

The Post-Divestiture Traditional LEC Network



Source: Jay L. Siliberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model*. 1989, Figure 3-1, p. 72. (P-89-6)

Criteria for Evaluating Alternative Costing Methods

1. Consistency with the goals of the FCC access proceedings:*
   - Preserve universal service
   - Deter uneconomic bypass
   - Promote economic efficiency
   - Eliminate interstate service pricing discrimination
2. Consistency with goals of state commissions
   - Local rate stability
   - Social contracts
   - Other alternatives to RBROR regulation
3. In
4. In
5. Re
6. In
   - Synchronized costing and pricing methods
   - Market-based pricing for competitive services
7. Effect on pressures to deaverage interstate toll prices
8. Effect on location of intelligence in or outside the network
9. Effect on regulatory costs
10. Flexibility to deal with changing types of uses
11. Effect on owners and debtholders
    - Preservation of stock value
    - Impact on dividend level and interest coverage
12. Impact on competitors
13. Impact on employees
    - Wage or benefit adjustments
    - Employment levels
14. Impact on business climate through service offerings and prices
15. Effect on development and offering of new services
16. Other

* In the Matter of MTS and WATS Market Structure Phase I, CC Docket No. 78-72, Memorandum Opinion and Order, 97 FCC 2d 682 (1983), at Para. 3.

Source: Jay L. Silberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model*. 1989, Figure 4-9, p. 108. (P-89-6)

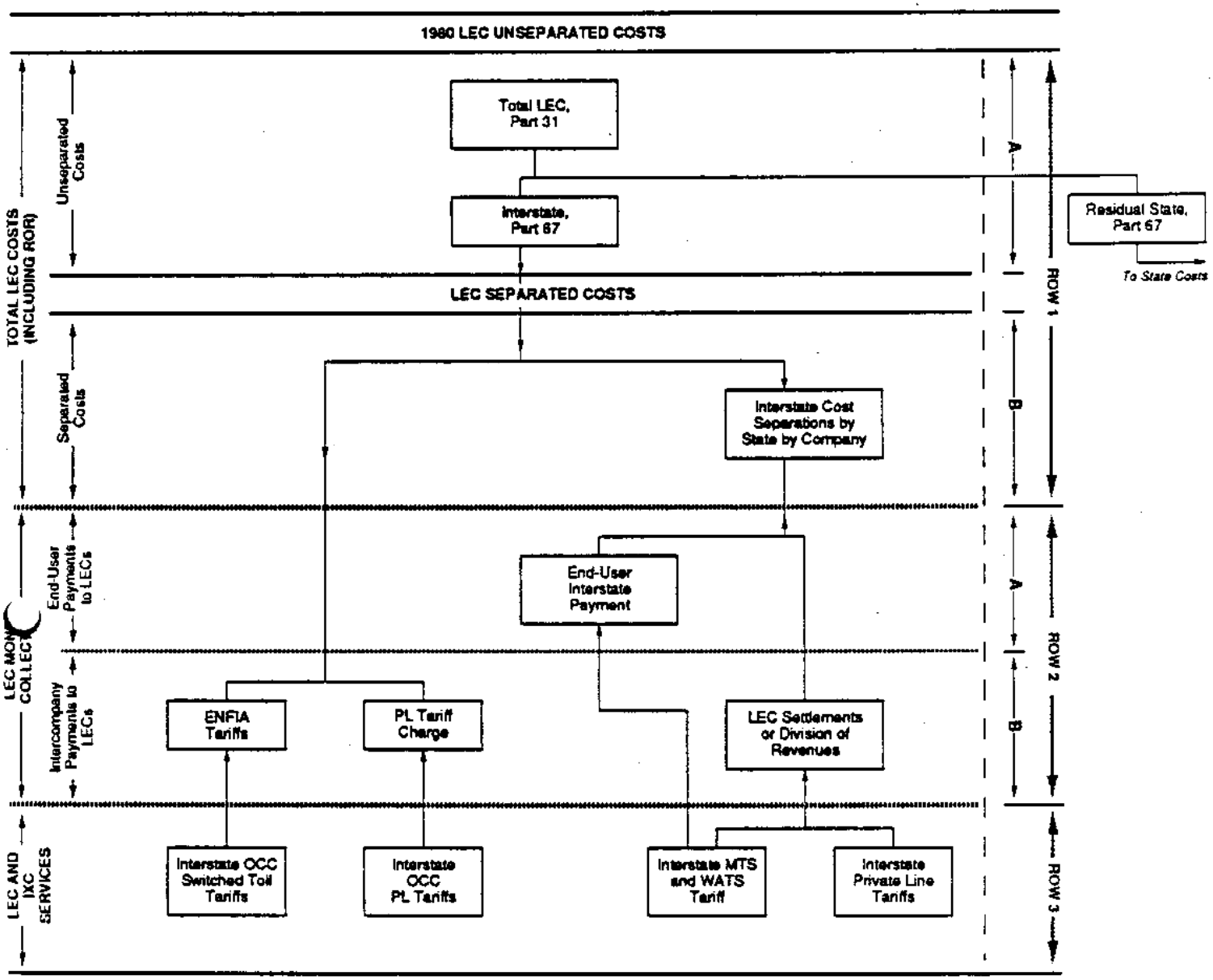
FCC Costing Rules

47 CFR, FCC Part No.	Title	Subject	Effective Dates	Relevant Dockets in Late 1980s
Part 31	USOA (Uniform System of Accounts)	Financial accounting rules	1933 – 1987	—
Part 32	USOAR (Uniform System of Accounts, revised)	Financial accounting rules	1988 –	CC Docket 78-196
Part 67	Jurisdictional Separations (Separations Manual)	Assignment of costs to inter- and intrastate jurisdictions	1947 – 1987	CC Dockets 78-72 and 80-286
Part 36	Jurisdictional Separations (Conformed to Part 32 USOAR)	Assignment of costs to inter- and intrastate jurisdictions	1988 –	CC Dockets 78-72, 80-286 and 86-297
Part 64	Nonregulated Accounting — "Part X"	Accounting for nonregulated activities by dominant carriers	1987 –	CC Docket 86-111
Part 65	Net Income and Rate Base Prescription	Interstate ratemaking adjustments	1988 – *	CC Docket 86-497
Part 69	Access Charges	Allocation of interstate costs to access elements, definition of access elements	1984 –	CC Dockets 78-72 and 87-113

* Previously covered by CC Docket 19129, Final Decision and Order, adopted February 23, 1977. In the Matter of American Telephone and Telegraph Company, the Associated Bell System Companies, Charges for Interstate Telephone Service, AT&T Transmittal Nos. 10989, 11027, 11657.

Source: Jay L. Silberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model*, 1989, Figure 1-1, p. 5.
Harvard University Program on Information Resources Policy. (P-89-6) (NS16)

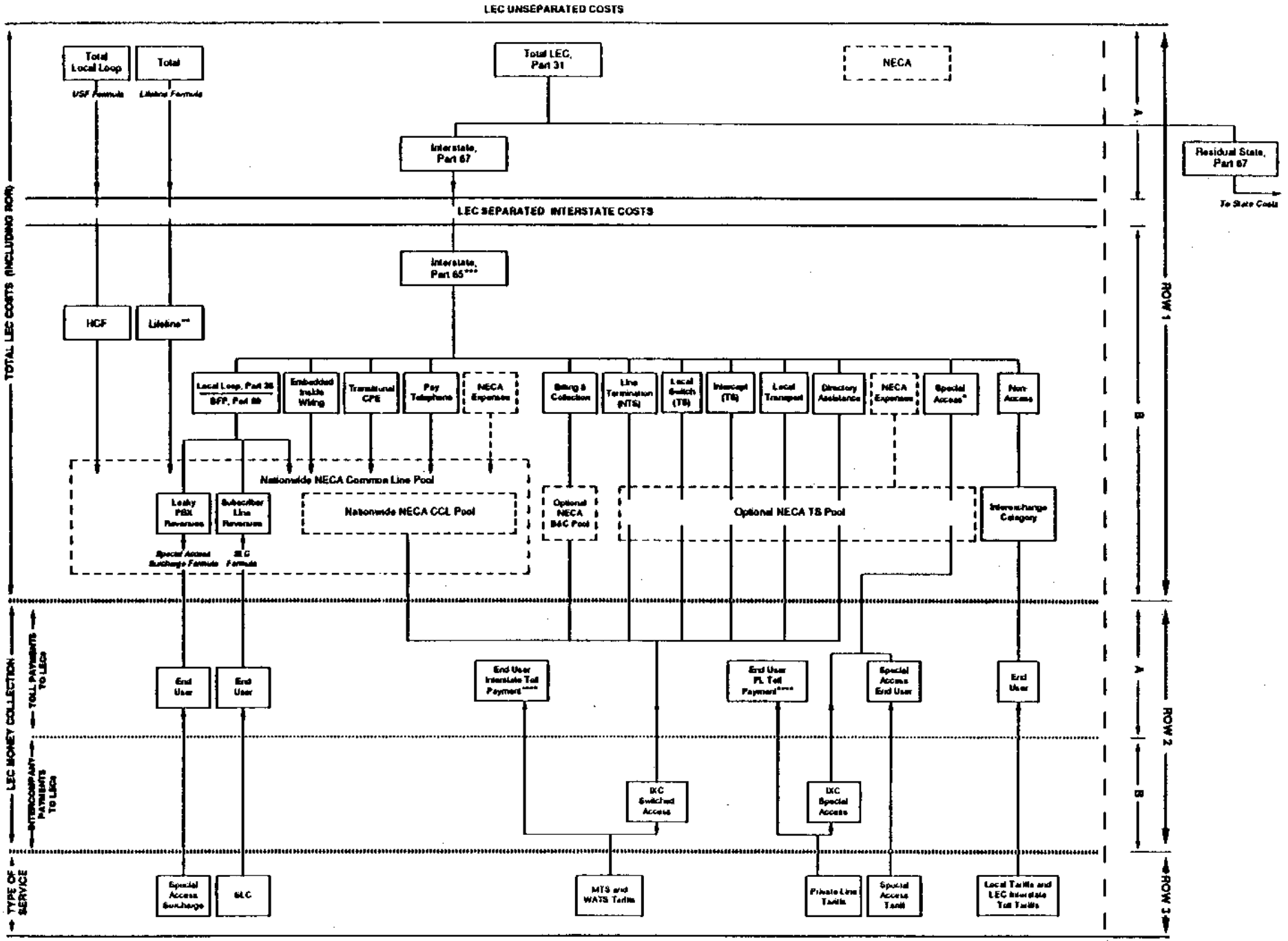
1980 Interstate Cost-Revenue Structure: Local Exchange Carriers



Notes:
Part 31: USOA, basic accounting
Part 67: Jurisdictional Separations

Source: Jay L. Silberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model*, 1989, Figure 1-5, p. 36.

1985 Interstate Cost-Revenue Structure: Local Exchange Carriers

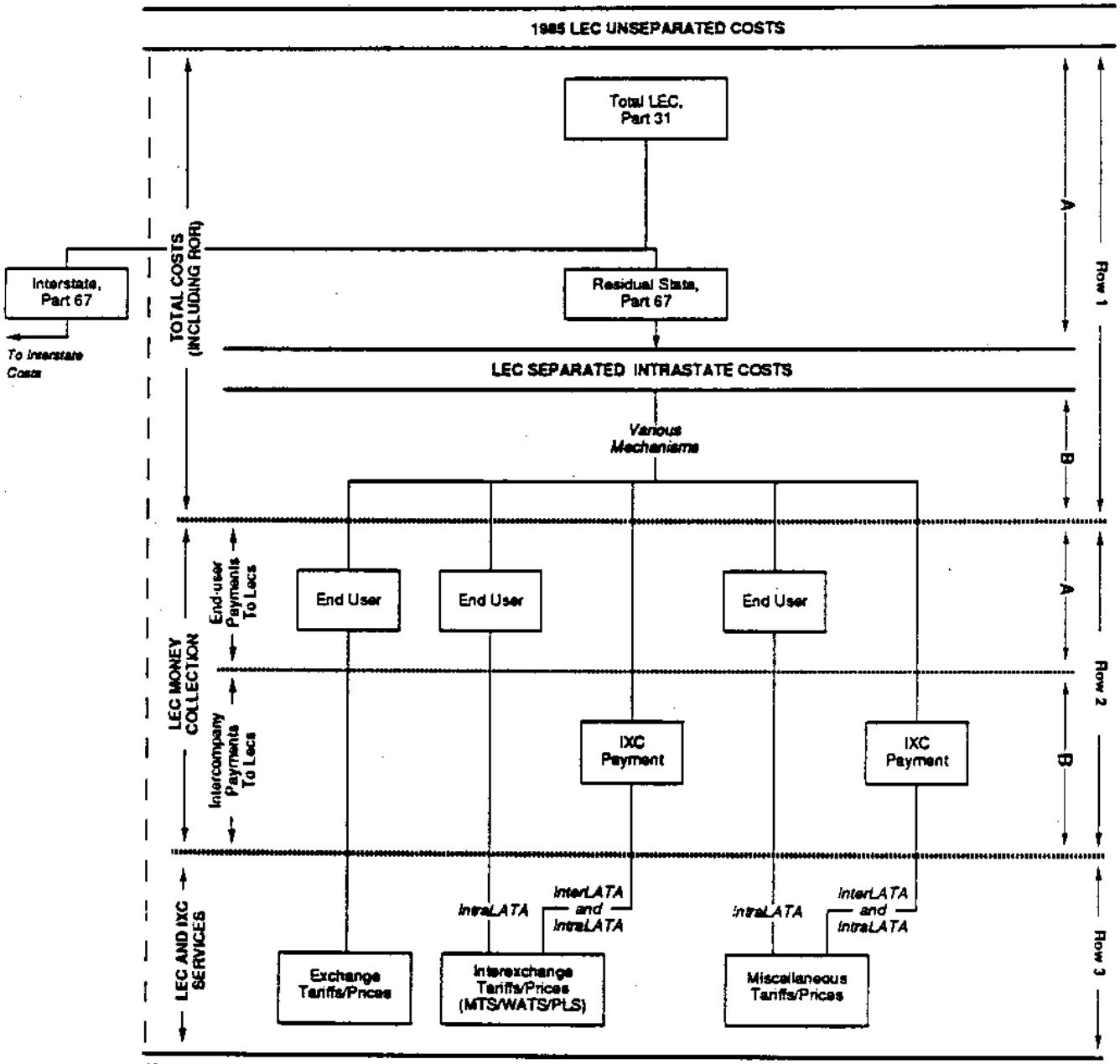


Notes: *Special access rates, included in optional TS pool, effective April 1, 1985
**Lifeline 1: December 19, 1984; Lifeline 2: December 10, 1985.
***Includes common line costs
****End-user payments collected by LECs for IXCs.

Part 31: Basic accounting
Part 65: Interstate rate-making adjustments
Part 67: Jurisdictional separat

Source: Jay L. Silberberg, *Fundamentals and Discretion. A Fixed Allocator Separations Model*, 1988, Figure 1-6, p.37. © 1989 President and Fellows of Harvard College. Program on Information Resources Policy. (NS18)

1985 Intrastate Cost-Revenue Structure: Local Exchange Carriers



Notes:

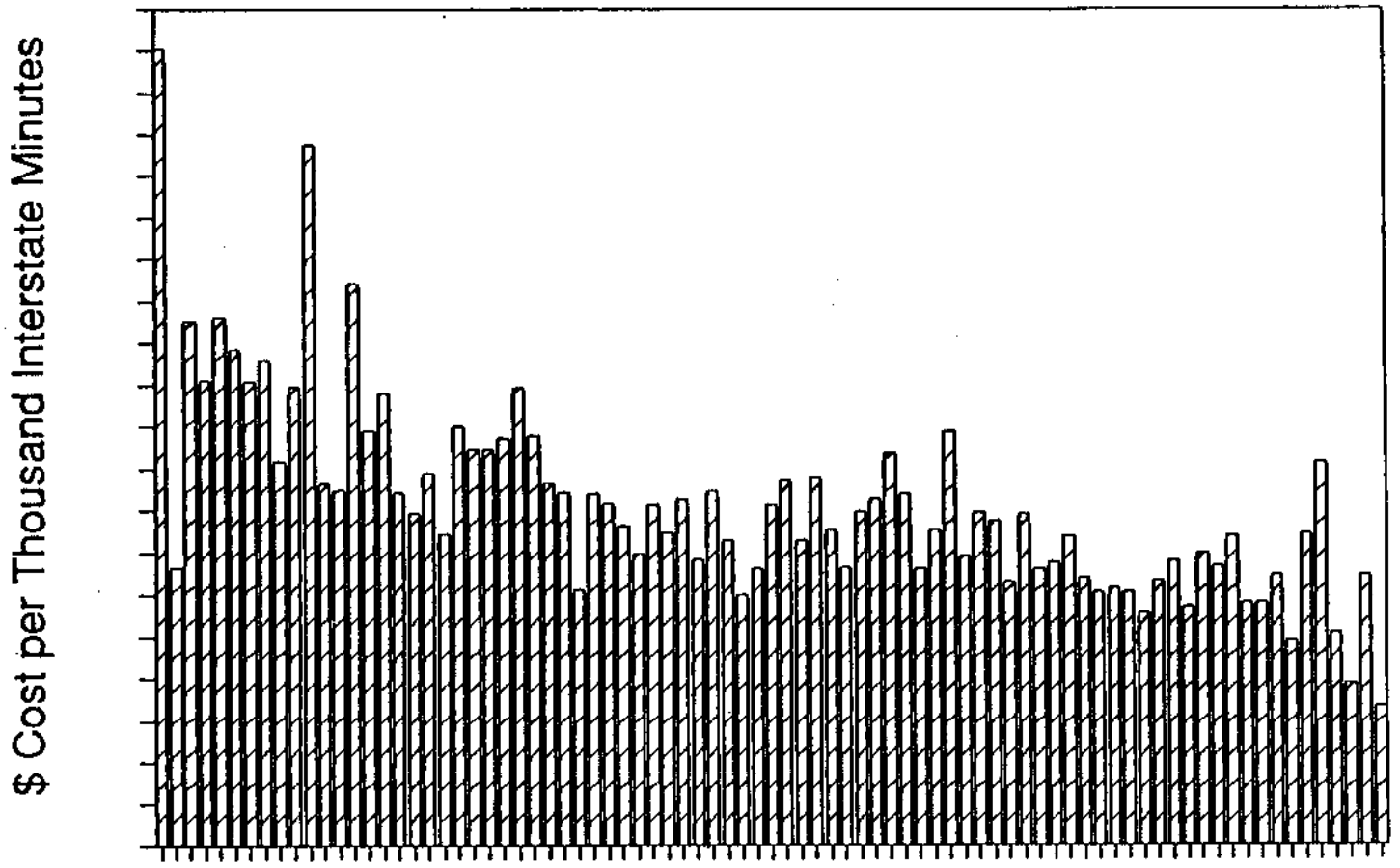
Part 31: USOA, basic accounting

Part 67: Jurisdictional Separations

Source: Jay L. Silberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model.* 1989, Figure 1-7, p. 41.(P-89-6)

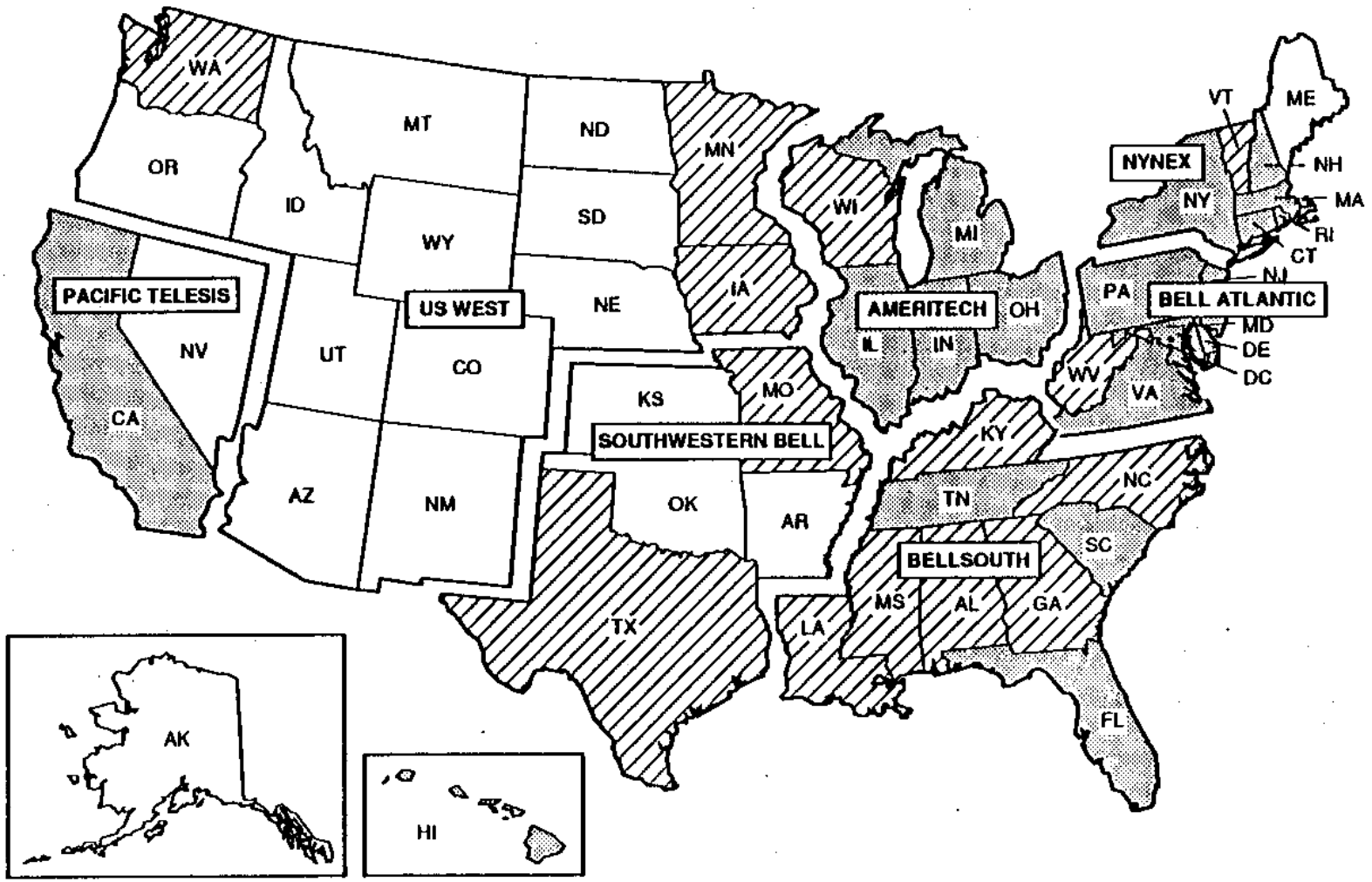
Interstate Cost Per Minute: Fixed Allocator Costs

83 Study Areas



Source: Jay L. Silberberg, *Fundamentals and Discretion: A Fixed Allocator Separations Model*, 1989, Figure 4-16, p. 118. (P-89-6)

Population Density of the States



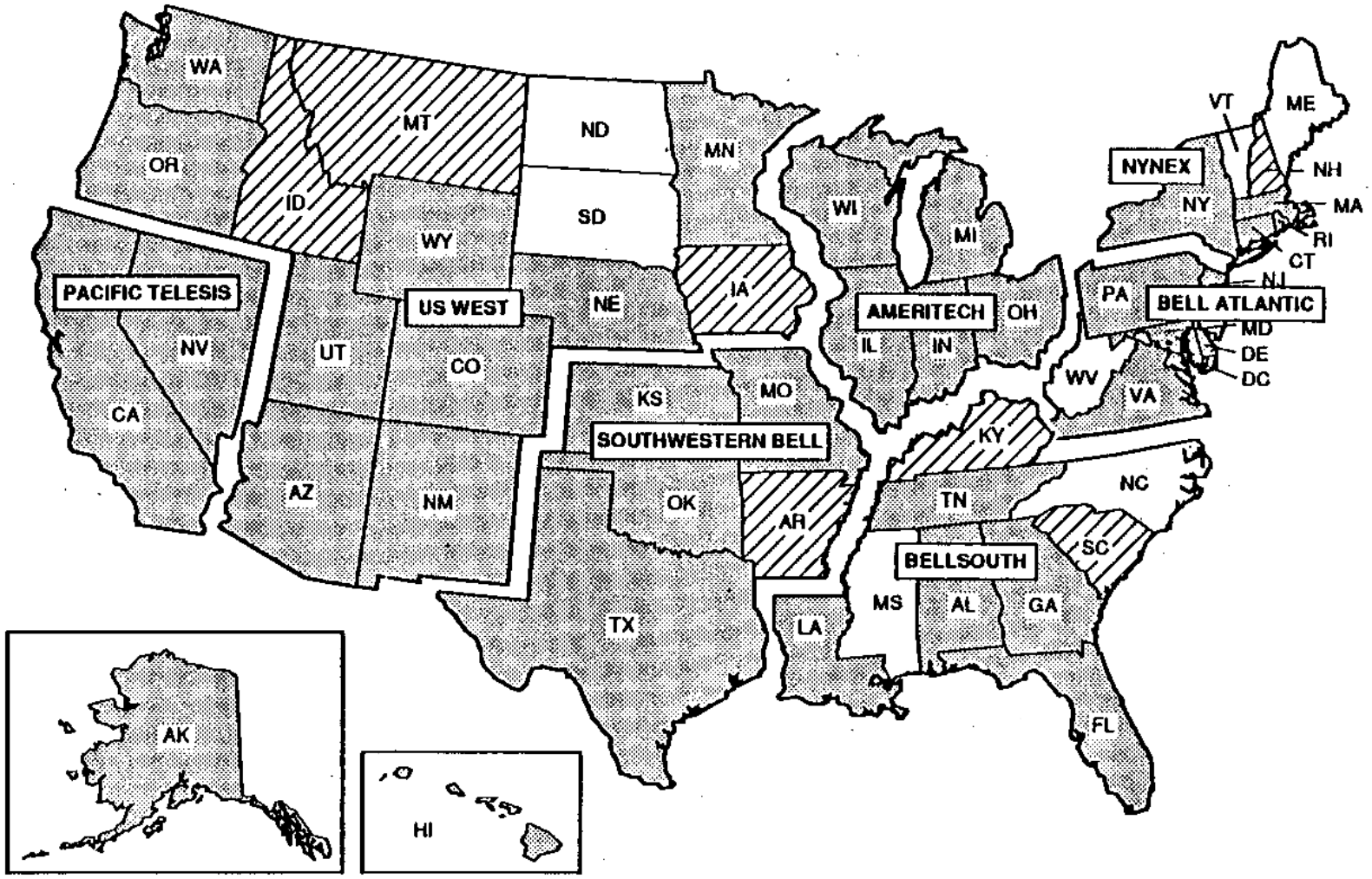
< 50 per square mile

50 – 100 per square mile

> 100 per square mile

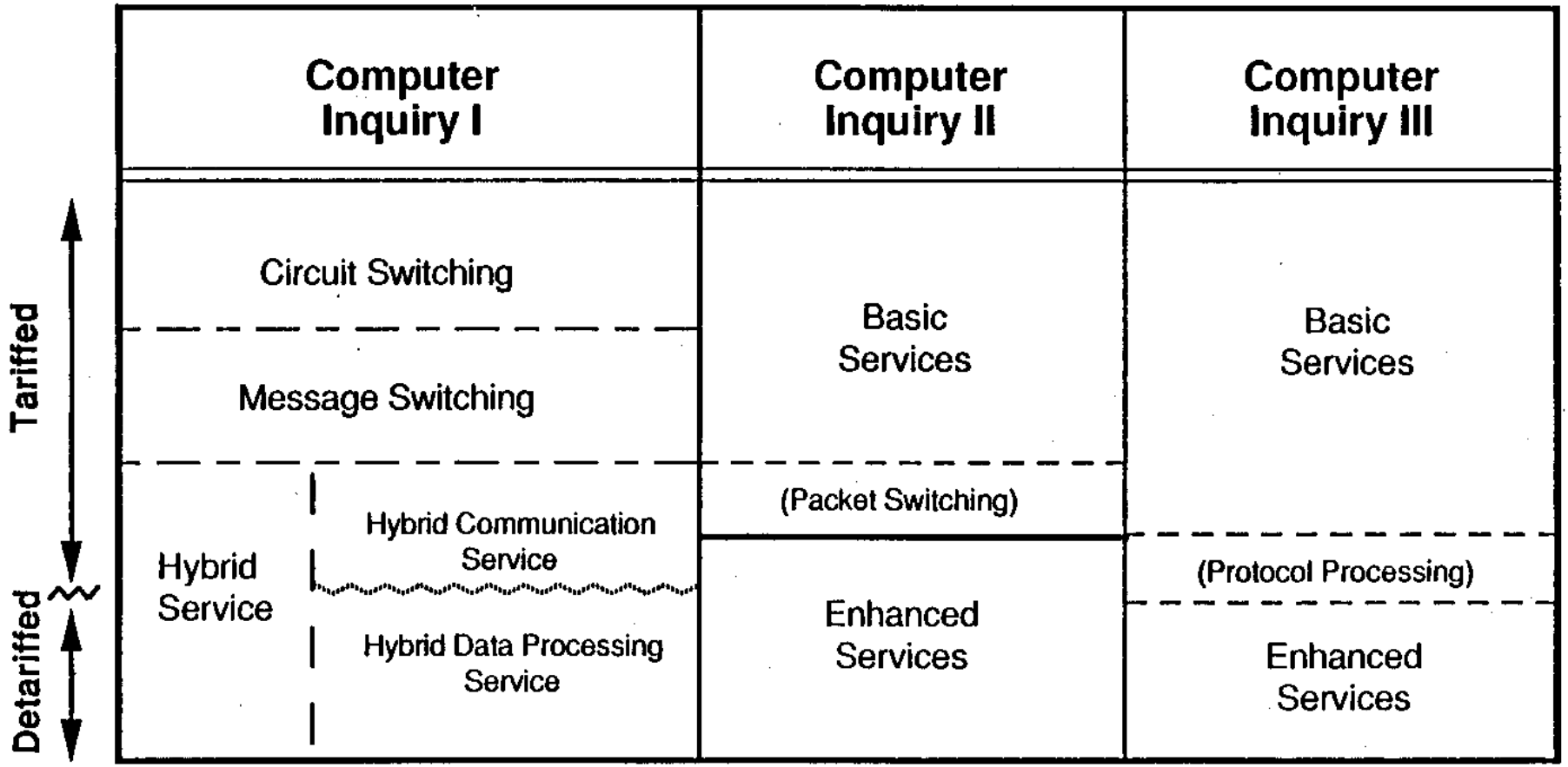
Source: *Statistical Abstract of the U.S.*, 1985, Table 12, pp.12-13. (S1, NS21)

Population Concentration of the States



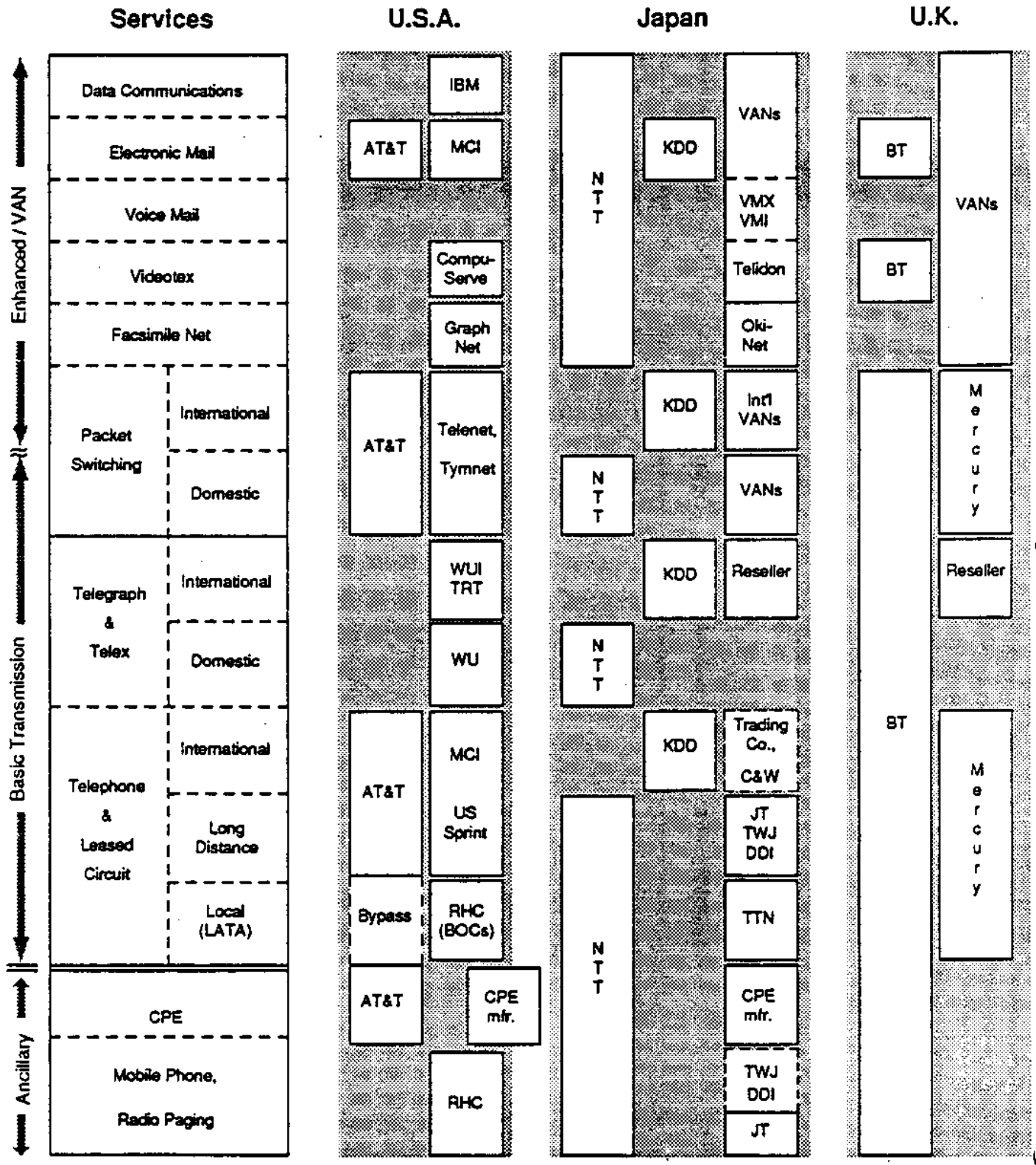
Source: *Statistical Abstract of the U.S.*, 1985, Table 12, pp.12-13. (S2-NS22)

Differences Among Service Definitions in Computer Inquiries I, II, and III



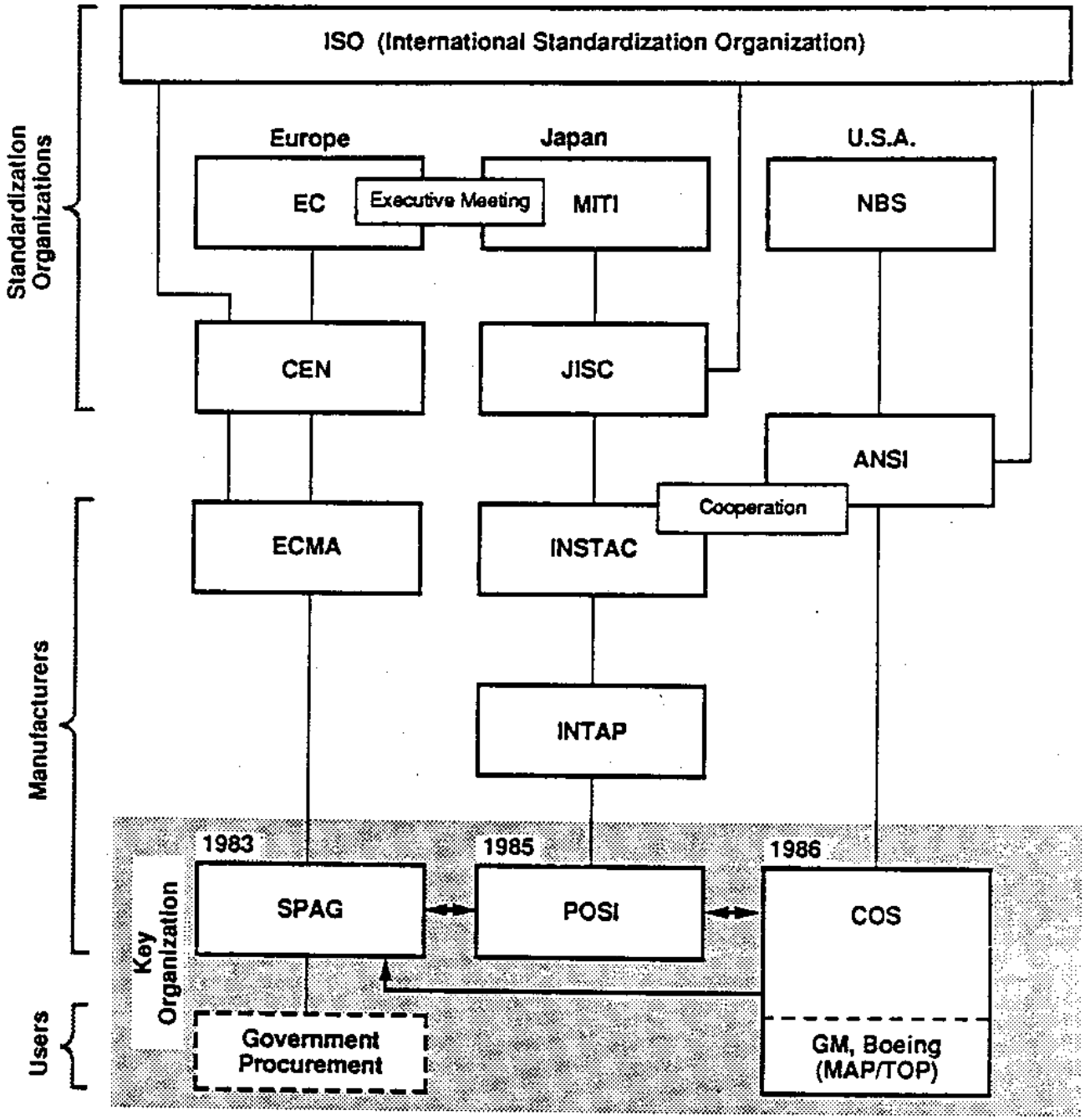
Source: Tatsushiro Shukunami, *The Race for Value-added Services: Challenges and Opportunities in the U.S., Japan, and the U.K.*, 1988, Figure 2-2, p. 27.

Market Structures of the U.S.A., Japan, U.K.



Source: Tetsushiro Shukunami, *The Race for Value-added Services: Challenges and Opportunities in the U.S., Japan, and the U.K.*, 1988, Figure 1-4, p. 17. Program on Information Resources Policy. (NS24)

Promotion of OSI (Open Systems Interconnect) Standards and Cooperative Relationships (1986)



ISO	International Standardization Organization
EC	European Community
CEN	Comite Europeen de Normalisation
ECMA	European Computer Manufacturers Association
SPAG	Standards Promotion and Application Group
JISC	Japanese Industrial Standards Committee
INSTAC	Information Technology Research and Standardization Center
INTAP	Interoperability Technology Association for Information Processing
POSI	Promotion of OSI
NBS	National Bureau of Standards
ANSI	American National Standards Institute
COS	Cooperation for Open Systems
MAP	Manufacturing Automation Protocol
TOP	Technical and Office Protocol

Source: "Quick Development of OSI Coalition among Japan, Europe, and the U.S.A.," Nikkei Computer, Sept. 1, 1986, p. 41. Adapted with permission. (Shukunami, Fig. 3-2) (NS25)

List of Critical Technologies and Their Objectives

Critical Technologies	Objective
1. Microelectronics Circuits and Their Fabrication	The production of ultra-small integrated electronic devices for high-speed computers, sensitive receivers, automatic control, etc.
2. Preparation of Gallium Arsenide (GaAs) and Other Compound S	The preparation of high purity GaAs and other compound semi-conductor substrates and thin films for microelectronic substrates.
3. Software Pro	
4. Parallel Com Architectures	
5. Machine Inte	
6. Simulation a	
7. Integrated Op	
8. Fiber Optics	
9. Sensitive Re	
10. Passive Sens	
11. Automatic Ta Recognition	
12. Phased Array	
13. Data Fusion	
14. Signature Co	
15. Computation	
16. Air Breathing	
17. High Power M	
18. Pulsed Power	The generation of power in the field with relatively light-weight, low-volume devices.
19. Hypervelocity Projectiles	The generation and use of hypervelocity projectiles to (1) penetrate hardened targets, and (2) increase the weapon's effective range.
20. High-Temperature/High-Strength/Light-Weight Composite Materials	Materials possessing high strength, low weight, and/or able to withstand high temperatures for aerospace and other applications.
21. Superconductivity	The fabrication and exploitation of superconducting materials.
22. Biotechnology Materials and Processing	The systematic application of biology for an end use in military engineering or medicine.

Critical Technologies	Objective
1. Microelectronics Circuits and Their Fabrication	The production of ultra-small integrated electronic devices for high-speed computers, sensitive receivers, automatic control, etc.
2. Preparation of Gallium Arsenide and Other Compound Semi-Conductors	The preparation of high purity GaAs and other compound semi-conductor substrates and thin films for microelectronic substrates

Source: Adapted from The Department of Defense, *Critical Technologies Plan for the Committees on Armed Services, United States Congress*, March 15, 1989, Table 1. (GL25, NS26)

Countries with Significant National R&D Efforts
(other than the US, Japan, USSR; or NATO, or Warsaw-Pact Bloc)*

Critical Technologies	Country
1. Microelectronics Circuits and Their Fabrication	India, South Korea, Taiwan
2. Preparation of Gallium Arsenide (GaAs) and Other Com...	China (for microwave applications)
3. Software P...	
4. Parallel Co...	
5. Machine In...	
6. Simulation ...	
7. Integrated ...	
8. Fiber Optic...	
9. Sensitive R...	
10. Passive Se...	
11. Automatic ...	
12. Phased Ar...	
13. Data Fusio...	
14. Signature ...	
15. Computatio...	
16. Air Breathi...	
17. High Power Microwaves	China
18. Pulsed Power	China, Israel
19. Hypervelocity Projectiles	China, Israel, Sweden
20. High-Temperature/High-Strength/Light-Weight Composite Materials	Australia, Brazil, China, India, Israel, Sweden, South Korea, Switzerland, Taiwan
21. Superconductivity	China, Switzerland
22. Biotechnology Materials and Processing	Many Countries

Critical Technologies	Country
1. Microelectronics Circuits and Their Fabrication	India, South Korea, Taiwan
2. Preparation of Gallium Arsenide (GaAs) and Other Compound Semi-Conductors	China (for microwave applications)

*Since there are significant efforts related to each of the critical technologies in all the countries (or national groups) listed (under the title), these countries are not repeated in the table.

Source: Adapted from The Department of Defense, *Critical Technologies Plan for the Committees on Armed Services, United States Congress*, March 15, 1989, Table 1. (GL26, NS27)

Types of Legal Protection for Business Information

- Patents
- Copyright
- Trademarks and servicemarks
- Trade secrets
- Sui Generis Legislation
- Export Administration Act
- Contractual agreements
- Unfair competition and misappropriation
- Rights of privacy, publicity, and moral rights

Source: Anne W. Branscomb, *Nurturing Creativity in a Competitive Global Economy: Intellectual Property and New Technologies*. 1988, Table of Contents. Program on Information Resources Policy. (NS28)

U.S. Difficulties in Addressing Legal Protection Problems for Business Information

- Conflicts in legal regimes
- Magnitude of the problem
- Changing nature of the work force
- Adaptation of the law
- The conflict between company loyalty and a proprietary interest in personal knowledge and skills
- Technology transfer as an international obligation
- Technology transfer as a national imperative

Source: Anne W. Branscomb, *Nurturing Creativity in a Competitive Global Economy: Intellectual Property and New Technologies.* 1988, Table of Contents.

continued ➤

U.S. Difficulties in Addressing Legal Protection Problems (cont.)

- Conflicts of philosophy
- Need for user-friendly interface
- Conflicting legal theories
- Technological fixes seem doomed to failure
- Mores of scientist/entrepreneurs
- Time required for resolution of applicable law
- Privatization of public information resources

Source: Anne W. Branscomb, *Nurturing Creativity in a Competitive Global Economy: Intellectual Property and New Technologies.* 1988, Table of Contents. Program on Information Resources Policy. (NS29 p. 2 of 2)

Types of Telephone-Transaction-Generated-Information

- *White Pages* information
- *Yellow Pages* information
- New telephone service orders
- Aggregate telephone traffic information
- Calling number identification
- Other network information
- Call detail records
- Billing and credit information

Source: Thomas E. McManus, *Telephone Transaction-Generated Information: Rights and Restrictions*, 1989, text, p. 3.

Parties with a Stake in Telephone-Transaction-Generated-Information

- Regional Bell Operating Companies (RBOCs)
- Interexchange Carriers (IXCs)
- Non-RBOC directory companies
- Information providers
- Direct marketers
- Enhanced service providers
- Manufacturers
- Gateway providers
- Customers

Source: Thomas E. McManus, *Telephone Transaction-Generated Information: Rights and Restrictions*, 1989, text, p. 3.

Decision Matrix of Strategies Concerning Security Product Development

Who Bears the Risk?	In What Environment?	
	Unclassified	Classified
Industry	Strategy 1	Strategy 2
Government	Strategy 3	Strategy 4

Source: George F. Jelen, *Information Security: An Elusive Goal*. 1985, Figure 2, p. IV-3.

Types of Rogue Programs

	TYPE OF ROGUE PROGRAM			
	VIRUS	WORM	TROJAN HORSE	TIME BOMB
	Name of Rogue			
	Pakistani Brain	RTM's Great "Hack"	Aldus Peace Message	Burleson's Revenge
Benign		✓	✓	
Malicious	✓			✓
Protective	✓			
Disruptive		✓		
Destructive	✓			✓
Costly		✓		✓
Punitive	✓			
Prowess		✓	✓	
Revengeful				✓
Instructive			✓	
Prankish			✓	

Source: Anne W. Branscomb, *Rogue Computer Programs*, 1989, Table 1, p. 12. I-89-3.

Motivation of Intruders

- Pranks
- Protection
- Punitive
- Prowess
- Peeping
- Philosophy
- Potential Sabotage
- Poverty
- Power

Anne W. Branscomb, *Rogue Computer Programs*, 1989, Table 2, p. 14. (I-89-3)

Perpetrators

- Employees
- Software distributors
- Pranksters
- Professionals
- "Cyberpunks"
- Saboteurs and terrorists

Anne W. Branscomb, *Rogue Computer Programs*, 1989, Table 3, p. 17. (I-89-3)

The Herger Bill, H.R. 55: The Computer Virus Eradication Act of 1989

101ST CONGRESS
1ST SESSION

H. R. 55

To amend section 1030 of title 18, United States Code, to provide penalties for persons interfering with the operations of computers through the use of programs containing hidden commands that can cause harm, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

JANUARY 3, 1989

Mr. HERGER (for himself, Mr. CARR, Mr. FRANK, Mr. MCCURDY, Mr. HYDE, Mr. SPENCE, Mr. DONALD E. LUKENS, Mr. LEWIS of Georgia, Mr. EMERSON, Mr. LAGOMARSINO, Mr. DANNEMEYER, Mr. RINALDO, Mrs. MEYERS of Kansas, Mr. SAWYER, Mr. MARTINEZ, Mr. STARK, Mr. HOLLOWAY, Mr. HANSEN, Mr. INHOFE, Mr. HOUGHTON, Mr. FROST, Mr. SIKORSKI, Mr. FOGLIETTA, Mrs. BOXER, Mr. WHITTAKER, Mr. OWENS of New York, Mr. DEFAZIO, Mr. BOEHLERT, Mr. MOORHEAD, Mr. MFUME, Mr. SHAW, Mr. NEAL of North Carolina, and Mr. GUNDERSON) introduced the following bill; which was referred to the Committee on the Judiciary

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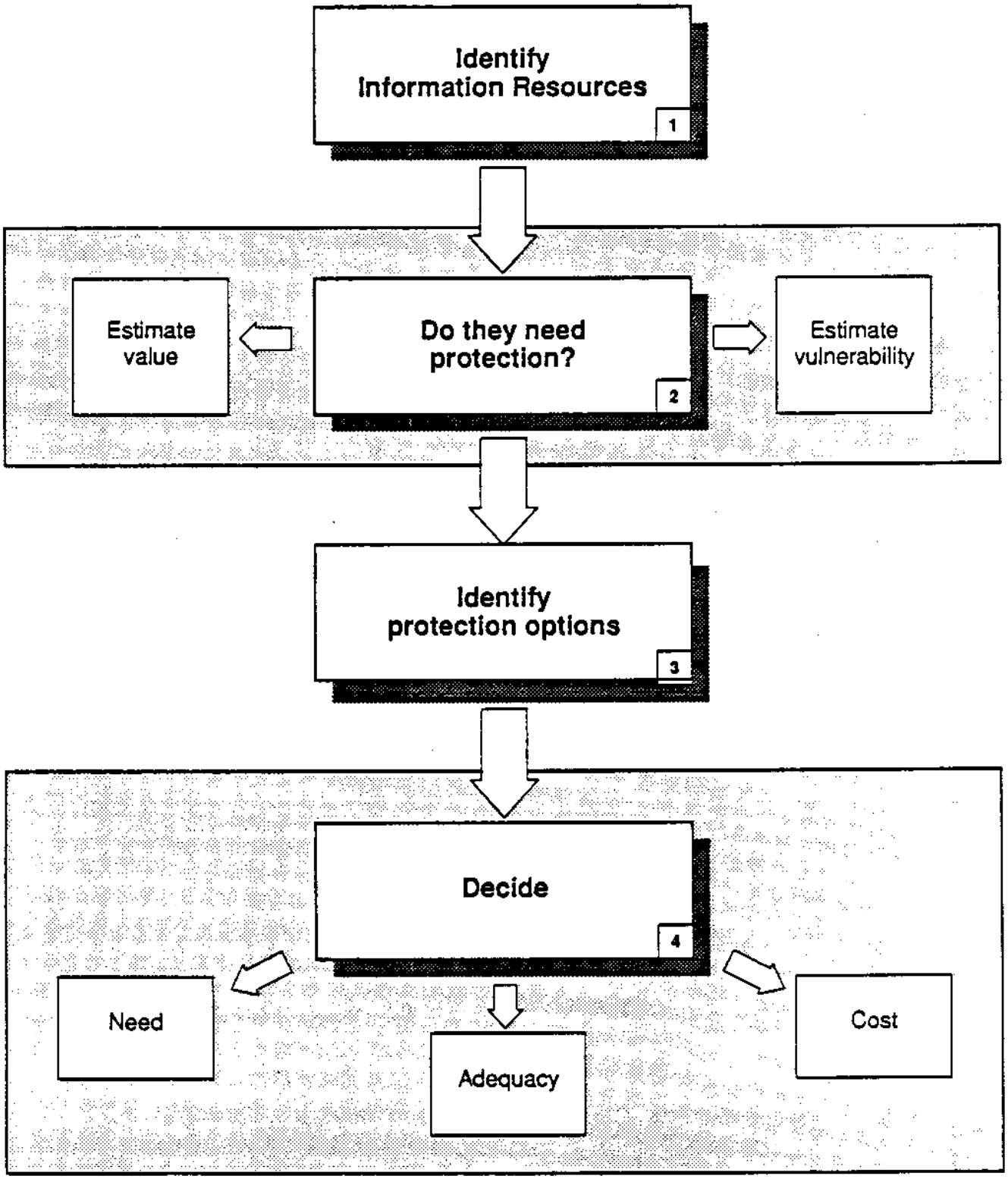
A BILL

To amend section 1030 of title 18, United States Code, to provide penalties for persons interfering with the operations of computers through the use of programs containing hidden commands that can cause harm, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

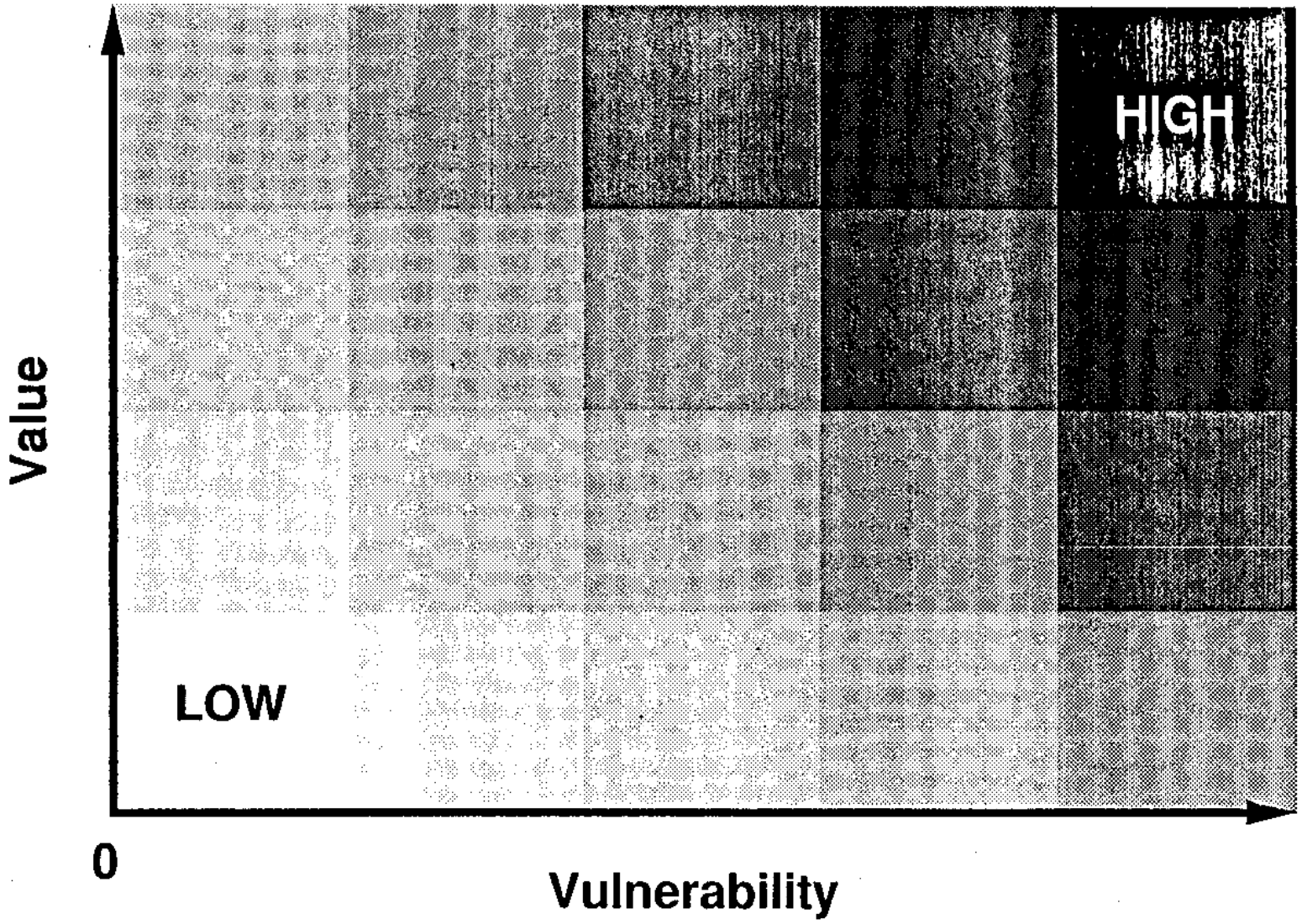
(See Anne W. Branscomb, *Rogue Computer Programs*, 1989, Appendix C, p. 51.) (NS36)

Protecting Information Resources: The Decision Process



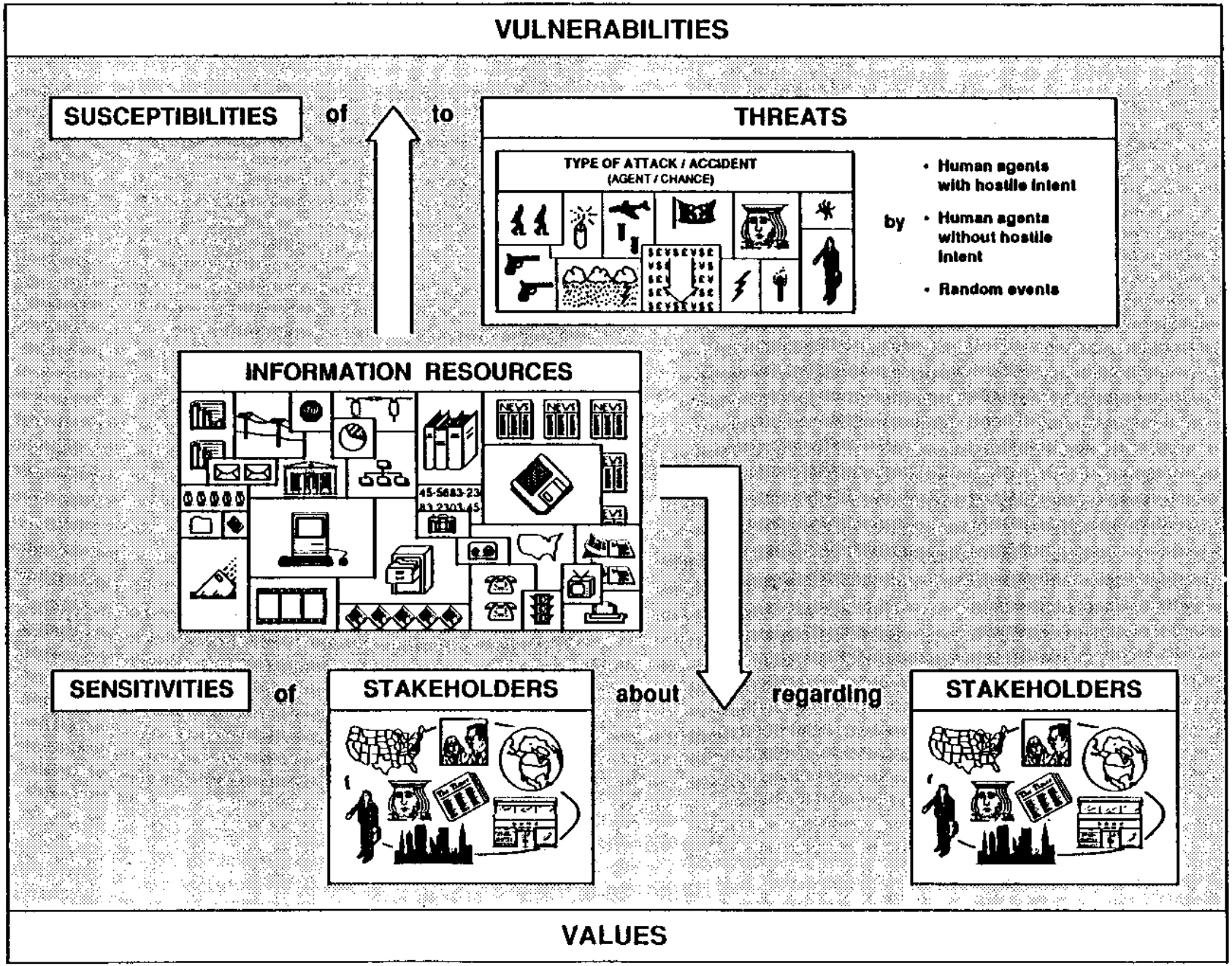
Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 2, p. 13.

Protection Priority



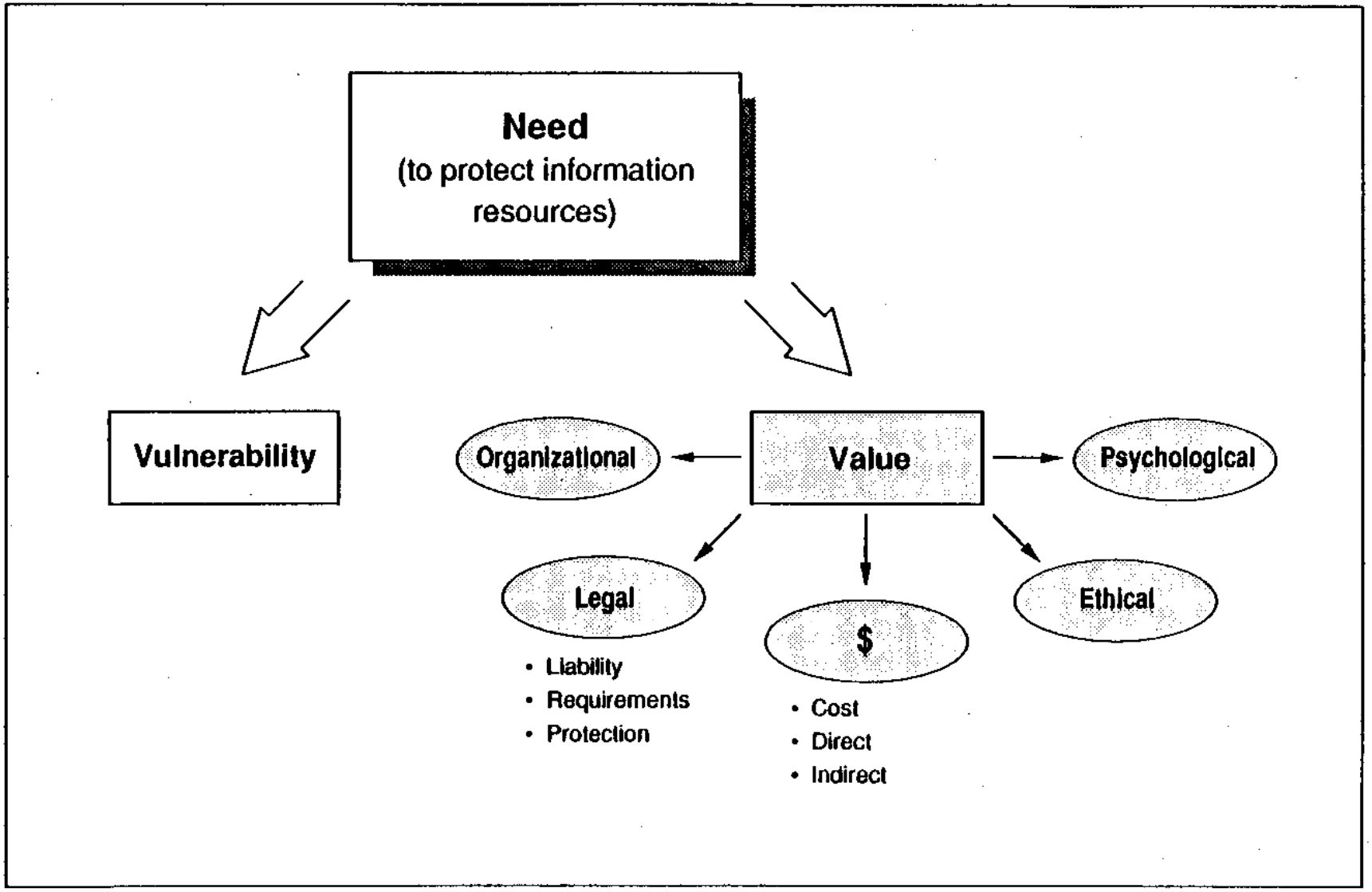
Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989. Figure 3, p. 14.

Value and Vulnerability of Information Resources



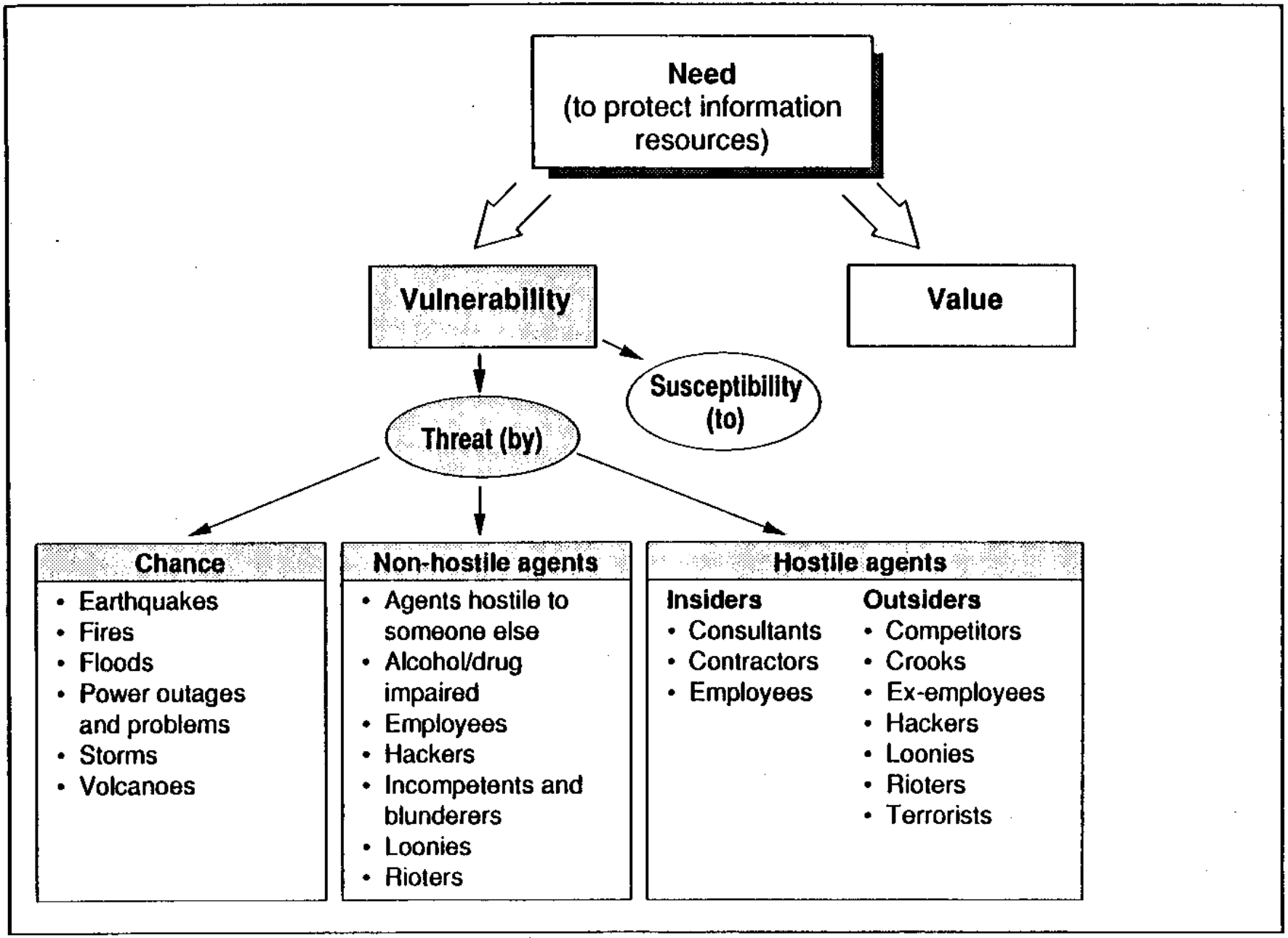
Source: Daniel J. Knaut, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 7, p. 23.

Protection Need: Value and Vulnerability



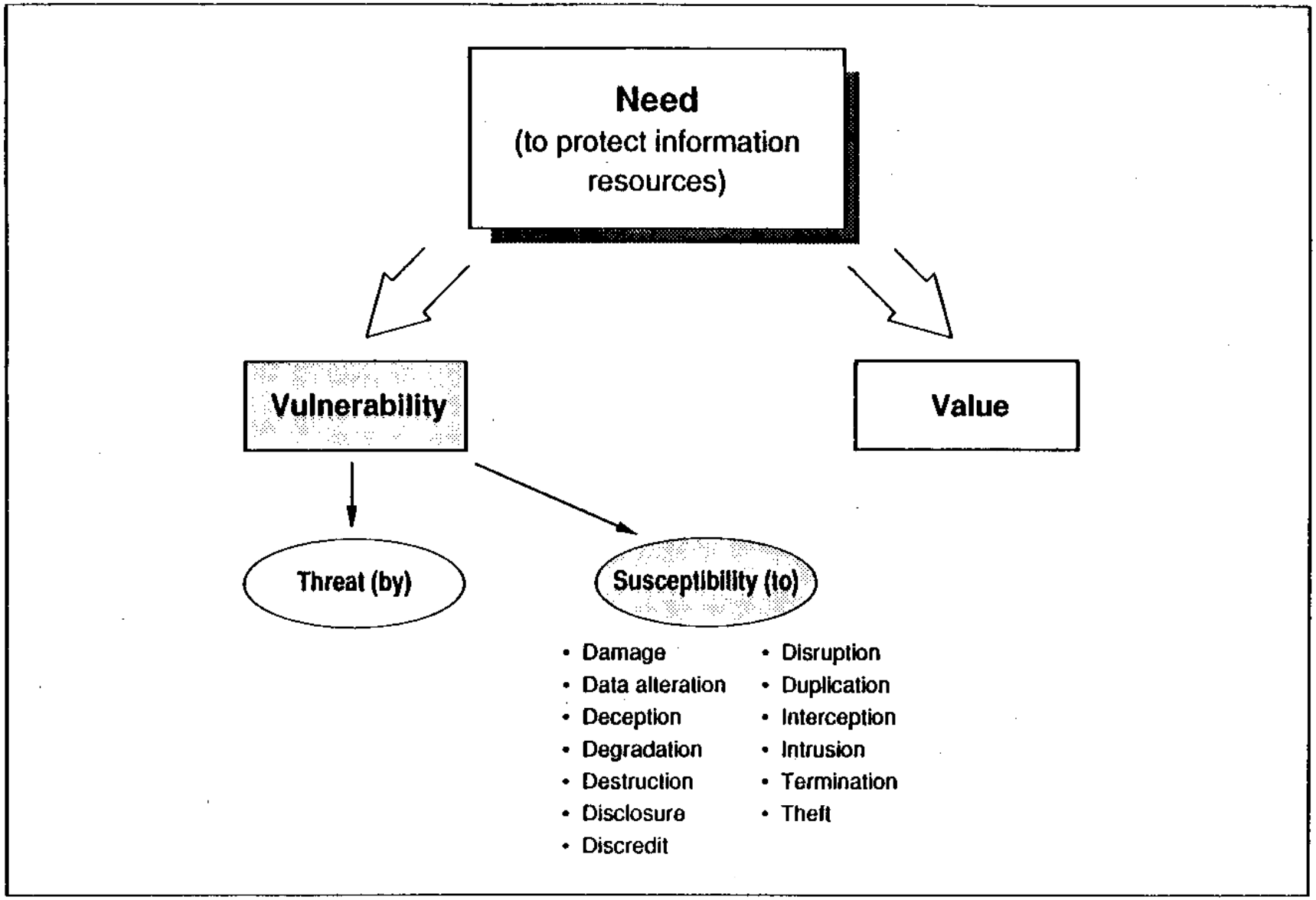
Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 4, p. 15.

Protection Need: Vulnerability to Threat By



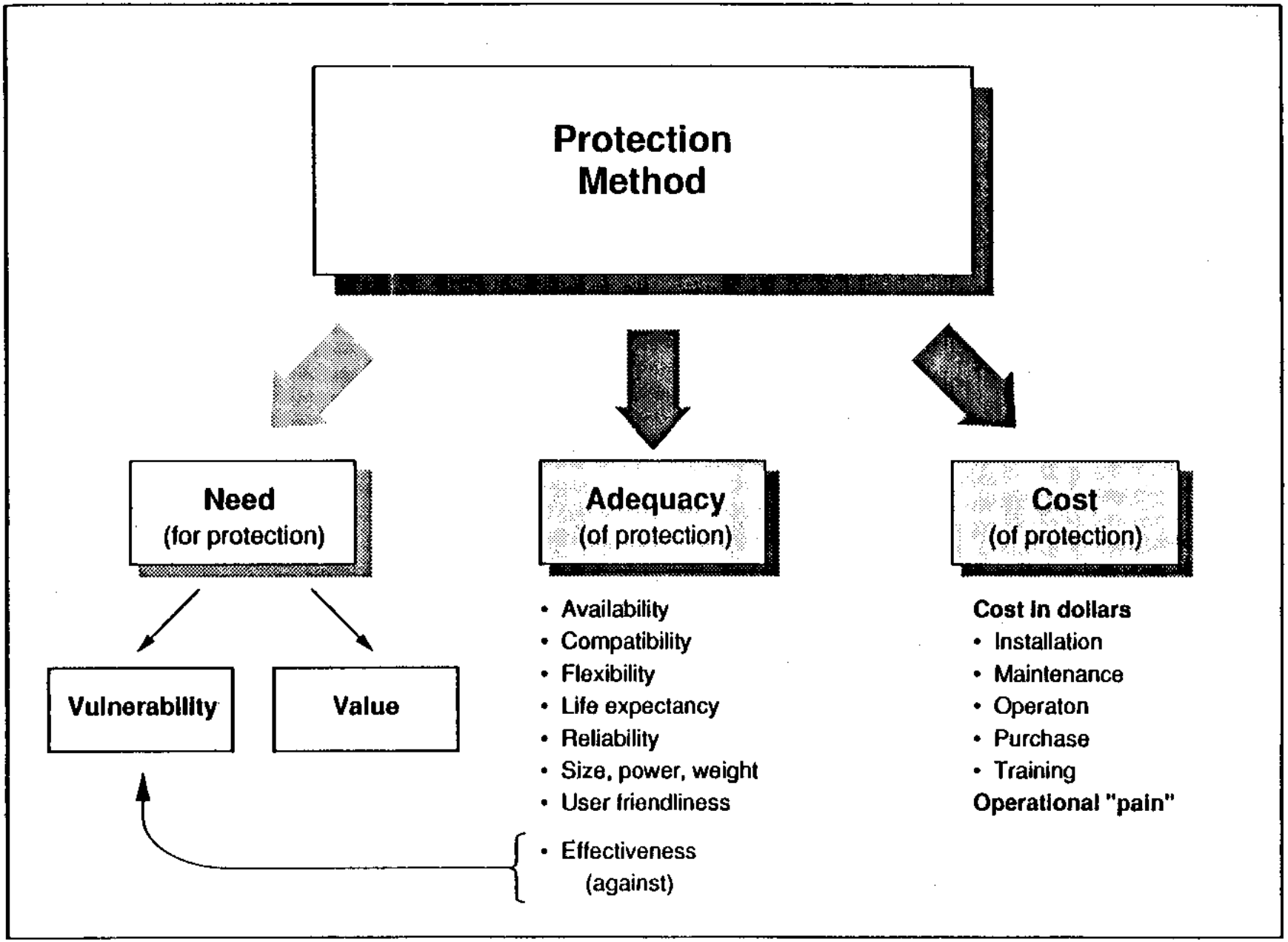
Source: Daniel J. Knaul, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 5, p. 20.

Protection Need:
Vulnerability to Threat of (Suceptibility to)



Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 4, p. 15.

Protection Method: Adequacy and Cost



Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Figure 4, p. 15.

U.S. State Information Protection Legislation

State	Access	• copy	• disclose	Use	• steal services	Modify	• add/insert	• delete	Disrupt		Reporting requirement	Trial secrecy	
Alabama	✓		✓	✓		✓							
Alaska	✓						✓						
Arkansas	✓				✓	✓		✓	✓			✓	
Arizona	✓					✓		✓					
California	✓	✓		✓	✓	✓	✓	✓	✓		✓		
Colorado	✓			✓		✓		✓					
Connecticut	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Delaware	✓	✓	✓		✓	✓	✓	✓	✓				
Florida	✓	✓	✓			✓		✓	✓				
Georgia	✓					✓		✓			✓		
Hawaii	✓			✓		✓	✓	✓					
Idaho	✓			✓		✓		✓					
Illinois	✓				✓	✓		✓					
Indiana	✓			✓		✓	✓						
Iowa	✓				✓	✓							
Kansas		✓	✓			✓		✓					
Kentucky	✓				✓	✓		✓					
Louisiana	✓	✓	✓	✓		✓	✓	✓	✓				
Maine					✓								
Maryland	✓			✓		✓		✓	✓				
Massachusetts	✓	✓		✓	✓	✓		✓	✓				
Michigan	✓					✓		✓					
Minnesota	✓				✓	✓							
Mississippi	✓					✓	✓	✓	✓				
Missouri	✓		✓			✓		✓					
Montana	✓			✓		✓		✓					
Nebraska	✓				✓	✓		✓	✓				
Nevada	✓	✓	✓	✓		✓	✓	✓	✓				
New Hampshire	✓	✓	✓	✓	✓	✓	✓	✓	✓				
New Jersey *	✓					✓		✓					
New Mexico	✓				✓	✓		✓					
New York	✓	✓		✓	✓	✓		✓					
North Carolina	✓				✓	✓		✓	✓				
North Dakota	✓	✓	✓	✓		✓		✓	✓				
Ohio	✓			✓									
Oklahoma	✓	✓	✓	✓		✓		✓					
Oregon	✓			✓		✓		✓				✓	
Pennsylvania	✓			✓		✓		✓	✓				
Rhode Island	✓					✓		✓					
South Carolina	✓					✓		✓	✓				
South Dakota	✓			✓	✓	✓		✓					
Tennessee	✓					✓		✓					
Texas	✓			✓					✓				
Utah	✓		✓	✓		✓		✓	✓		✓		
Vermont													
Virginia	✓	✓		✓	✓	✓	✓	✓	✓			✓	
Washington	✓					✓	✓	✓					
West Virginia	✓		✓	✓		✓		✓	✓				
Wisconsin	✓	✓	✓		✓	✓	✓						
Wyoming	✓	✓	✓			✓	✓	✓					

*New Jersey's law provides a statutory basis for civil action, but no criminal penalties.

Source: Daniel J. Knauf, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, Table 3, p. 50.

U.S. State Information Protection Legislation: Topics

Access

- ❑ copy
- ❑ disclose

Use

- ❑ steal services

Modify

- ❑ add/insert
- ❑ delete

Disrupt

Reporting requirement

Trial secrecy

Source: Daniel J. Kraut, *The Family Jewels: Corporate Policy on the Protection of Information Resources*, 1989, detail of Table 3, p. 50.

Technology Improvements Create Business Opportunities

Areas of Opportunity	Technology Improvements			
	Smaller	**Faster**	**Cheaper**	**Better**
Products	Smart Weapons			
Applications		Weather		
Markets			Calculators	
Strategies				Japanese

Source: John C. LeGates and John F. McLaughlin, *Forces, Trends and Glitches in the World of Compunications*, 1989, Figure 13, p. 22. (P-89-2)

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