COST289
Spectrum and Power Efficient Broadband Communications

PROGRESS REPORT

Period: 1 July 2004 to 30 June 2005

Web site: http://cost289.ee.hacettepe.edu.tr

TC-TIST & MC Chairpersons Meeting, 28 June - 1 July 2004, Vitznau, Switzerland

Management

- Chair:
  - Prof. Dr. Mehmet Şafak, Hacettepe University, Ankara, Turkey
- Vice-Chair:
  - Prof. Dr. Hermann Rohling, Technical University of Hamburg-Harburg, Germany
- Secretary:
  - Researcher Serap Haşimoğlu-Ertaş, Hacettepe University, Ankara, Turkey

Signatories

- Start date: 23 April 2003

  End date: 22 April 2007
- Signatories: 18+1

  Belgium, Bulgaria, Czech Republic, France, Germany, Greece, Hungary, Italy, Norway, Portugal, Romania, Serbia and Montenegro, Slovak Republic, Spain, Sweden, Switzerland, Turkey, UK, Malta
- Participating Organizations: 30

Management Committee Meetings

- 1. MCM: 24 March 2003, Brussels, Belgium
- 2. MCM: 3-4 July 2003, Hamburg, Germany
- 3.MCM: 30-31 October 2003, Kosice, Slovakia
- 4. MCM: 25-16 March 2004, Zurich, Switzerland
- 5. MCM & 1st Workhop: 7-9 July 2004, Budapest, Hungary
- 6. MCM: 28-29 October 2004, Barcelona, Spain
- 7. MCM: 6-8 March 2005, Munich, Germany
- 8. MCM & 2nd Workshop: 6-8 July 2005, Antalya, Turkey

Project Groups

- Wide Area Coverage with High Mobility Access Systems for 4G
  - Centralized systems with high mobility, lower data rates and wider coverage areas
- Pervasive Wireless Access for 4G
  - Decentralized systems with low mobility, higher data rates and restricted coverage areas
- Software Defined Radio (SDR)
  - Bridges the two projects horizontally

Wide Area Coverage with High Mobility Access Systems for 4G

- Coordinator: Prof. Arne Svensson (Chalmers University of Technology)
- Participating organizations (10): Chalmers University of Technology, University of Florence, Ramonn Llull University, CEI-CETI, University Carlos III of Madrid, Hacettepe University, TU Kosice, Czech Academy of Science, Norwegian University of Science and Technology, DLR

Wide Area Coverage

- Intense research efforts are currently ongoing towards the definition of physical layers for 4G systems.
- For the downlink, there are several proposals based on
  - OFDM transmission techniques, and
  - the combination of OFDM and CDMA

Wide Area Coverage

- The typical parameters for the downlink include
  - Available downlink bandwidth is 100 MHz
  - Carrier frequency around 5 GHz
  - Maximum speed is 250 km/h
- The downlink design is simpler than the uplink design, since it is all about multiplexing within each cell.

Wide Area Coverage

- In the uplink, the situation is more complicated,
  - since a combination of multiplexing and multiple access takes place in each terminal when more than one service is transmitted at the same time.
- The uplink is also normally asynchronous and oscillators in different terminals are not synchronized.
- This may suggest that OFDM can not be used in the uplink due to its sensitivity to frequency synchronization errors.

Wide Area Coverage

- Typical uplink parameters
  - Wide area coverage (cell of similar size as 3G)
  - High mobility < 250 km/h
  - Carrier frequency around 5 GHz
  - Available uplink bandwidth 40 MHz
  - ITU requires 100 Mbps (is this possible in 40 MHz bandwidth?)
  - Multiple cell system
  - UMTS channel models

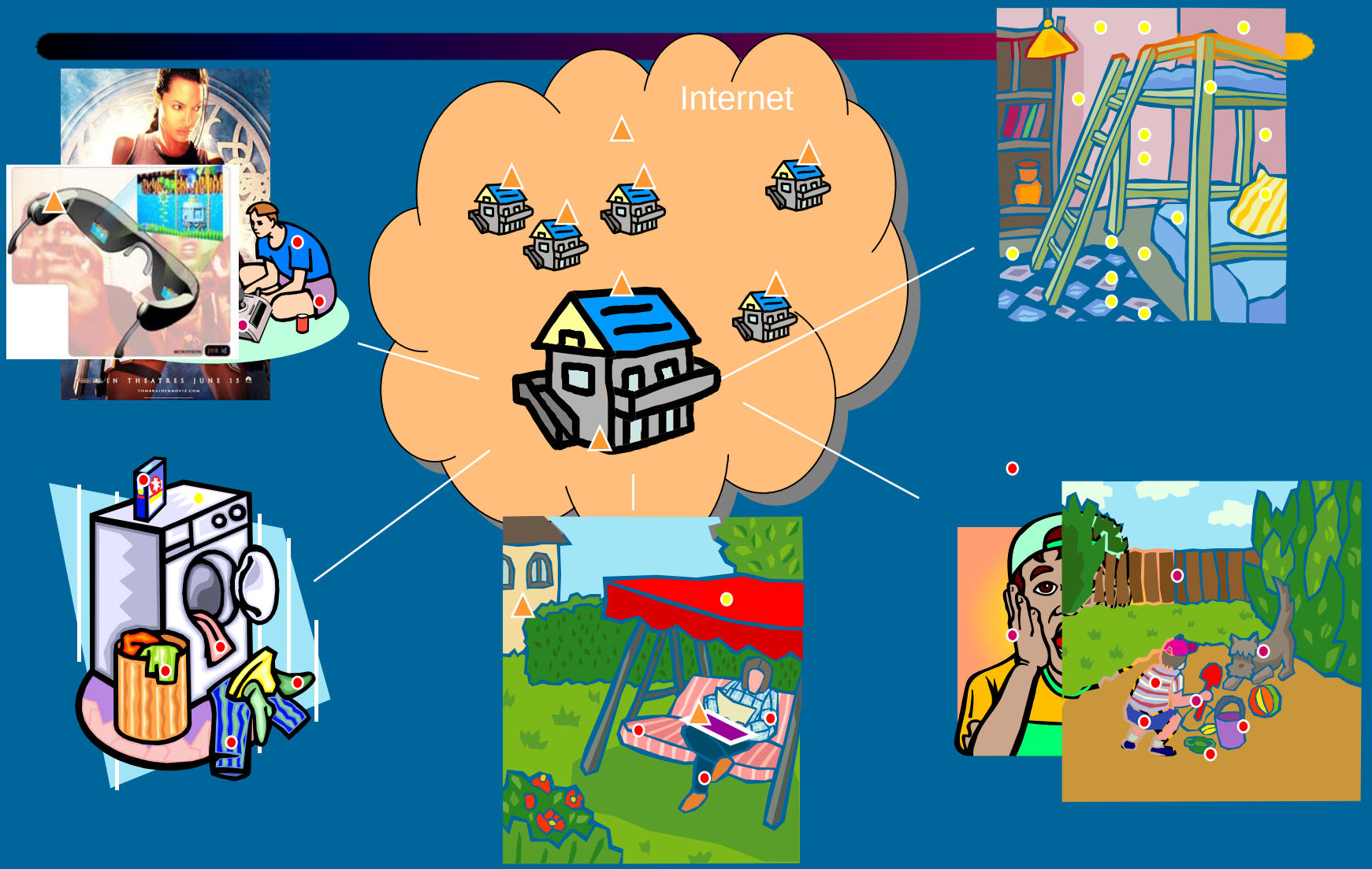
Pervasive Wireless Access for 4G

- Coordinator: Prof. Armin Wittneben, ETH Zurich
- Participating Organizations (6): ETH Zurich, Hacettepe University, Norwegian University of Science and Technology, University of Ulm, Budapest University of Technology and Economics, University Carlos III of Madrid

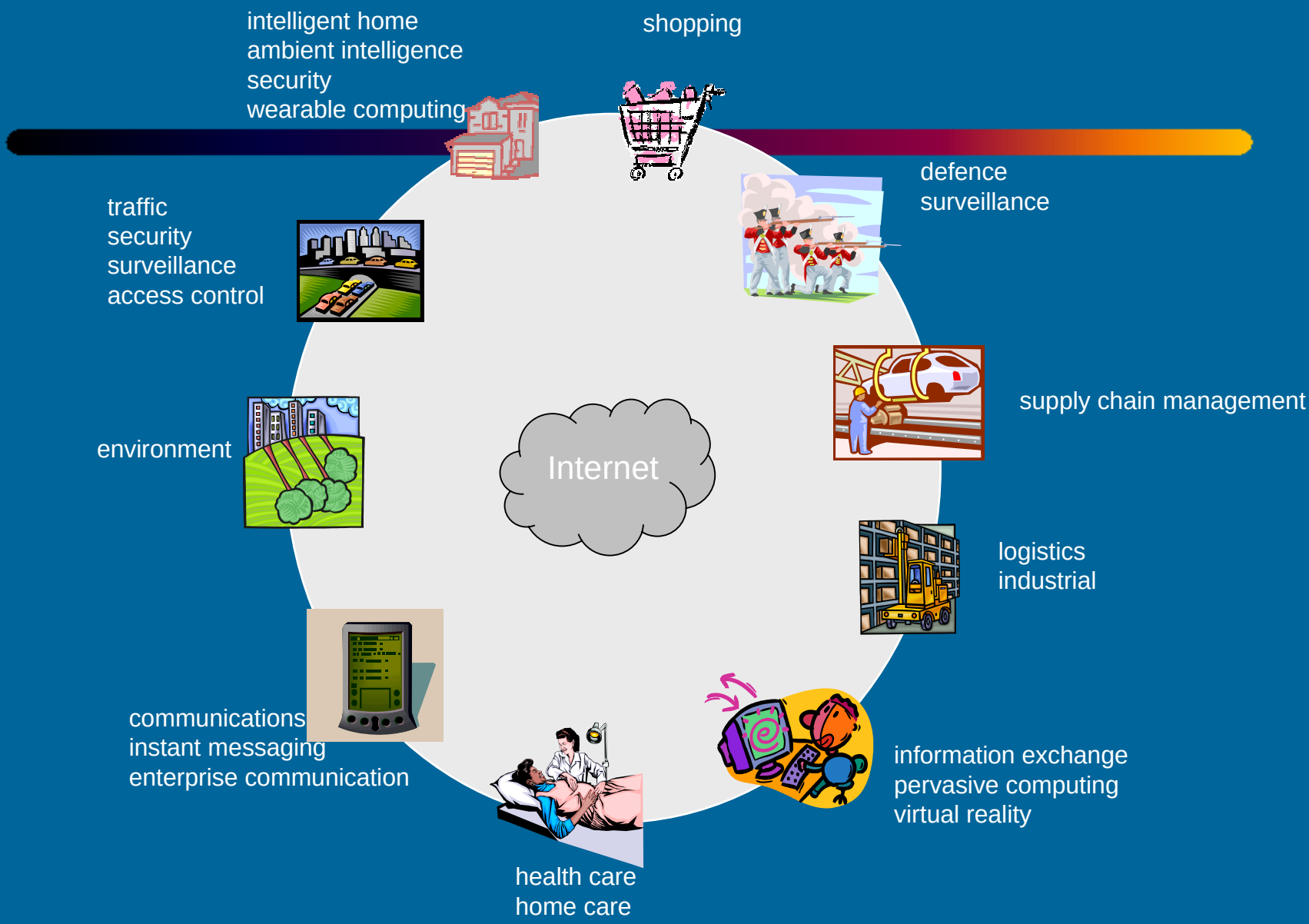
Pervasive Wireless Access for 4G

- Pervasive wireless access networks imply next generation WLANs that will provide ubiquitous connectivity
  - for a variety of heterogeneous nodes, e.g., RFID tags for object identification, sensors and computers,
- Data rate requirements :1 Mbps - 1 Gbps.
- We foresee high node density and low node mobility

Pervasive Wireless Access: Home Scenario



Applications of Pervasive Wireless



Pervasive Wireless Access for 4G

- For spectral reasons, the next generation WLANs will operate beyond 5 GHz, e.g., 17/24 GHz ISM bands.
- In the 17/24 GHz ISM bands, we face a poor scattering/rich array situation as opposed to the rich scattering/poor array situation at 5 GHz.

Pervasive Wireless Access for 4G

- Pervasive wireless access networks will exploit
  - Cooperative signalling, which has a potential to benefit from spatial multiplexing in poor scattering channels.
  - adaptive modulation and spatial multiplexing (MIMO) for scalability and spectral efficiency
  - adaptive scheduling to meet heterogeneous QoS requirements

Important Work Items within COST 289

- adaptive distributed space-time processing
- adaptive modulation in cooperative wireless networks
- adaptive scheduling in cooperative wireless networks
- cooperative multiple access
- Multihop / multinode forwarding

SDR

- Software Defined Radio (SDR) :
  - Coordinator: Prof. Sandor Imre, Budapest University of Technology and Economics
  - Participating Organizations (4): Budapest University of Technology and Economics, University Carlos III of Madrid, Ramon Llull University, Politechnical University of Catalunya

SDR

- Inter-system roaming and handover (e.g. due to traveling or multiple coverage) would require implementation of many different standards in a single radio terminal/base station.
- Reconfigurable equipment with universal hardware and downloaded software can solve the problem efficiently.
- Easier and cost-efficient system upgrades.
- Efficient design of reconfigurable radios.

SDR

- The efforts are focused in
  - the physical layer organization (DSP-type or INTEL-type philosophies)
  - downloading and reconfiguration algorithms and protocols
  - Specific hardware architectures that allows, e.g.,
    - reconfiguration with a minimum power consumption penalty
    - dynamic adaptation to the variations in user traffic

1st Workshop

- The aim was to create an opportunity to discuss and to encourage cooperation for the joint research projects
- Held in Budapest during 7-9 July 2004.
- Invited speakers:
  - Prof. L. Hanzo, Southampton University
  - Dr. H. Atarashi, DoCoMo, Japan
  - Prof. A. Wittneben, ETH Zurich
  - Prof. Joan Lluis Pijoan, Ramon Llull U., Barcelona

2nd Workshop

- To be held in Antalya, Turkey, during 6-7 July 2005
- Invited speakers:
  - Prof. H. Rohling, TU Hamburg-Harburg
  - Prof. A. Wittneben, ETH Zurich
  - Prof. A. Polydoros, University of Athens
  - Prof. M. Sternad, Uppsala University, NoE WINNER

Statistics

MCM	Participants	Presentations	Tutorials
1st MCM, 24 March 2003	12		
2nd MCM, 3-4 July 2003	16	7	
3rd MCM, 30-31 Oct. 2003	25	8	
4th MCM, 15-16 March 2004	30	12	
5th MCM and 1st Workshop, 7-9 July 2004	40	20	4
6th MCM, 28-29 Oct. 2004	30	11	1
7th MCM, 7-8 March 2005	35	6	1

STSMs

Host	No. of Visitors	Project
Prof. Arne Svensson, Chalmers U. of Technology	5	Wide Area Coverage for 4G
Prof. Hermann Rohling, Technical U. Hamburg-Harburg	1	Wide Area Coverage for 4G
Dr. J. P.Romero, U. Polytechnic Catalunya	2	SDR

Cooperation

- Dr. Hiroyuki Atarashi, DoCoMo,

  Broadband Packet Wireless Access and its Field Experiments.
- Prof. Lajos Hanzo, University of Southampton,

  Recital on Multicarrier Communications: Space-Time Coded Versus Adaptive OFDM/MC-CDMA.
- Simone Morosi, *University of Florence, NoE NEXWAY,*

  Reconfigurable Antennas for Future Wireless Communications

Cooperation

- Stefan Kaiser, DLR

  Overview on MC-CDMA
- Prof. Mikael Sternad, Uppsala University, NoE WINNER

  The WINNER beyond 3G air-interface.
- *Dr. P. Fazekas, BUTE, NoE in Wireless COMmunication (NEWCOM)*

  Structure, aim and achievements.

Dissemination Plan

- Three workshops will be organised
- An e-mail network is already established
- The web site of the Action is used
  - for communication within the Action
  - to convey aims and objectives to scientific community
  - to disseminate the results and developments
  - to advertise important activities
  - for accessing the publications of the Action members