Future Radio Access
-FUTURA-

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Introduction

- FUTURA is one of the four spearhead projects of TEKES NETS (Networks of the Future) Technology programme.
  - 190 man-months in 2002
  - 206 man-months in 2003
  - 226 man-months in 2004 (planned).
- Basic research:
  - Develop *general theory and techniques* that can be applied in various applications
Sponsors

- TEKES
- Nokia Technology Platforms (Nokia Mobile Phones)
- Nokia Networks
- The Finnish Air Force
- Finnish Defense Forces Technical Research Centre
- Elektrobit
- Instrumentointi
- CWC
Project Definitions and Objectives

- Develop future (“4G”) broadband wireless:
  - Systems and radio interfaces
  - Related advanced transceiver algorithms
  - Networking techniques

- Applications:
  - 3G evolution and beyond 3G cellular systems,
  - WLAN's and PAN’s,
  - new military communication systems.

- The main emphasis
  - develop the basic technology knowledge needed for different future applications.
Project Definitions and Objectives

- Outputs:
  - Academic theses and publications
  - Inventions (patents)
  - Direct support of sponsor companies system development
    - system concept development
    - involvement in hardware demonstrations
  - Input for standardization by sponsors
Progress toward the Plan

• RA1: Radio Interfaces: 30 % emphasis
  – Adaptive Radio Links
  – MIMO Techniques (Signal Design for MIMO Channels)
  – Multiple Access Schemes (Future Broadband Communication Systems)

• RA2: Transceiver Algorithms: 30 % emphasis
  – Synchronization and Channel/Parameter Estimation
  – Interference Suppression
  – Detection and Decoding Algorithms
Progress toward the Plan

• RA3: Wireless Networking: 15 % emphasis
  – Network Architectures for 4G
  – Radio Resource Management for 4G

• RA4: 4G Systems: 25 % emphasis
  – Air Interface Comparisons
  – Flexible and Dynamic Use of Spectrum
  – Simulation Environment for Multicell Network
  – Testing and Verification with Field Measurement Data
  – System Concept Description and Promotion
Major Achievements

- Insight of ARL usage
- Unique and deep knowledge on
  - space-time coding
  - spreading matrices
- New results on MC-CDMA concerning
  - performance evaluation
  - multirate analysis
  - channel estimation
- New way of synchronisation with antenna arrays
- New interference suppression algorithms
- Iterative detection for FH-SS
Major Achievements

• 4G candidates:
  – Multicarrier for downlink?
    • MC-CDMA appears to be flexible and robust
    • Adaptive OFDM can provide high capacity with TX-CSI

  – Single carrier with an equalizer for uplink
    • turbo processing
Intellectual Contribution 02-04

- **Scientific publications in:**
  - Published/Accepted Journals: 25
  - Submitted Journals: 16 => 41
  - Published/Accepted Conferences: 82
  - Submitted Conferences: 5 => 87
  - National magazines: 2

- **Patents:**
  - Invention reports: 23
  - Filed patent applications: 7

- **Theses (2 Dr, 2 Lic, 6 Master):** 10

- **Seminars/Workshops:** 4

- **Presentations/Reports:** appr 40
Impact for Out-World and Sponsors

- Journals, conferences and theses
- Open seminars
- Closed seminars for sponsors
  - for sponsors 2002, 2003, 2004
- Monthly presentations for sponsors
  - 2-3 long (30 min) presentations on the topics
  - brief summary of all topics (ppt)
- Outputs and results from previous month