The Internet and past and future communications revolutions

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Predicting the evolution of the Internet is an error-prone business. An instructive, as well as amusing, exercise is to read the previous January/February 2000 Millennial Forecast issue of *Internet Computing.* The authors were all Internet luminaries with sterling records. Yet, although there were many perceptive and accurate comments in their essays, most of their predictions turned out to significantly miss the mark. In many cases this came from overestimates of the speed of change. That is a tendency that is almost universal among inventors and promoters of new technologies. As just one example, Bill Gates predicted that books would "go digital ... broadly in the next five years." With the arrival of the Amazon Kindle and other ebook readers, we are probably finally seeing the start of this transformation. But it now seems safe to say that a broad move towards digital books is at least five years further out, fifteen years after Gates made his forecast. Many other predictions seem in retrospect to have been completely misguided. For example, Eric Schmidt, at the time head of Novell, touted a secure worldwide "distributed directory service" as the "master technology" of the next wave on the Internet. Yet such a service is nowhere in sight. Instead, Schmidt at his current position at Google has found how to gain profit and influence through insecure statistical approaches that serve sufficiently the needs of the public and the advertisers.

The lack of accuracy in the previous forecast issue should not be a surprise. History is replete with examples of the difficulty of forecasting how quickly technologies will advance, and how society will use them. Hence the most that we can do is speculate, and this essay should be taken with a grain of salt.

Although accurate prediction is hard, there are some broad patterns that are likely to persist, such as "a continuation of current trends in bandwidth and connectivity" mentioned in Stephen Lukasik's essay in the 2000 issue. And, based on extensive historical precedents, some major misperceptions will govern many decisions about research, development, and deployment of new technologies. What is not well known, is that people can be remarkably oblivious to massive moves that are taking place around them and affect their industries. In the previous forecast issue there is just one discussion of voice, in the prediction (in Jim White's essay) that voice browsers would become widespread and important. Yet the big communications revolution that was taking place then, and has continued over the past decade, overshadowing the Internet all the time, has been the growth in mobile voice.

Just in the U.S. alone, wireless industry revenues reached almost $150 billion in 2008. That is about four times the revenues from U.S. residential high speed Internet access.

It is also almost twice the worldwide revenues of Hollywood. And it is almost 7 times the worldwide revenues of Google in that year. Further, the wireless service providers are nicely profitable (even if not as profitable as Google). Of their $150 billion in annual revenues, 80% is from voice. Thus even a cursory glance at the market clearly shows that narrowband mobile voice is far more important to people, in terms of either the number of users or willingness to pay, than broadband Internet access. (The figures for the rest of the world, especially the less developed countries, are skewed even more dramatically in favor of wireless voice over Internet, both in users and in revenues.) But that is the past and the present.

Advances in mobile technologies are providing higher transmission capacities, and are leading to a the widely touted convergence of wireless with IP, the Internet Protocol. That has obvious implications for wireless. But potentially it has even more important, if less obvious, implications for the Internet.

Of the 20% of wireless revenues that do not come from voice, the lion's share is from texting, which, just like voice, is a simple connectivity service. This shows that one can be successful by providing dumb pipes. However, the wireless carriers misunderstand this, and claim their success is due to the tight control they exercise over their networks. They worry that bringing Internet technologies to their industry will lead to their businesses becoming just bit carriers (which is, of course, what they are now), and are trying to tightly control just what services are offered over their channels. And, following extensive historical precedents, they appear mesmerized by the (extensively misleading) prospects of selling content. The extent to which they succeed will be fascinating to watch, but appears impossible to predict, since it depends far less on technology than on economics, industry structure, and regulation.

Many of the old battles over issues such as QoS or flat rate vs. usage-based pricing, as well as the on-going one over net-neutrality, are likely to be fought again in the wireless arena. It is possible that some outcomes might be different this time. The reason is that the balance between supply and demand is different. In the wireline arena, the growth in demand is still high, but it has been declining, to a level that is currently just about counterbalanced by improvements in technology. This produces incentives for service providers to increase usage, and such incentives suggest simple pricing and simple networks. In wireless, on the other hand, growth in data transmission appears to be significantly ahead of what technology can support, at least without major increases in levels of capital expenditure. And the incentives to raise investments are lacking, since most of the large potential sources of new wireless data transmissions are not anywhere near as lucrative as voice and texting. Users would like seamless mobility, but the huge gap between capacities of fiber and radio links is unlikely to allow this. So service providers will have strong incentives to closely manage their network traffic, and are likely to try to ration capacity and discriminate among applications and among service providers. Network management will be especially important to protect the cash cow, voice. (In particular, the unified, all-IP, network, may take much longer to arrive than expected.)

On the other hand, many of the incentives towards open networks that have so far prevailed in the wireline Internet do apply, and will continue to apply, in mobile data.

Service providers and their system suppliers have demonstrated repeatedly that they are terrible at service innovation. They have neglected numerous opportunities even in the basic services, for example by not providing higher quality voice. And their major successes, such as texting and ring tone downloads, were happy accidents, not something they planned. The AT&T deal with Apple over the iPhone may be a sign that the wireless industry is beginning to acknowledge its limitations and is willing to open a door to more innovative outsiders. But the battles for control will surely not go away. (Even the iPhone deal involves considerable control, by Apple this time. It is not a fully open ecosystem.) And though wireless data in an all-IP setting, a brand new development, would appear to be ideal for introduction of new technologies, such as IPv6, the attractions of sticking to what works in the wireline Internet seem to be dominating.

For the wireline Internet, the convergence of IP with wireless may have various unanticipated outcomes. Because mobility has great value for users, spending may tilt even further in that direction, and as a result, innovation may shift to the wireless arena. (This could happen both in an open environment, and in a collection of walled gardens.) New services may be designed primarily for the relatively low bandwidth wireless sector, and not for the big pipes available in wireline, which may end up as a backwater. On the other hand, availability of wireless Internet access may spur growth of very high bandwidth wireline access even in countries that are currently lagging in that field. Some wireline providers, especially those with dominant wireless operations, may stop upgrading their land lines. But others may find that the only way to survive is to exploit their one natural advantage, that of being able to provide big neutral pipes with low latency. That might lead to a surge in available bandwidth, and intensified growth in high-bandwidth innovation.

The only safe bet is that service providers will continue repeating many of their old mistakes, in particular in their preoccupation with control and with content as opposed to connectivity. But beyond that, predictions appear even harder than a decade ago, as there are more options before us, and many more complicated feedback loops affecting decisions.