

ICC'2006

Cooperative Strategies for Future Wireless Communication Systems

Organizers: Frank H.P. Fitzek, Aalborg University and Marcos Katz,
VTT Electronics

Date and Time: Tuesday, 13 June 2006, 14.00-15.30 hs.

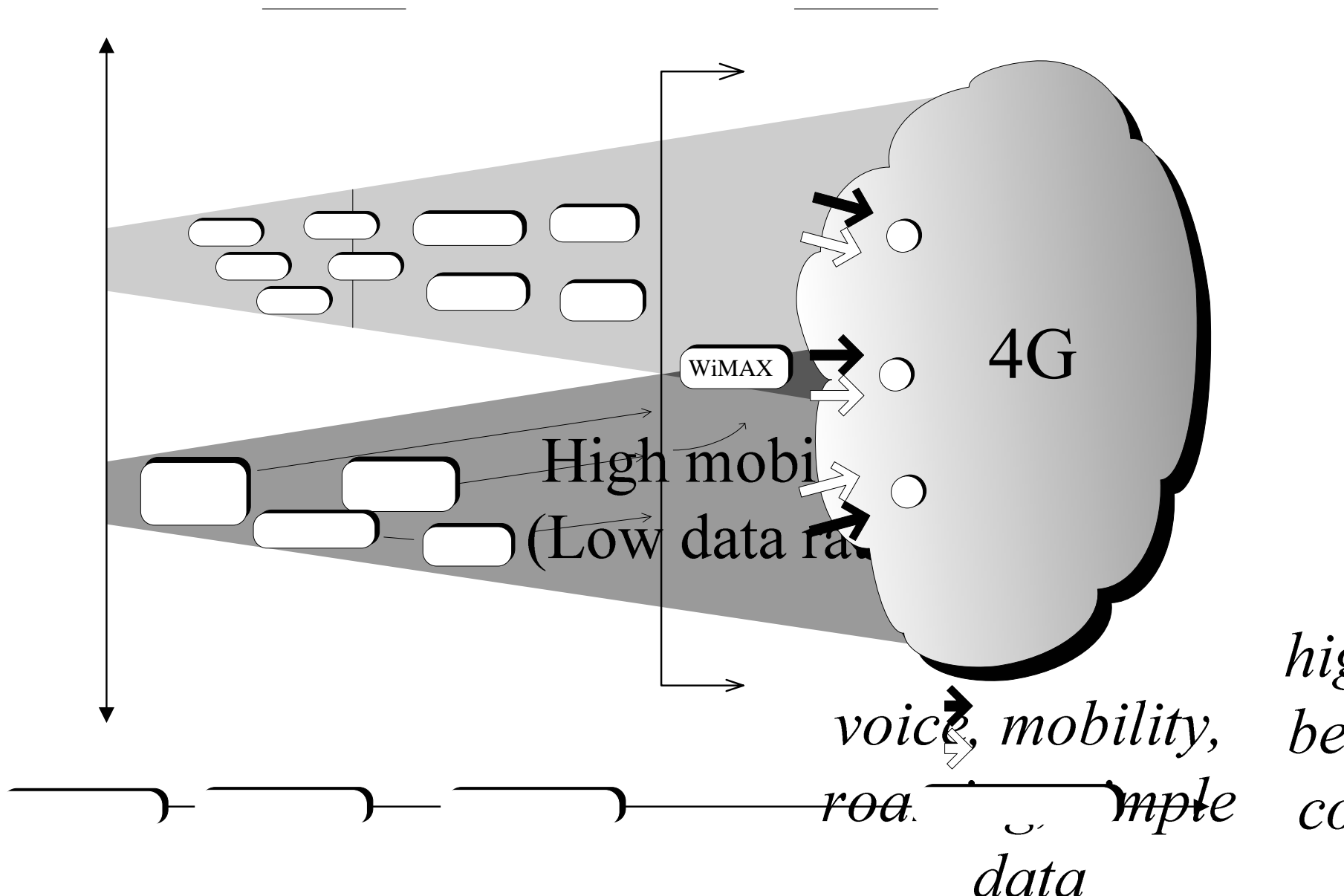
Panelists:

- **Halim Yanikomeroglu**, Department of Systems & Computer Engineering, Carleton University.
- **Matthias Lott**, Siemens.
- **Shuguang Cui**, Dept. of ECE, University of Arizona.
- **Frank Fitzek**, Aalborg University.

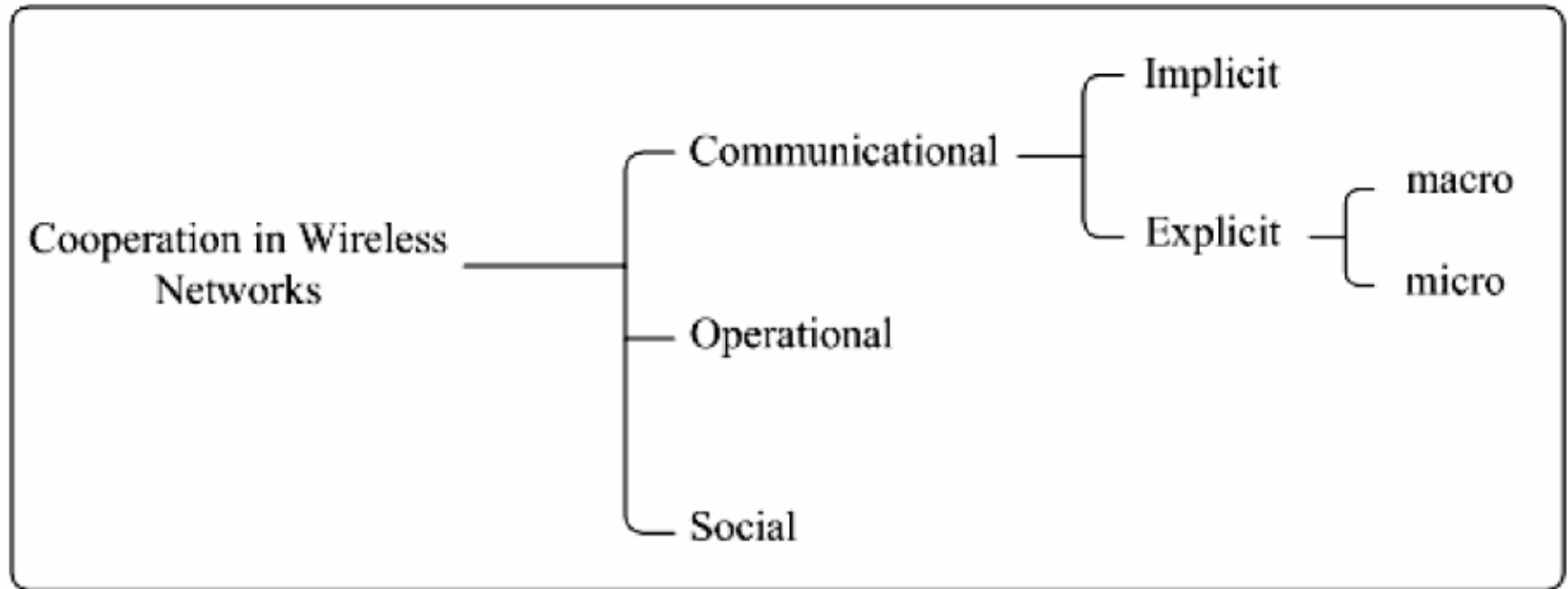
Defining 4G

- A **network of networks** characterized by **convergence** and **heterogeneity** of **terminals, networks** and **services**.
- Two main components:
 - Wide-area, centralized architecture, licensed spectrum.
 - Local-area, distributed (ad hoc) architecture, license exempt spectrum.
- Gluing element enabling widespread interconnection is the use of the IP protocol in the access and core networks.
- Less UL/DL traffic unbalance due to advanced terminals (users ultimately will become service providers)
- High flexibility: Highest ever available degree of granularity of resources, e.g. spatial and frequency domains

Evolution of wireless and mobile networks toward 4G



A classification of cooperation from the mobile and wireless communications perspective



Defining cooperation in wireless networks

- **Communicational cooperation:** Techniques exploiting the joint collaborative efforts of multiple entities in the system aimed at bringing some advantages like enhancement of performance and better use of resources.
 - Entities like signals, algorithms, processing elements, building blocks and complete units interact mutually in order to improve performance.
- **Operational cooperation:** Interaction and negotiating procedures between entities required to establish and maintain communication between different networks.
 - The main target is to ensure end-to-end connectivity, where the main players could be different terminals operating in different networks

Defining cooperation in wireless networks (cont.)

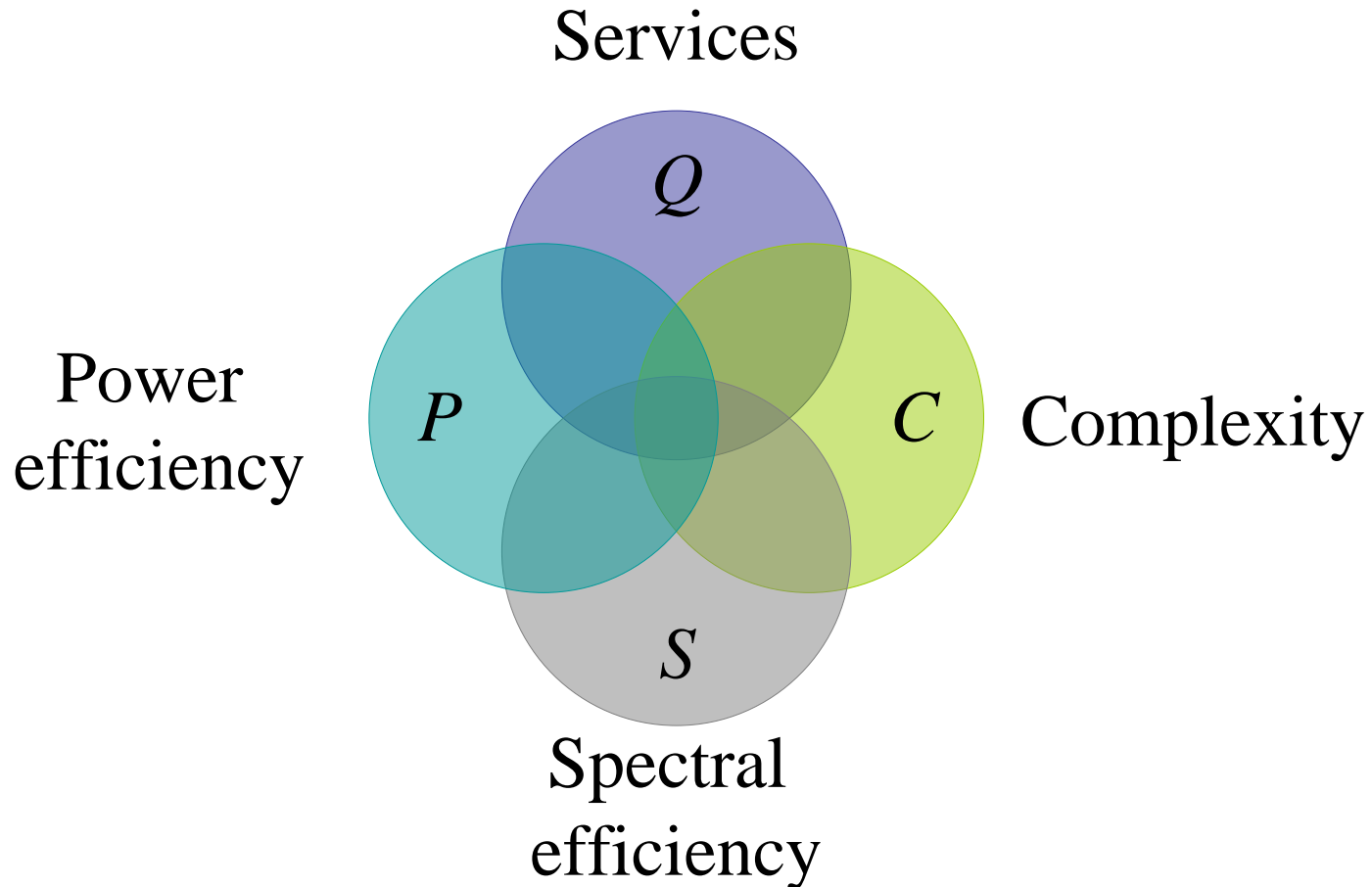
- **Social cooperation:** Dynamic process of establishing and maintaining a network of collaborative nodes (*e.g.*, wireless terminals).
 - The process of node engagement is important as each node needs to decide on its participation in a (ad hoc) network, having each decision an individual and collective impact on performance.
 - Unlike the previous approaches, in this arrangement each user is in a key position as he or she ultimately decides whether to cooperate or not.

Defining cooperation in wireless networks (cont.)

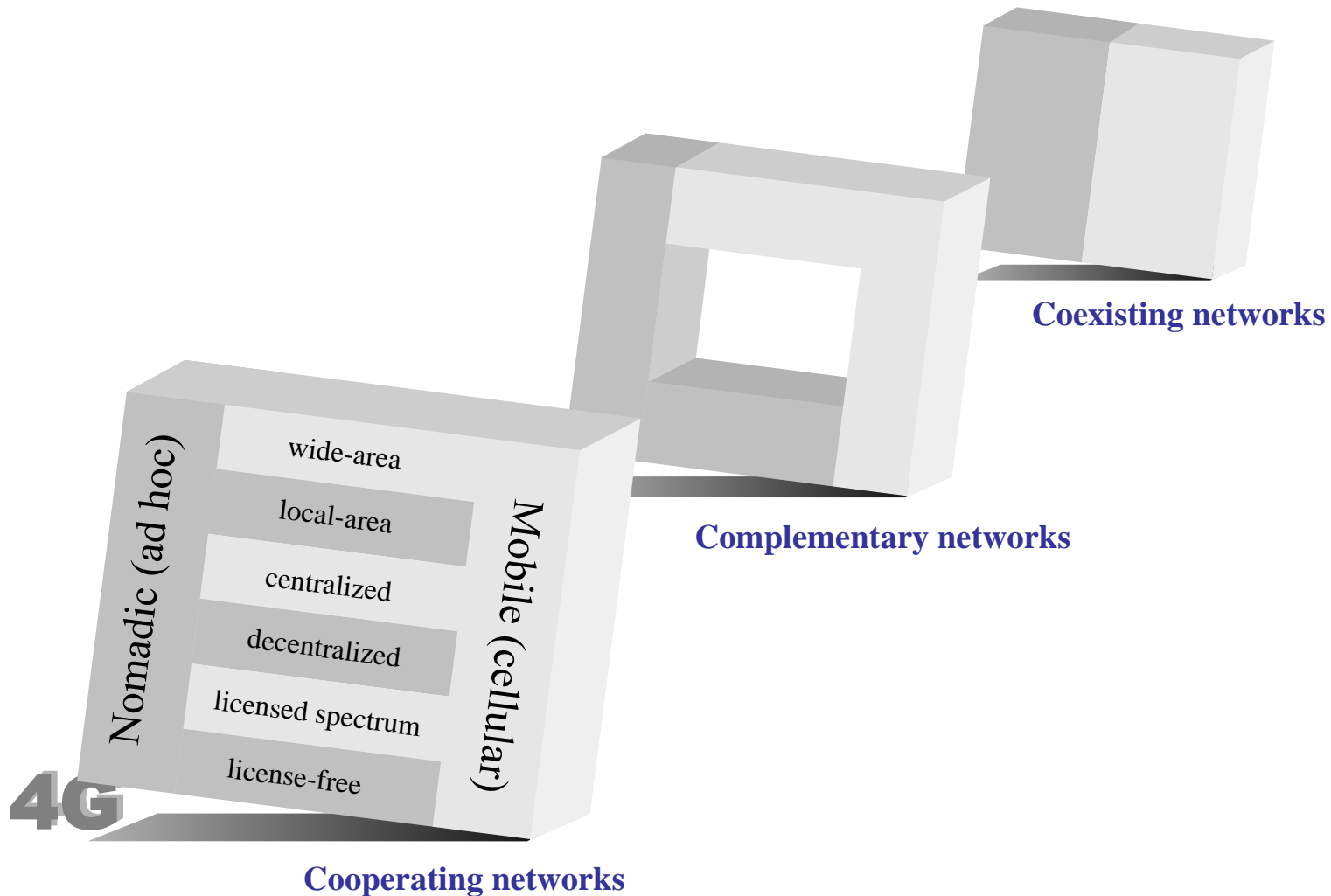
Communicational cooperation:

- **Implicit:** Interaction takes place without any pre-established cooperative framework. Cooperation focuses on the fair sharing of a given resource without gaining anything else. E.g., protocols.
- **Explicit:** Established through a given framework. Cooperative behavior is allowed and supported by design, allowing counterpart entities to actively interact directly with each other.
 - **Explicit Macro Cooperation:** Wireless terminals, virtual access points and wireless routers.
 - **Explicit Micro Cooperation:** Microscopic cooperating entities like functional parts, processing units and algorithms.

Key performance measurement figures that can be enhanced by using cooperative techniques



Evolving views of future heterogeneous wireless networks



From competition to cooperation

Conclusions

- 4G is a very fertile ground not only for researching on cooperative techniques but also for applying them in real systems.
 - Highly heterogeneous systems (networks, terminals and services)
 - High granularity of resources available
 - Different network architectures (e.g., centralized, distributed)
 - Cooperative techniques have the potential to enhance
 - Network and link performance, QoS, spectral and power efficiency, etc.
 - Cooperation can take place within any OSI layer and accross them.