Untethered Local Communications: From Wireless Access to Social Glue

Renato Lo Cigno, DISI, University of Trento, Italy – locigno@disi.unitn.it

I. Foreword

Electric communications, wired or wireless, have always been about farther and farther connections: Marconi achievement was to cross the Atlantic in single hop; intercontinental telephone helped easing cold-war relations with the "red line" connection of the White House with the Kremlin; and finally today Internet collapsed the entire world (well, almost . . .) in a single flat community. The reason and the rational are simple: close-by communications are easy and the difficult and value-added asset is the connection of people far away.

The use of wireless transmission has been about untethering people from the plug where they access (long-distance) communications. Cordless, cellular, or WLANs they are all just means to *access* communications, never communication means themselves. Some notable exceptions like ad-hoc networks and some autonomous sensing and actuating systems may exist, but they do not change the broad picture.

Thus the global communication scenario is that of an integrated, centralized service, with humans and their devices spinning around as clients. Even social networks, probably the most intrinsically peer-to-peer communication models, are now in practice centralized, as facebook proves. Users 'google' (an intermediation server) instead of asking a friend to select a restaurant, exposing themselves to arbitration and manipulation. Users call their next-door friends with the cell phone, involving in the process nearly the entire telephone network . . . or they use Skype, possibly with the help of a couple of superpeers, acting as servers, hundreds of kilometers apart, instead of knocking on the door. Users are being 'fidelized' by their communication services to the point of being always online, always connected, always googling, facebooking, surfing, chatting, skypeing, messaging, . . .

Human communications, however, are richer, broader and more sophisticated than googling, chatting or messaging. Human communications are about establishing relations, exchanging sensations, building trust and making consensus using also non-verbal, non-formal communications as social scientists know better than computer scientists [1], [2]. Human communications are about staying together, sharing moods, joy, sadness, they are about encounters and farewells, they are physical, not virtual.

Our natural networking is not a virtual social network like Facebook, neither an augmented reality system full of avatars and imaginary lives, which are still (nearly) entirely detached from the physical world and life. Recently, however, some visionary works started delineating the idea of *"social computing"* [3]–[5], a generic, and often blurred, system where machines and humans interact (how??) on a peer base for the enhancement of society. Though some ideas spinning around the social computer may be (or just sound) weird, the grand idea of an ITC infrastructure that permeates and enhance society and life, but does not invade it, is fascinating. And at the heart of it lies the problem of information exchange, between devices and also between devices and humans.

II. The role of SRC

SRC —Short Radio Communications— call them WLANs, WPANs, Cellular LTE if you prefer, are in practice one of the big revolutions in networking of the last 10-12 years. And yes, a good question: What do they have to do with the jarring between the digital communications of the global Internet and our natural, social, analog, animal communications?

Actually, they do represent the potential entanglement of the two, the reason why two worlds entirely apart, just like two quantum particles can be separated by an arbitrary distance[1] but are still correlated, similarly the Internet and the SocialNet can meet and be the base for unforeseen evolutions of the 'social computer'.

One of the key issues, if not **the** key issue, is how these two networking universes can meet, and the answer is the evolution of SRC towards entirely novel architectures and principles, so as to make them a support of a future *SocialNet* as we can dub natural human communications supported by ICT, and not only an access to the Internet.

III. Foundation Issues

Transforming our wireless access networks into an entirely different system, which can support the envisaged pervasive and *very* local interaction and information exchange that are the base of the SocialNet, is far from an easy task and requires fundamental leaps ahead in our comprehension of communications and networks.

1) From global to local: As discussed above, our communication infrastructure has essentially a global scoping, with local communications representing only the access. The SocialNet requires instead a tiered scoping starting from local for the interactions with the close by environment and people, scaling to global only when it is needed.

[1]The quantum entanglement is the property in quantum mechanics that make one object of a quantum system to acquire a definite state, regardless of the distance, when a measurement on another object force this second 'entangled' object to acquire a definite state.

978-1-61284-188-5/11/$26.00 ©2011 IEEE

This requires new systems able to connect and communicate locally without the need of the global infrastructure. For instance, the naming and identification space of the communicating devices must be changed: DNS and IP are global systems, which are not suitable for the SocialNet. The communications at the base of the of the SocialNet must recognize the local scoping, and use appropriate identification systems that do not require global interaction: chatting with family and friends should not depend on or require the intervention of the state!

The point here is not economic (though we may find out in the end that the entire system results cheaper than today). The point is to evolve ICT communications to support and enhance the non-verbal, non-formal human communications by proper peering systems and techniques, recognizing, for instance a situation of group consensus building. This cannot be done unless SRC systems recognize autonomously the situation and become capable of conveying forms of non-verbal communications.

2) Distributed, informal trust: Trust management and identification/authentication in the Internet is centralized, while natural communications use different models. Centralized authentication and trust is suitable for commercial purposes, but not for the SocialNet, thus entirely novel systems for building informal, local trust between communicating devices are needed, supporting also fuzzy levels of trust, which are typical of the social natural interaction. We don't need a strong authentication system to trust somebody telling us the time.

3) Environment interaction: The SocialNet must also interact with the environment to give the system the context it needs to grab the semantics required to take decisions on the scoping of the communication (see the following point III-5).

One may claim that this is the "usual" wireless sensor network or "ambient intelligence". This is, to say the least, wishful thinking!

First of all, most works on WSN and ambient intelligence in particular are based on the assumption of an intelligent, active infrastructure, where the human and the local communication device are normally the most passive entity of the system. Not only this approach is complex, cumbersome and conceptually wrong, but it also poses unnecessary privacy issues. The situation should be reverted: the ambient and its sensing/communicating capabilities should be passive, and the active element should be the personal device, restoring the natural situation where humans (and their extensions) "know" the environment and not vice-versa.

4) Body interaction: As discussed at the beginning, rich human communications are (also) non verbal, based on body, mood, etc. This is one of the big challenges for ICT in general: developing capabilities for devices to understand and "read" the human being that are using them. Some advances have been recently done incorporating accelerometers and similar sensing systems in devices, but much more is needed.

5) Context, scoping and cognition: One of the basic functionalities that are required to SRC for SocialNet is the capability of understanding the context. This is fundamentally different from the so called "context-aware networking," where the assumption is that the users' devices communicate the local context (whereabouts, location, preferences, etc.) to the network, thus giving away the users' privacy. Understanding the context here means that the local devices must be able to understand the 'scope' of the communication and, consequently, it must have cognitive capabilities. Systems should be autonomous in taking decisions (e.g., on the communication subsystems to be used, but not only) based on the vicinity of the destination, on the context of the communication, and similar scenario variables.

Interestingly, one of the first "context" to be acquired is the vicinity of the destination, not necessarily its actual location. This is an information which is not difficult to know, but present days infrastructures in practice prevent to have access to it, because the communication model is client-server with the network as server, thus the information is retained at the server. At the human level, instead, we normally have a good perception, though a fuzzy one if we do not see or hear each other, if the person we intend to communicate with is in the same room, building, campus, or in another continent. A physical/access layer of the SocialNet which is aware of this is not difficult to design, but requires a different approach from the "wireless as access" dominant today.

The key term here is 'vicinity' and not 'location', thus we are just talking about the fact that the communication is close-by. This information need not be published (giving away privacy as in today cellular systems), but only shared locally during communication, thus increasing both privacy and security.

IV. Epilogue

There is no real conclusion to this summary of freewheel thinking about the evolution of SRC towards SocialNet, the local communication system supporting 'social computing' concepts, en route to an ICT science sustaining social evolution without invading society. Maybe some additional ideas can be found in the companion slides used for the talk (browse my web page for them).

The epilogue is that times seem mature to start global rethinking of networking, questioning and challenging the roots themselves of now dominant systems like cellular mobile communications and the Internet. Clean slate design should be focused on some needs coming from fields different from ICT, and not, as in many projects and proposal, on technical modifications to re-do the same (service- and model-wise) Internet or cellular system.

References

[1] M. Buchanan, "Secret Signals: Does Primitive, Non-Linguistic Type of Communication drive People Interactions?," *Nature* Vol. 457, n. 7229, pp. 528–530, Jan 29, 2009.

[2] A. Pentland, T. Heibeck, "*Honest Signals: How They Shape Our World*," MIT Press, Cambridge, MA, USA, 2008.

[3] aa.vv., *IEEE Computer Magazine* vol. 43 no. 11, Special Edition on "Cyberinfrastructure for Social Action on National Priorities," Nov 2010

[4] A. W. Woolley, C. F. Chabris, A. Pentland, N. Hashmi, T. W. Malone, "Evidence for a Collective Intelligence Factor in the Performance of Human Groups," *Science*, Sept 30, 2010

[5] The Social Computer home page http://socialcomputer.eu/, a FET flagship proposal.