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## Foreword

This book is about visions. Every sphere of human undertakings needs visions to proceed and to succeed. So do we, the engineering-scientist community in wireless mobile communications. However, early visions arose from sources other than engineering. As early as 1932, just after radio broadcasting had had a fledgling start and had been newly discovered as a means of propaganda, the German writer Erich Kästner had a vision that he expressed in a children's novel, *The 35th of May, or Conrad's Ride to the South Seas*: "But most impressive was this: A gentleman, who was coasting in front of them on the moving sidewalk, stepped down on the street, took a telephone from his pocket, spoke a number into the microphone and said: "Gertrud, listen, I'll be an hour late for dinner tonight. I have to go to the lab first. See you, honey!" Then he put away his pocket phone, stepped onto the moving belt again, continued reading his book and off he went." What a vision! The only thing Kästner did not foresee was that we would now telephone while on the move. It is all but a coincidence that a man of letters would voice such a prophecy. Language and communication are constitutive elements of mankind. We define ourselves by our social interactions, and for such we need to speak to each other. Some philosophers go so far to say that speaking to each other makes us human. Wireless mobile communications turned out to be the most rapid technology ever to reach a billion people (taking just 17 years) because it fulfils a basic human need: communication. The changes that wireless communications have brought about in society are enormous. It was not just becoming free from a certain location, the termination of a phone line, to be able to communicate over distance. It is the way we interact today socially, how we plan our activities, both private and business, how businesses have been accelerated by push-email. All these changes are unprecedented, as are mobile micro payments that have enabled economic growth in regions where banks are not accessible, but also the blurring of work and leisure times.

Societal issues and needs are the true drivers of technology. Thus, I welcome and applaud the concept of the *NEWCOM++ Vision Book* starting from the viewpoint of society's needs.

It is debatable whether wireless communication was invented in Europe, beginning with Guglielmo Marconi's pioneering work. In terms of *technology* alone, re-

searchers from Motorola and AT&T' Bell Labs, claiming priority for new ideas in telecommunications (as usual), and Japan's NTT have set undeniable, significant milestones. But, at the 1984 news conference announcing the divestiture of AT&T, the outgoing CEO, Charles Lee Brown, was asked what would become of AT&T's infant cellular properties. He could not give an answer. Either he wasn't aware there was such a business or, at least, he wasn't aware of its potential. In terms of *systems*, on the other hand, GSM ended the frustratingly incompatible standards for public wireless communications in operation in the early 1980's in Europe, and eventually in the world. Remember that GSM is rooted in a political decision taken by visionary European politicians at that time. Since then, European *industry* and *academia* have accomplished a magnificent job originating from the political vision of a pan-European mobile telephone system to the current de facto global standard. After the Paris 1986 technology beauty contest, a major decision was taken for a narrow-band TDMA access method, following essentially Scandinavian innovations. Interestingly enough, at that time, going digital was not an obvious decision but a courageous one. The European Commission clearly and deliberately saw GSM and its follower technologies (UMTS, HSPA, LTE) as a means to create a mass market and started to fund R&D in wireless communications. The funding comprised a two-tier approach, a cheap one and an expensive one. The expensive one, let me call it the "D" branch of R&D, started out modestly with a single Mobile Communications project in RACE I (i.e. the legendary R 1043), but soon exploded to innumerable projects. Making up the majority of projects in the Third, the Fourth, the Fifth, and the Sixth Framework Programmes of European funded industrial R&D, they however provided ever diminishing returns. After the enthusiastic, truly innovative period had faded out, some lines of research turned into run-on projects without vision. Most of the money flowed into large companies, some of which ceased to exist, while underfunded universities were condescendingly included in the consortia in order to have at least some novel ideas to present at the end of the project.

The cheap path, let us identify it as the "R" branch, started with COST Action 207 *Digital Land Mobile Communications* (COST stands for European Cooperation in the field of Scientific and Technical research) and was, beyond comparison, cheaper in terms of budget spent by the Commission. With participation of public and private telecom research centers, four universities and the research branches of several European telecom operators – indeed, in the days of monopoly operators, there did exist dedicated research branches, some even staffed with thousands of researchers and engineers! – clarified many open technological issues in GSM's specification phase. A key contributor to GSM's success was the cooperation among colleagues modeling the radio channel and those who would use these models to base their decisions on competing proposed technological solutions. The agreed-on "typical models" – I would prefer the term "reference models" – for rural areas, (RA), typical urban (TU), bad urban (BU) and hilly terrain (HT) have become legendary. The successor actions, COST 231, 259, 273, and 2100 turned out to be as high-yield for wireless as low-budget for the Commission.

The general discontent with the situation of heavily funded industrial R&D and underfunded academic research in many technology areas finally lead to the estab-

lishment of Networks of Excellence in European research, of which NEWCOM++ is a grand example. NEWCOM++ was graded as the best proposal in the Sixth Framework Programme's call for an NoE in "Systems Beyond 3G". However, another contender originating from the COST track had valuable expertise in the radio channel and network areas. Bearing this in mind, the NEWCOM++ management made the brilliant move to merge the best of both proposals.

What will be the future of wireless communications? This book indicates possible technology paths to this future. It would be great to give specific answers, but I can formulate only questions. Who will dominate the value chain? Content, carriers, or vendors? I would not go as far as calling the *apps* business a parasitic industry, but, in the words of a non-European service industry leader, "We're continuing to invest to carry the data but we're not really monetising it and this is a global issue that we have to address." The apps hype will lead to more important questions about our way of handling them (or not). Brain research and psychology tell us that humans are not very good at time-sharing, but "always on" forces us into that direction. Will we be able to resist downloading every piece of information offered to us? Will we stay free of gadgets, which are so extremely useful that we yielded to them without realizing that we already have become addicted? Isn't there a hazard to lose skills that in our evolution had been essential for survival? Assuming that many of our daily activities will be handled by apps from our smartphone – or whatever it will be in the future – what will happen, if there appears this tiny little bug disabling the phone? Or it runs out of power at a place where we cannot reload our battery?

In the past, the vast majority of forecasts about numbers of wireless communication users had been consistently on the low side. Recently, I read about a forecast of 50 billion (!) connections by wireless world-wide. Machine-to-machine evidently will have to make the majority of these. Will we communications engineers succeed to reduce the power requirements of these connections to levels that power engineers will be able to supply?

Looking at today's European wireless industry, I see dark clouds hovering. Of course, as wireless communications has become a commodity issues other than scientific ones prevail, by necessity mostly commercial ones. Instead of regarding research as an asset to make future business, inflated controlling and marketing departments at vendors and operators consider research merely as an element of expenditure. Handing out subsidized phones and implementing flat-rate policies ("1000 minutes for free") have given the public the notion that wireless isn't worth much, while shaking the commercial basis of operators. Despite obviously fierce competition, which turned into nothing less than a suicidal fight for market shares, sector-specific regulation still applies for operators – a singular atavism in Europe's neoliberal policies. In contrast, parasitic industries flourish, like selling esoteric plastic chips (without any effect at all) claiming protect against the never-proven hazards of cell-phone radiation.

What can we learn from this brief recount? First, practising cooperation and sharing knowledge is the best way to promote engineering, innovation, and science. The success of NEWCOM++ success is vivid proof. Second, as scientists/engineers are replaced by marketers, it will require new scientific visions to regain Europe's lead in

wireless communications. And third, communications engineers, who have a proven record to enhance mankind's abilities, will have to focus on responding to other basic personal needs, as there is security, recognition, possibly play/entertainment, without putting at stake our autonomy.

Enjoy reading about the visions of NEWCOM++!

Vienna, May 2011

*Ernst Bonek*

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## Acknowledgements

This book is the result of an *integrated* effort of many excellent European researchers all inhabiting for a few years a one and only large virtual laboratory: the European *Network of Excellence in Wireless COMMunications* NEWCOM++ supported by the European Commission's research Framework Program 7. The main objective of a Network of Excellence (NoE) is creating an environment to foster cooperation across the different excellent research Institutions in Europe, and nurturing an attitude towards *integrated research* in a new generation of young researchers. In particular, NEWCOM++ started in January 2008 and ended in April 2011, and its purpose was addressing medium/long term, complex, interdisciplinary, fundamental research problems in the field of wireless networks, with a specific focus towards identifying, casting into the right modeling perspective, and at least partially characterizing the information-communication theoretical limits.

This "Vision Book" is the indirect results of the many researchers who contributed to the success of the NoE, and whose invaluable work we would like to explicitly acknowledge here. The reader will see their names at the start of the papers they contributed to prepare – we just say that it was a pleasure coordinating such a distinguished group of people. But we would also like to explicitly mention the Technical Officers of the European Commission, DG Information Society, who helped us shape, support, and sustain NEWCOM++: Peter Stuckmann and Andy Houghton whose precious and continuing cooperation was the soil on which our research rooted and grew.

In addition to the contributors that appear at the beginning of each paper, a special mention goes to Giacomo Bacci from the University of Pisa whose help in collecting all the contributions, giving them a uniform and coordinated shape and assemble what could be called "a manuscript" was invaluable.

Seeing so many young researchers working together and wishing to pursue a career in research was the best reward we could have asked at the time when we started NEWCOM++. As an encouragement to all those who still wish to pursue a career in research, we conclude this acknowledgement section with a quote by the Danish-born scientist Niels Stensen (1638–1686, Latinized *Nicolaus Steno*), discoverer of the *ductus stenorianus* (the duct of the parotid salivary gland):

*Pulchra Sunt Quae Videmus*  
*Quae Scimus Pulchriora*  
*Longe Pulcherrima Quae Ignoramus*

or, in plain English,

“Beautiful is what we see  
More beautiful is what we know  
Most beautiful by far is what we still ignore”

*Sergio Benedetto*  
*Luis M. Correia*  
*Marco Luise*

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