New Directions in Mobile Communications,
or
How to Learn to Stop Hating the Cellular Telephone Industry

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ABSTRACT

In this article, we discuss the lessons in innovation from the last twenty years of the Internet that might be applied in the cellular telephone industry.

Categories and Subject Descriptors

C [.]: 2.1 [Packet-switching networks],[Network Communication]

General Terms

General Terms: Algorithms, Performance, Design

1. THE INTERNET INNOVATION LESSONS

The Internet is a wonderful thing, none-the-least because it is almost infinitely malleable, infinitely extensible. Historically, there have been several phases of rapid evolution of the Internet, roughly once per decade, in 1980, 1990, 2000, and now. The first phase corresponded to the switch over from ARPANET protocols (NCP) to TCP/IP. Already at that point we had packet radio, satellite, and land lines, and international connectivity. The second phase was when congestion control, multicast, real time (voice/video) on RTP, integrated services[1], and the web were all devised. The third phase was the emergence of really bullet proof search engines [2], the development of robust data centre and hosting services, viable peer-to-peer, torrent and swarm-based content distribution systems, and of social networking tools and platforms. Now we are seeing a whole plethora of radical new ideas via world wide projects in re-engineering the net to be more robust, while retaining its extensibility and evolutionary flexibility.

A key aspect of this was openness. Not just open specifications, but also open source. Not just open APIs, but the internals of all the protocols are available for scrutiny, and, crucially, for everyone to learn from. First the BSD TCP/IP stack, including examples of routing implementations, no matter how naive; then the web with browsers and web servers; now, torrent clients and open social network systems. We all grew up with these – as with early computers, where a generation of programmers cut their teeth on simple games and bulletin boards, the Internet benefited from 2 or more generations of kids growing up able to add their own value to the net. And make a buck from it, if they were so inclined.

Of course, as the systems at each level become more successful, the architecture for that level becomes more entrenched, harder to modify, and rightly so, since it works, evidently, and is critical infrastructure for the next level – and the we all go to the next level, where the action is.

2. THE CELLULAR OPPORTUNITIES

So what of the cellular telephone industry, arguably even more successful in the same period, the last two decades, at deploying a global, useful service to a world-wide population of approaching 3 billion in the next year. Arguably, this has reached more socially diverse groups than the Internet (certainly more end users) , and worked better to build other businesses, and social bonding, and make a buck for a lot of people at the same time. And so what might be wrong with the cellular telephone industry?

I think there is a catalogue of missed opportunities in mobile , many of which are the kinds of opportunities that the canned history of the Internet which I outlined above (however idiosyncratically), might teach us were available, with a modicum of imagination, but also, with a huge amount more transparency.

The cell phone service has not really changed in any way whatsoever that impacts any significant fraction of the user base in the past 20 years – I guess some pundits might like to claim that the business of SMS text messaging, or the business of ring tones is immensely innovative. As a commercial venture it has to be said that cellular industry has been highly creative, but its energies seem to be largely locked up in weird and wonderful ways to make vast amounts of money out of trivial additional services (spectacularly so when you consider the way they managed buying 3G spectrum licenses, and also when you look at the subtlety and ingenuity in the breadth of cell phone contracts available!).

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[1] No matter that this didn't get deployed -we do now have differentiation and traffic engineering.

[2] with the associated robust advertising revenue models

While I would be the first to defend commerce, I think this can lead down a long term, blind alley

I'd like to give three main examples of services which might have flourished in a more inclusive environment:

1. Handset operating systems make it extremely daunting to develop a decent widely deployable new application – one example is the idea of a mobile social network, which leverages co-location of smart devices to build up a set of social links, like the geo-physical analogue of the virtual online communities that use common interest to build up relationships. The diversity of APIs across the dozen or more different handset OSs available,(and non existence of features on some mean that portability is simply intractable. One has to carry out multiple, almost completely different implementations, so code bases are not sharable. Many other handset-to-handset applications could be deployed if the platforms were more tractable.

2. Failure to deliver location services affordably has meant all context based UbiComp ideas have only happened in wifi, and will now happen when new phones with gps or Galileo on come out which is a completely missed opportunity for them – knowing where a nearby gas station, or restaurant is should have been something available on all cell phones a decade back. Tracking down friends at a large concert, or ones kids, modulo privacy concerns should have been built in from 1990.

3. The value of the SIM and micro-billing efficiency that they have for calls and identity management has been closed to all other industries, but would also enable a whole slew of interesting services. Only this year do we see a major city (London) deploying a mechanism for people to pay to use public transport from a cell phone (combined with the Oyster travel card). Why was this sort of thing not deployed 10 years ago?

All of the examples above would have massive revenue streams associated with them, but only if the primary service is not expensive (or closed or exclusive) – the revenue would accrue from subscription, and from mining interests and potentially, from advertising – targeted advertising that proves its market worth (unlike, say, traditional broadcast advertising, which is rarely if ever evaluated in terms of its effective impact) is just one thing the Internet could teach the cellular folks – there are many others.

3. IS IT TOO LATE TO FIX?

One key aspect of the cell phone business is that it is structurally (and historically) different from the Internet business in some important ways. Most service providers build no equipment. They rely on equipment from a small number of telecom equipment companies who build the technology for the GSM, CDMA and UMTS infrastructure . They rely on a larger number of companies who build handsets. There is a great gulf between the core equipment manufactures and the handset manufacturers (compared, say to the distance between PC, workstation, server and router vendors, who share a lot of common history, and were all engaged in the same communities when discussing interworking).

A simple example of the harmful fragmentation that this causes is illustrated by the vast number of completely incompatible handset Operating Systems (famously, Symbian

OS and Windows Mobile, but at least 9 other major systems exist, and only one, Linux, is vaguely open and is quite possibly the least successful). Simple, but essential things to the application writer, such as power management, enabling/disabling bluetooth, and being able to forward between data over GPRS, wifi and bluetooth in a consistent manner, either do not work, or are carried out in completely different ways in different systems – even when the same system is on a different handset! It is like trying to work on Unix and Windows systems in the mid 1980s, only two orders of magnitude worse, as we have high expectations, and a much wider range of potential functions that we are obstructed from trying to use. I am sure the same is true within the network itself. Given the slow deployment of 3G, one must infer this is the case (although perhaps to be fair, a comparison might be with IPv6 in the Internet).

Even the computer console games industry is not faced with quite such a vast, and dysfunctional diversity. (there are even some open APIs for graphics for some games, although alignment between Sony, and Microsoft seems hardly likely).

Structurally, it is hard to see how they can get themselves out of the mess, and I think the situation is ripe for an Internet-style revolution which simply bypasses them. Those of us with long enough memories recognise this as a re-run of the battles with telecoms that best some earlier packet switching researchers.

We can see the artificial pressures placed on innovative companies such as the constraints put on the iPhone in terms of it being locked into networks, and being locked against 3rd party applications. What a truly bizarre fate for one of the most promising steps forward, given the history of the manufacturer. Other initiatives (the consistency of Windows Mobile 6.0 for example, and the advent of Google's android open phone initiative) also point the ways that end-to-end, Internet style thinking will find its way around obstacles to deployment, even as end-to-end, IP packets and the the Internet found its way around obstacles to just about anything in the past.

There are dozens of small companies out there itching to deploy a huge plethora of new ideas, far more interesting and profitable than anything I've mentioned above. There are also wonderful opportunities to make a smart phone the way that an entire new generation of kids get interested in programming[3], and enter computer science to set up a generation of new ideas for businesses ten or twenty years from now (the same could be said of games consoles, but I feel that that is far less likely to open up).

The revenue from voice traffic (and SMS and ring-tones) may be a very strong barrier to the cellular telephone industry switching over to an Internet style of business. This is understandable, but there are tipping points in markets, as the fixed telephone business discovered a few years back.

To finish on a positive note, then, there are opportunities for mobile, ubiquitous services which could be as exciting as the last 20 years of Internet services have been. There are ways this could come from within the industry, or it could arrive from outside. The industry could use its existing infrastructure, its knowledge of radio propagation, spec-

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[3]Of course, low cost laptops with good programming environments would be better, but there are large parts of the world where something with a primary use, like calling a doctor, might be a more justifiable expense.

trum utilisation, design of interfaces to backhaul, expertise in power management, for location services, for secure identity, for secure micro-payment, to accelerate this innovation, and, indeed, even leapfrog today's fixed Internet in fun and profit.

4. ACKNOWLEDGEMENTS AND POINTERS TO FURTHER READING

I am indebted to Jordan Auge of the Computer Lab, Meeyoung Cha of Kaist and Eng Keong Lua for numerous pointers to radical services in Japan and Korea, and for a bold set of attempts at end runs in the US and Europe including the Richard Stallman article on *Why 'Open Source' misses the point of Free Software* available at `http://www.gnu.org/philosophy/open-source-misses-the-point.html` and the notes on *Exploiting the iPhone* from `http://www.securityevaluators.com/iphone/` which make it clear that it is hard to resist opening Pandora's box, as well as *XBoX Media Center*, described at `http://www.xboxmediacenter.com/`, where the closed world of the games console has been laid open.

Pablo Rodriguez of Telefonica I+D provided some very useful commentary on the positive influence that open platforms, APIs and flat rates might have on future improvements in the situation. Tim Griffin from Cambridge also suggests an evolutionary path is available, where one establishes a special relationship for transparent IP over cellular, on a base station by base station basis, (perhaps analogous, almost in inverse to the one used by Fon (see `http://www.fon.com`) for voice over WiFi APs), and then adds a number of specialised, open protocols for each of the novel services. This might allow the cellular provider to mutate into a *Knowledge Plane* provider for the mobile Internet.

I would also like to acknowledge discussion with fellow members of the EU Haggle project (`http://www.haggleproject.org`), where we have battled with these problems to try to build useful applications on multiple smart portable devices.

Further discussion with Bill Lehr and David Reed of MIT during the Cambridge MIT CRN Project also helped clarified the arguments about openness and innovation. .