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GENERAL TOPIC: <u>EMERGING TECHNOLOGY AND THE POTENTIAL</u>

<u>FOR NEW SERVICES</u>

Whenever one talks about emerging technology, what gets most
attention is the emerging super pipe, ISDN, IBN, etc., what could
be called <u>integrative</u> technologies. But this is only one side of
the coin. Technology and ec development also lead to centrifugal
developments, and those have been in recent years the much more
powerful forces, although you wouldn't find them discussed in
engineering journals. There are a lot of other things you won't
find in engineering journals, and I'll talk about two of them.

I promised Bruce that I'll talk about technology in a
futuristic vein, and about how some of this affects regulation.
So let me start with future in the information society.

What we are seeing is an evolution of the pluralistic
network from monolithic central hierarchy to a
interconnected vertical array based on user communities.
Now any kind of group theory will suggest an increasing
profusion of rapidly coalescing and dissolving communities
of interest.

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What is emerging is a pluralistic network that is user-group oriented, that will be functional and international rather than general and territorial, where the distinction between private and public will become vague, and where any national policy will be increasingly difficult in the face of international networks, and where state regulation will have to be justified on substance rather than on tradition. The stages of evolution in telephony, as I see them, started with a first stage, that of

(1.) <u>The cost-sharing network</u>,

Where the expansion of the network was based the logic of spreading fixed costs across many participants, and increasing the value of telephone interconnectivity. This period of telephony, in the United States, lasted through late 1940's.

Next, the US and other industrial countries passed through the stage of

(2.) <u>The redistributory network</u>.

At the next stage, the network grows politically through transfers from some users to others, particularly to newcomers to the network. Its beginnings may be put at [_____] when the allocation from long-distance to local service began in serious. This period lasted into the early 1970s, when it began to change slowly.

3. The pluralistic network

In the current phase, the uniformity of the network is breaking apart because the interests of its numerous participants cannot be reconciled anymore, and a federation of sub-networks is emerging.

[skip in speech]

There are all kinds of reasons why this is happening.

To name only three:

1. REDUCTIONS IN EQUIPMENT COSTS

The underlying economics of transport and switching have shifted considerably downward. A unit of communications has become much cheaper, both to transmit and to switch.

In 5 years, switch prices for Nynex came down in price per line from $230 in 1983 to $144 in 1988. Manpower requirements] [declined considerably, with number of employees per 1000 lines decreasing by annually more than 10% annually.

Similarly, the price per meter of fiber has come down from $7 in 1977 to 23 cents in 1988 while its transmission capacity has increased enormously; LEDs dropped from $2000 a few years to $30 today. In 3 to 5 years fiber will be cheaper to install than copper.

Thus, the cost curve drops down as a whole. It becomes more affordable to start alternative network arrangements.

2. INCREASES IN USER SIZE

The trend of information-intensive large users has been to grow rapidly, as part of the move to a services-based information economy. As the traffic volume of large users goes up, it takes fewer users to travel down the cost curve and benefit from economies of scale.

3. SPECIALIZATION

As the information flow requirements of large users become still larger, they are also becoming increasingly specialized. Equipment offered by numerous vendors permit many configurations to accommodate the requirements and procedures of organizations.] [It is no longer as necessary to forgo benefits of specialization in order to benefit from cost sharing.

If you have any dynamic perspective, you've got to understand that all this has long-term architectural implications. In terms of network architecture it means a distributed rather than centralized intelligence; it means distributed central office functions, which is why I don't believe in the scenario that there will be only 4 switching

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manufacturers left in the world. As companies become modular,
you'll have lots of entrants, and you don't have to give out
billion dollar government grants.

INDUSTRIAL POLICY

The question of significance is whether regulators should be
involved in all this. Why not let the market take care of
technological development? One major problem with this view is
global competition, which will accelerate to a degree that we
can not imagine.

I ask you, is there a role for American government in
technology development? I think so. First, there often is a
chicken-and-egg situation, where vendors, network providers and
end-users tend to negate each others efforts and desires until
there is a sufficient critical mass. This may require an
assertive role by government. Although I happen to be quite
unenthusiastic about the French Minitel, having had a terminal
at] [my Columbia University office, but it's a fact that the
government was successful in pooling the critical mass necessary
to launch a new type of service. Neither Germany nor Britain
with their less aggressive policy managed that, not to mention
the US. Just ask Knight-Ridder.

Secondly, there is a real role for government in standard
setting. This does not mean uniformity. We don't need to move

in total lockstep, whether it's in technology or policy. But reasonable action to get technical standards set, and technical standards changed seems to me essential. If it makes no more economic sense for Sweden to drive on the left side of the road, it takes government action to shift it to the right. You can't do it gradually without blood-shed. Anyway, if we don't do it for ourselves, the standards will be set in Tokyo or Brussels.

Thirdly, there is a role for government in demonstration projects that require great financial risk but whose benefit externalities go far beyond the initial backers.

Fourth, there is a role in targeted procurement. If you have a big project, you may as well benefit from the technological fall-out. I recently served on the Board of FTS-2000, the $25 bil. federal network. When I asked the GSA folks the to me reasonable question if they considered the technological benefits to the civilian sector as one of the] [several factors in the selection, they looked at me as if I was crazy, or from Mars. I'm not sure how they do it on Mars, but I'm pretty sure that's not how they do it in Tokyo.

Fifth, there is a role in trade policy. If US communications technology can't be sold abroad in major advanced markets, then there will be less of it produced here. In this sector, talk about free trade is largely surrealistic:

practically everywhere except here, since the divestiture, are

the public telecom markets administered by governments rather

than by markets. The procurements are political decisions, and

they must be dealt with politically.

[end of skip; resume]

Information Screening

Let me return to technology, and tell you why the real

challenge for the future technology is not what we normally talk

about, how to transport information, but rather how to deal with

it once it's there.

As you know, sometimes the worst that can happen to a person

is to get what one really wants.

Perhaps this is happening to us with the information

revolution.

The information revolution progressing on the whole

successful, and by so doing creates its own problems.

We can speak of "information pollution," or of the

information revolution devouring its own children.

The technical trends are toward digitalization,

broadbanding the last mile, abolishing all bottlenecks. Except

one. This last bottleneck I'll call the last 15 inches, those

from the terminal to the human brain. Human eye, ear, and brain

can only handle so much. There are biological constraints.

We have tidal waves of info. Xerox machine, e-mail, voice

mail, answering machines, junk-mail. Fax now adds midnight junk

mail, at your expense. There is also much more production of

info. Spread-sheets, data, reprints. Also, there is more

happening that is important. Cable TV provides dozens of

channels of TV.

I don't have a study for the office setting, but I have one

for residential media use. One study by Ithiel Pool and Russ

Newman looked at the overall number of media words that the

average household has been flooded with. They found that in

1960, mass media supplied about 3 million words per capita per

day, including unwatched TV, unread papers, etc. By 1980, this

figure had increased by 267% to 11 mil. words. Obviously, only a

tiny fraction is actually consumed, about 60,000 media words/day,

or about 4000 per waking hour, 1 word per second. This number is

up by 51% from 1960 to 1980. Even so the ration of consumed to

supplied words declined from 1.4% to .6%. TV, incidentally,

accounted for 64% of word consumption, and this doesn't even

count the visual images that are not part of the analysis. When

you start factoring in the price per word of different media, you

also find that broadcast words are a real bargain for consumers

relative to print words, which explains why their share increases while attempts are made to charge more for them than before. ~~This leads to Information Overload.~~

¶ *Given much increase in info, the real issue is not technae of production and of distribution, but rather of dealing w/ info overload*

How to deal with the inadequate human factor in this development?

1. education: i.e. Make them smarter. But limits to this, as ~~I found~~ *you find* out quickly after *about* 2 weeks of teaching. There is only so much the human brain can handle. After all these years of education, you try to multiply 73 X 86 in your head. Or try to remember last week's ~~memos~~ *press releases by* ~~from~~ your fellow commissioners.

2. ~~Harder work. I.e.~~ Make them spend more time on information. That is clearly happening. The average HH that has cable TV has it on for 58 hours per week, which is 13 hours more than HH without cable. In office settings, people spend more time on paper flow; lunches get shorter, work hours longer. (Although looking around *the room* here you couldn't tell.) There are clear limits to that approach, one of them is called the 24 hour day.

3. Tinkering with mother nature, by pharmacological or biological engineering. Some drugs enhance memory. This is not an attractive proposition. Probably and hopefully has natural and ethical limits.

4. Information Darwinism: let the computer chips fall where they may. Survival of the information fittest. You'll

have an under class of those unable to handle demands of info society. And this can become a permanent under-class if info handling ability transmits itself across generations by heredity or social environment.

5.   This then gets to the more promising mechanisms, namely creating screening mechanisms for information.

Examples are

(a)   Professional screens, such as journalists, editors, movie critics, specialized magazines, administrative law judges.

(b)   intra-organization screens, such as secretaries and staff.   As Pres. Reagan proved, one can boil down any issue under the sun into ~~a one page memo~~ *an index card*. It helps of course if you have 5 mil. people working for you.

(c)   economic screens.   E.g., impose a charge from recipients to sender. Why is my time a free good for anyone who wants to access my mailbox or telephone receiver? Now I even have to pay for somebody sending me a fax?! Let them pay for access to me!

(d)   Most important is an automatization of the info. screening process. This, to me, is the key technological challenge for info. sector. Never mind the super pipe. What about the super screen? Technology to help us get only info. we want or need.

Examples for simple screening mechanism: customized newsletters.   For me, for example, it would have only items on

Columbia University football victories, Northeastern skiing, and Albany sex scandals. (this makes for a very short newsletter). As everyone who ever used Nexis can tell, the tricky part is to automate system so you won't get repetitive or unimportant information. I.e. one needs a quality screening. Expert systems and artificial intelligence applications may be useful, but I wouldn't hold my breath.

6. (5) This gets to the more radical solutions: Restructuring of way info. gets transmitted into the brain. (a) [First, maybe one could bypass eyes and ears and get directly into the brain. Remember as kids having a book under the pillow rather than studying it?]

(b) Second], maybe the ways we get info. input needs change. Eyes can get visual info. at a broadband bit-rate. In fact, if the TV action is too slow, one gets bored, which means that you can pack a lot into the visual, as TV advertising proves.

On the other hand, written info. gets absorbed at a much slower bit rate. 300 words/min., or x bits. Ears are even slower about y words/min. or y bits. And the tactile sense can get you up to perhaps x words/min. in Braille.

The implication is that visual info. is by far the fastest, if it uses the entire bandwidth of the eye's ability.

But print language can't do that. We are talking here
hopelessly outmoded phoenician and latin *communications* protocols. But we are
stuck with them. Changing form of written language is radical,
and the written word is often sacrosanct. Try to change a letter
in the Bible, and you start a religious war. The form of written
language has hardly changed in centuries. We have a big social
investment in this particular form of standardization. We need
compatibility. The social and cultural fabric revolves around
it. Therefore, even streamlining spelling is a culturally
traumatic event.

So instead of junking the latin alphabet, and traditional
form of written language, what is more likely to happen is a
shift to a multimedia form of communications with more visual,
and more symbolic info.

TV-ads are an example. They pack a lot into 30 seconds.
Or: visual presentations, with slides, etc., and now video
clips. Music video is another example. The future belongs to
info. that can provide parallel info. tracks. Take voice
telephony. It's very inefficient, in terms of information flow
per time unit. That's why I believe that there is a great future
for picture phones. (I Seem to be the only one who thinks so, *unfortunately!*)
That's *also* why fax will have an enormous future, because it's much
faster than voice. *In NY some deli sandwich
places accept orders by fax, because it's
faster than by voice phone. Also, you don't need
to speak English to fill the order.
In Aspen, where I skied last month, they
have 2 credit-card operated fax machine,
at the top of the mountain.*

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Once you have picture phones, you'll also have video "memos." combining written info., spoken word, film clips.

There's a
Also, promising future for info media that can be used in a split-screen fashion, where you get supportive info. as you speak, for example on-screen messages from whoever tries to reach you as you talk.

In the very long term, this leads also to new forms of communication language. Much more symbols will be used. Can speed up absorption process considerably, and combines abstraction of written document with speed of visual message.

Of course, Chinese and Japanese have been doing some of it for a very long time. Their absorption of words/min. is

_____. (higher/lower?) But the ideograms are frightfully hard to read and write. So it's an inefficient system.

Info. Technology makes it possible to simplify this system considerably, because you can input by traditional letter-by-letter typing; or by voice recognition.

But output can be displayed partly traditionally, partly symbolically.

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So written language is changing with technology, and with it how we speak, think, and interact.

In other words, we may be talking broadband technology as if its just getting movies into the home and stock market data into the office. But it's naive to think that it will stop there, *and not affect ~~society~~ as much more deeply*.

Common Carriage

As these changes unfold, ~~as~~ they challenge traditional regulation of communications. And I suppose that we will discuss several of them here. I cannot go into them, there is no time. I won't speak about ONA, which I've done for four years, since we *But I did promise Bruce* now seem to have a little bandwagon here. Let me instead move to what I consider the central theme of the new communication environment, the question of ~~common carriage in~~ *re legal status of* a broadband environment.

a regulatory theme with future potential and affected by future technology.

The upgrading of the telephone network toward broadband capability and its use for video, data, and text transmission will bring telephone transmission ever-closer to mass media. Mass announcement services have exploded in use since third party providers have taken control of the content of these services from the RBOCs. And in recent years we have seen claims by network operators to possess the status of "broadcasters" or "publishers" of information, with the concomitant right to select the information carried over their network. ~~The interplay between these claims and the common carrier obligation is thus a~~

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~~central issue for discussion.~~

Now common carriage principles ~~have long influenced~~ _telecommunications have traditionally operated under_

~~commercial relationships.~~ The~~y~~ _principles_ guaranteed that no customer

willing and able to pay the going rate could be denied lawful use

of the network. For over a century this principle has aided

users by stimulating the wide distribution of the

telecommunications network.

As with other efforts to balance private and public

interests, common carriage is at times burdensome to one party or

another. Yet in the aggregate, the balancing act helps the flow

of societal and commercial transactions, and benefits the public

as a whole. It permitted society to entrust its vital highways

of information to for-profit companies, without the specter of

discrimination and censorship by government or private

monopolies; it was an important element in establishing a free

flow of information, neutral as to its content; it reduced the

administrative cost and the burden of liability of the network

operator, since it needed not inquire as to a user's background

(beyond credit-worthiness) and intent; and it protected the

telephone industry from various pressure groups who would have it

otherwise not deal with their targets of protest or competition.

Thus, in telecommunications, as in other areas, the common

carrier principle, extended the reach of personal and business

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liberties beyond the immediate sphere of the user to many other users at great distance, and this encouraged usage and benefitted industry and society. As an institutional arrangement, it did for the transportation and communication sectors what free speech did for the press, limited liability did for corporations, legal tender did for currency, and negotiable instruments did for commercial transactions. It has probably resulted in a broader, more useful and more profitable network system than would have developed without common carriage principles.

While common carrier principles go back a long time, their application are in a constantly shifting terrain, and require continuous updating. Broadband Telecommunications are such a challenge, and raise the question how a principle going back to the Elizabethan Age should continue to apply.

This is not the time or place to provide answers, but I'd like at least to raise some of the questions which I'd like to raise more formally in another regulatory setting. For example:

- To what extent do common carrier principles allow network providers to become involved with the content of communications over their networks? Are they responsible? Can they be censors?

- Can or should common carriage and private carriage coexist? In the same entity? Can a telecommunications

carrier function as a common carrier to users at one end of a communications link, but as a private carrier to the user at the other end?
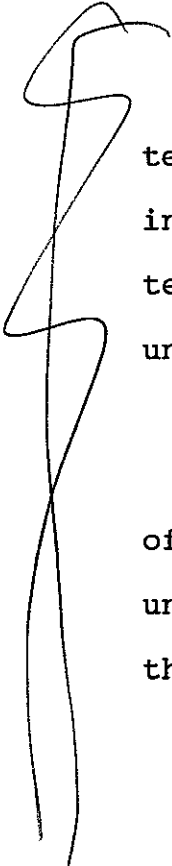
- What parts of a carrier's business activities fall under the mantle of common carriage? How finely segmented must they be?

- Where and to what extent should considerations of market power or monopoly enter into common carrier issues?

- Do common carrier principles apply to resellers?

- What restrictions are permissible on use, users and user groups? What would qualify as legitimate distinctions between classes of users? What restraints may user groups exercise in admitting new members? What are the rights of access to such groups?

And I could go on.

The importance of these issues extends beyond telephony and telecommunications common carriage. Their resolution also may influences the realms of regulated broadcasting, cable television, and publishing. These communications media operate under different regulatory regimes from that of telephone.

Print publications are virtually free from the constraints of government regulation, except those laws affecting other unregulated businesses and exert nearly complete control over their content. In recent years, both broadcasters and cable

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television operators have gained additional rights that move them more in the direction of publishers. Also, the status of broadband telephony is of vital interest to the cable industry. And so the question arises what the status of telephone carriers and will be.

This question seems to me central for communications in the future, and it is terribly important that we don't slide into a legal, political, and economic _morass_, but instead protect the principle that has served us well.

Thank you very much.