NEWCOM Advisory Board Review of Scientific Deliverables
Evaluation form

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Document under Review: **DR 1.1: Signal Processing for Wireless Networks**

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Identification of knowledge gaps: Are the identified topics timely and important? Are there topics missing?

This is a high-quality report covering a broad front of research in wireless. It does not address topics at the device layer such as integrated circuits and antenna design, nor does it address higher protocol layers and applications. Its focus is on information theory, communications and signal processing for wireless, and within this layer the report lays out a comprehensive research program. The individual researchers are first-rate, and there is the potential for real synergy between the different groups.

One might have expected that *ad hoc* networks would be represented in this report, but they appears to be covered in a different Newcom project. We expect that coordination between the two projects will be part of the overall management plan for Newcom.

For each of the identified topics, there is reason to believe that progress will be made, and in some cases results have already been obtained. Overall, one can expect world-class research over all active topics within its layer.

One might consider adding a few highly speculative topics that have an entirely different character; *i.e.,* the project might lead to a spectacular success, but the probability of that success appears small. An example of this type of research topic might be to study the practicability of time-reversal in wireless. It might well turn out that this is a dog that does not hunt – certainly, nobody has managed to find a useful balance between precoding at the transmitter and equalization at the receiver in wireless. If it does turn out to be practical, however, then the potential value of time-reversal would include highly secure wireless communication, and that would likely motivate applications. It has been shown that interesting things are possible in water (see the work of Mathias Fink), where the combination of time-reversal with advanced coding and modulation for MIMO systems may well enable higher-rate communication with autonomous underwater vehicles.

Action Plan: Is the envisioned plan effective to fill the identified research gaps? Are there actions to be added?

The action plan is well constructed. One expects that one of the lasting benefits of this large-scale collaboration is that researchers in Newcom will get a much better perspective on the relative priority of various research areas, not least their own. Just producing a document like this is bound to be stimulating and educational.

It might also be useful to maintain an inventory of the state of the art in wireless communication, in industry as well as in academic research. We recommend participation in standards activities, which would provide access to industry standards submissions. These provide a common language for a dialogue with infrastructure vendors (*e.g.*, Ericsson and Nokia), and inform participants about when industry innovations (for example, HSDPA) will be available in the field. Standards contributions are also useful in that they document link requirements for services and capacity requirements for networks, which would provide a common language for dialogue with carriers. Outreach to industry may lead to new project directions.

Although this is a wireless project, advances in signal processing often impact completely different areas. It might be useful to maintain an inventory of possible secondary application areas and contacts from these domains who could make the bridge to signal processing. For example, it is not a stretch to suggest that fundamental advances in message-passing algorithms might find application in understanding gene expression (see the work of Brendan Frey). We have already seen connections between statistical physics, computer science and the asymptotics of message-passing (*e.g.*, the work of Marc Mézard and Andrea Montanari). Such far-flung connections are icing on the cake, but serendipity is something that excites sponsors.

Research Group: Is the research group matched in skill and consistency to the research effort and challenge? Are there research groups in Europe that could add a substantial contribution?

These are challenging problems, to which the research team is appropriately matched. The issue is not whether every distinguished European researcher is a participant, but whether the team as a whole has the necessary skills.

This Newcom project is the root of a tree; the direct participants form the next level of nodes; and their research collaborators and colleagues form a still larger network. The total number of researchers with an opportunity to contribute to Newcom is impressive.

It is worth thinking about how to capture the innovation in the larger network of *all* European researchers, industrial, and academic, for Newcom. One mechanism might be sponsorship of a small conference with talks by Newcom participants and invited talks by other research groups (*e.g.*, EPFL, Tel Aviv, Linköping, IBM, Philips, Motorola) in the larger network.