TNO
A CONTRACT RESEARCH ORGANISATION

• About TNO
  • Founded by law in 1930
  • Partner in innovations
    (e.g. assistance of companies that have no in-house R&D)
  • Independent of public and private interests

• Features
  • Many disciplines under one roof
  • Expertise from concept to innovation
  • International footprint and client base

• Key figures*
  • Annual turnover: EUR 553 mln
  • 5100 employees

* in 2003
TNO
ACTIVE IN FIVE CORE AREAS

TNO Quality of Life
TNO Defence, Security and Safety
TNO Science and Industry
TNO Built Environment and Geosciences
TNO Information and Communication Technology
TNO ICT

• About TNO ICT
  • Established on January 1, 2003
  • Bundling of former KPN Research with TNO’s ICT related departments
  • One of the largest ICT knowledge centers in Europe

• Features
  • ICT: both Telecom and IT
  • Multi-disciplinary: technical, economical, sociological
  • Contract research & consultancy
    • For both industry & government
    • Diverse labs, test centers

• Key figures*
  • Annual turnover: EUR 40 mln
  • 375 professionals, average age 36
  • Locations in Delft, Groningen & Enschede
Involvement in networks
(Global Billing Association, DSL Forum, Home Gateway Initiative, Dutch Spectral Forum, Wimax Forum, international conferences, etc)

Customer objectives
- Consultancy
- Products & tools
- Prototyping
- Testing

Applied knowledge

Scientific knowledge
Diverse markets
- Wireline  e.g. operators, vendors
- Mobile    e.g. operators, vendors, industry fora
- Corporate e.g. energy sector, banks, transport/logistics, SME
- Public    e.g. regulator, defense, health sector
TNO ICT

- Expertise/knowledge innovation
  - (Inter)na(tion)al cooperations
  - Universities, research labs
    - Expertise center e-Quality, part-time professorships
  - (Inter)national research projects
    - COST 290
    - IST FP6: Ambient Networks
    - ITEA: Easy Wireless
- Standardisation activities
  - ITU
  - 3GPP
TNO ICT
PLANNING, PERFORMANCE, QoS

• Focus
  • Technology assessment, experiments
  • Network planning and dimensioning, capacity management
  • Design, evaluation, optimization of QoS control mechanisms
  • Performance monitoring
  • Evaluation/prediction of perceived end-to-end QoS
  • SLA specification

• Application areas
  • Mobile/wireless networks
  • Fixed networks
  • IT systems

• Approaches
  • Analysis - Queueing models
  • Simulations - Delphi, Matlab, NS2, OPNET
  • Experiments - measurements, monitoring
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PLANNING, PERFORMANCE, QoS

• Technologies
  • 802.11a/b/e WLANs
  • 802.15.4 WPANs
  • 802.16e mobile WiMax
  • UMTS/HSPA
  • LTE (OFDM)
  • Ad hoc networks
  • Sensor/actuator networks
  • Multi-access networks
  • Hybrid networks

• Operations perspective
  • Performance assessment
  • Impact on network planning
  • Optimization of QoS control mechanisms
Some recent/current example studies

- **HSDPA**
  - Technology assessment, performance modelling & analysis, assessment of opportunistic scheduler, derive impact on network planning, assessment/validation/development of planning module, …

- **EUL**
  - Technology assessment, performance modelling & analysis, …

- **Ad hoc networks**
  - QoS differentiation, power control for throughput enhancement, performance modelling & analysis of a bottleneck node; development of testbed, emulations, simulations, analysis for performance evaluation/optimisation, …

- **Multi-access networks**
  - Assessment of multi-access diversity gain, trunking gains, impact of (non-)cositing, switched vs parallel multi-radio transmit diversity, …

- **OFDM networks**
  - Propagation modelling, network planning, opportunistic scheduling/subcarrier allocation, …
TNO ICT
PLANNING, PERFORMANCE, QoS

• Primary interests for new cooperations, e.g. IST FP7
  • Planning, performance & QoS of OFDM-based networks
    • E.g. 3GPP LTE, (mobile) WiMax
  • Planning, performance & QoS of ad hoc/sensor/actuator networks
  • Planning, performance & QoS of UMTS/HSDPA/EUL networks