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On Power Efficient M2M Data Transmission in a Mobile Environment

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Agenda

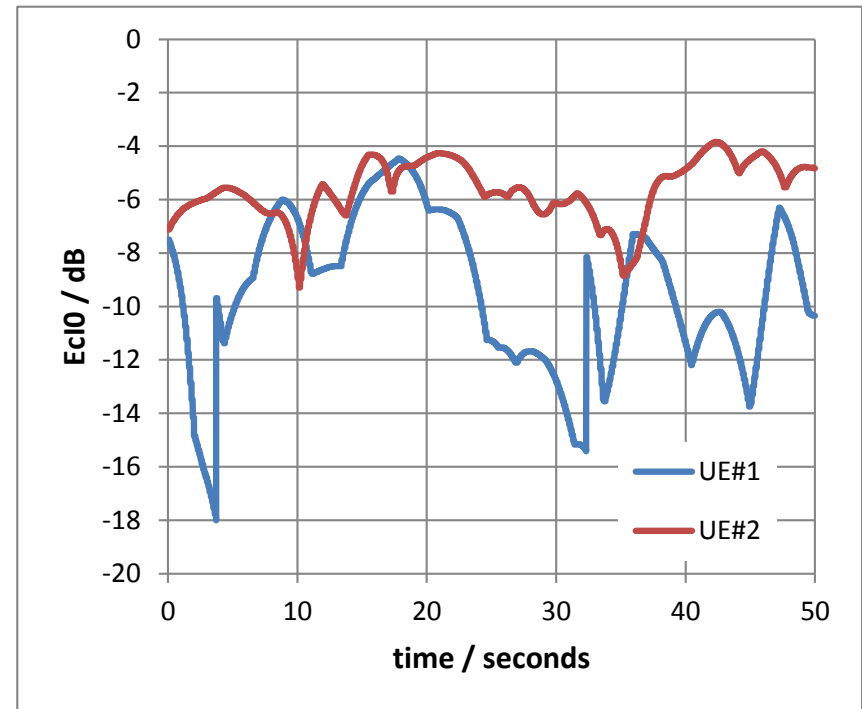
- Introduction
- Data Transmission for Mobile M2M Applications
 - M2M Applications in the Mobile Environment
 - Adaptive M2M Transmission Algorithm
- Simulation Study
 - Impact of the Parameter Settings
- Conclusions/ Outlook

M2M Communication in Mobile Networks

- Large variety of M2M applications already in use
 - Stationary applications: metering of consumption data, environment monitoring, telemedicine, telemonitoring
 - Mobile M2M applications: tracking of goods (logistics), autonomous communication between vehicles (Car2X)
- Communication over cellular systems
 - In parts of the world (nearly) complete coverage
 - Low cost connection to even hardly accessible locations
 - Often in 2G systems, 3G/ 4G upcoming
- Challenges for cellular M2M communication
 - Occurrence of variable radio conditions
 - Times with bad or no radio link
 - Small data reports but for a high number of M2M devices

M2M Applications in the Mobile Environment

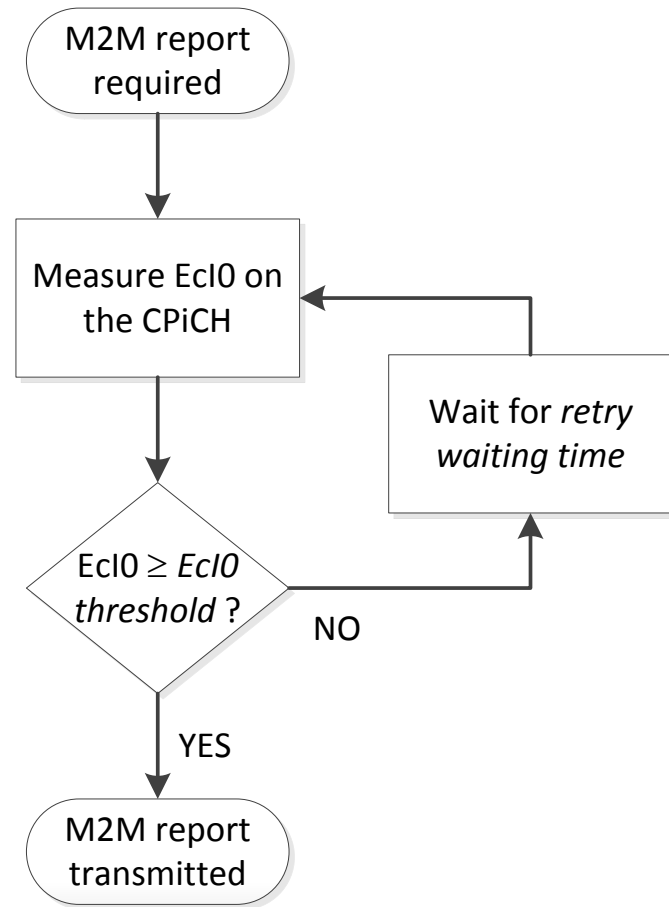
- Effects due to mobility of M2M applications
 - Radio link quality fluctuations: fading
 - Change of the radio connection: handover
- Approach of the improved transmission algorithm to mobile M2M applications
 - Check radio link quality before transmission
 - Applied to less time-critical M2M applications



Urban Scenario, 3 km/h

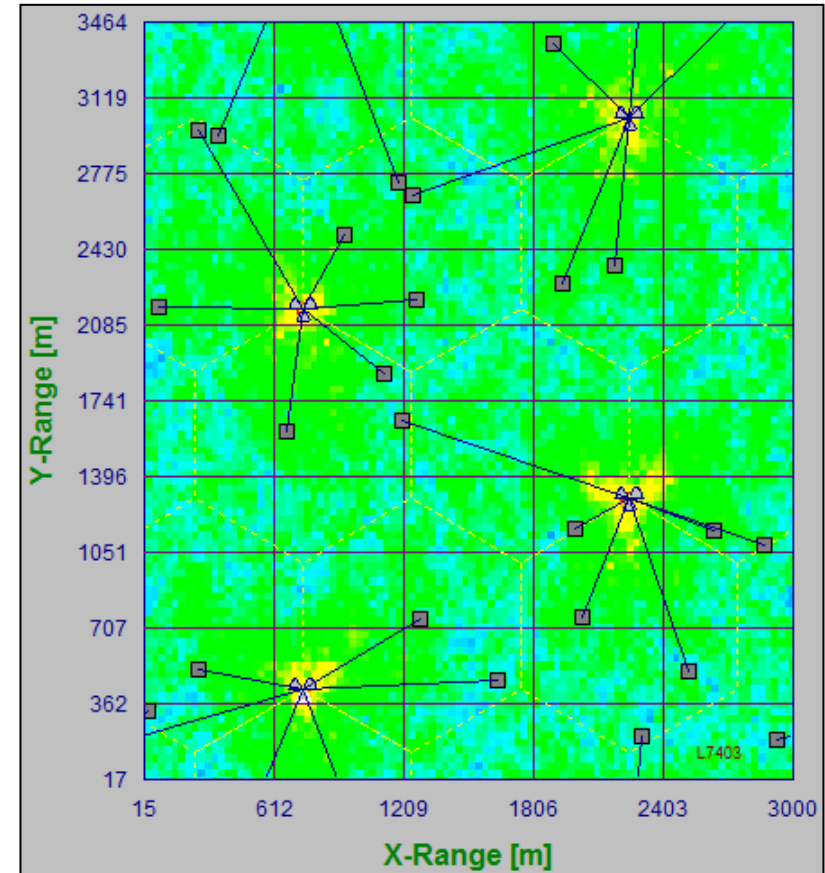
Enhanced M2M Transmission Algorithm

- Improved M2M algorithm with check for sufficient radio link quality
 - The estimated E_cI_0 must be higher than a threshold before transmitting
 - In case of bad radio link quality the report has to wait until E_cI_0 improves
- Tunable parameters
 - E_cI_0 -threshold
 - Retry waiting time



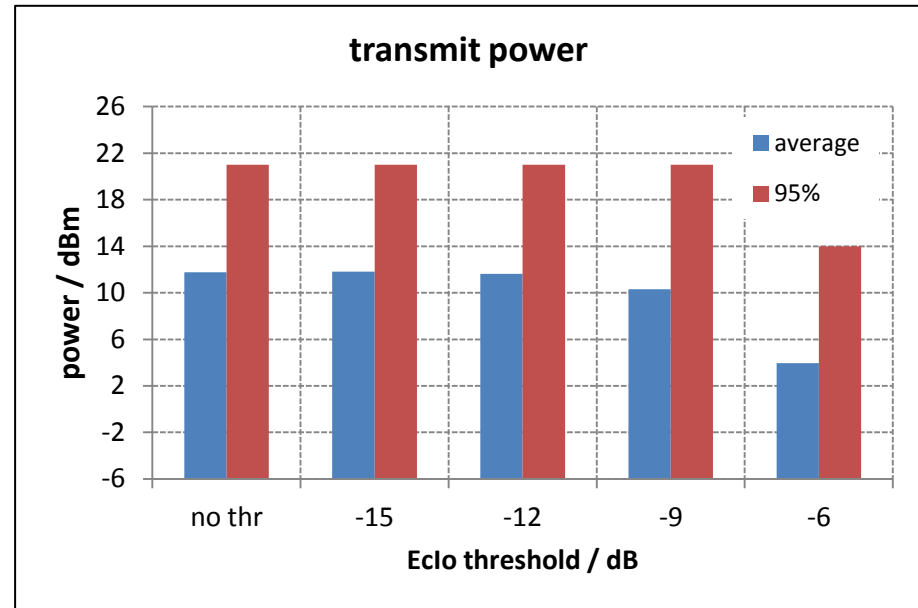
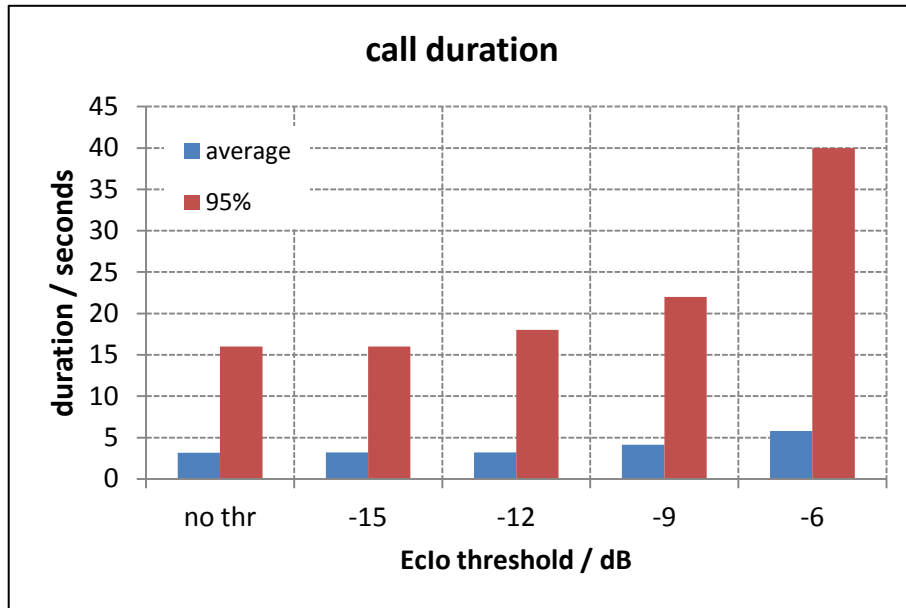
Simulation Scenario

Parameter	Value
# of NodeBs/ sectors	12 sites/ 3 sectors each (wrap around)
Cell radius	Urban: 1000 m Rural: 4000 m
Pathloss model	COST 231 Okumura Hata urban/ rural
Shadow fading	Urban: 7 dB standard deviation, 50 m correlation length Rural: 5 dB standard deviation, 200 m correlation length
Channel model	Urban: PedA3 Rural: VehA30
Mobility	According to channel model
Max. UE power	+21 dBm
Transp. Channel	DCH, 384 kbit/s
# of UEs	360
Message size	500 Bytes, fixed size
Traffic model	Chatty app./ 20 s think time



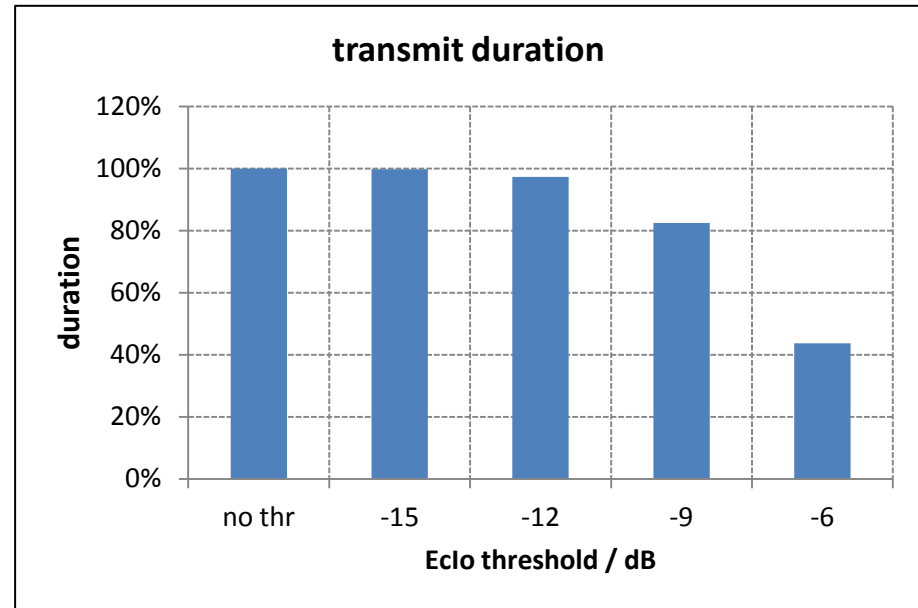
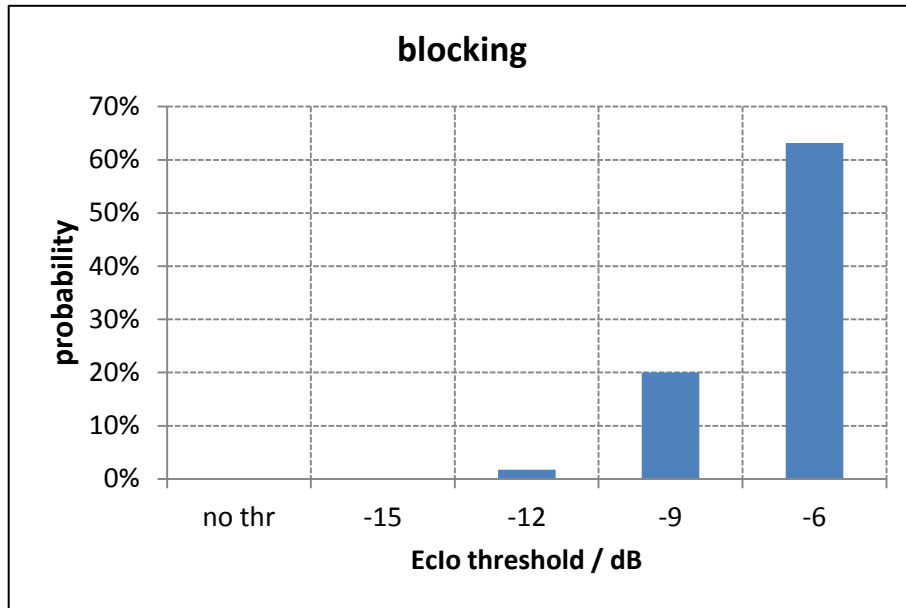
Urban Scenario (4 sites)

EcI0 Threshold – Rural Scenario



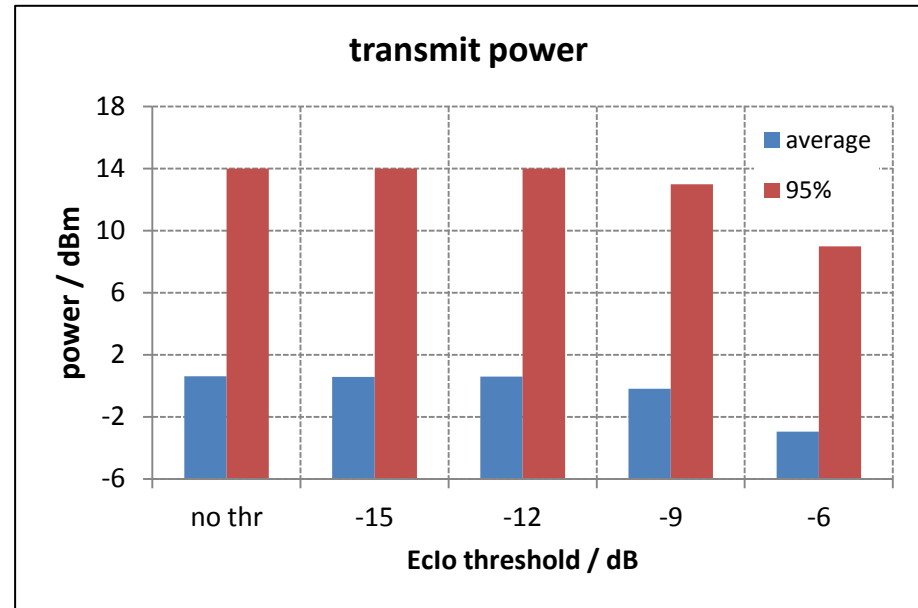
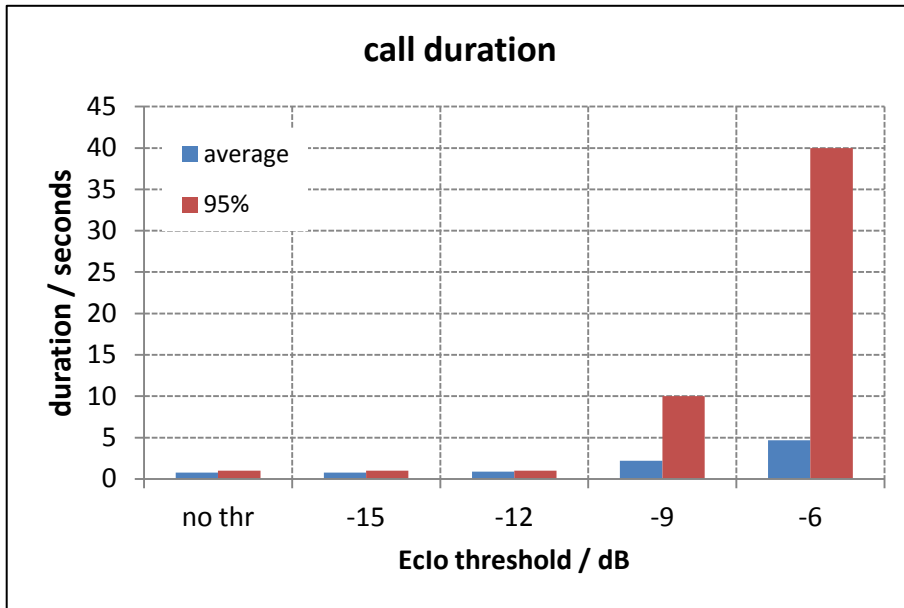
- Increased call duration at higher EcI0 threshold
 - Significant maximum duration without impact of algorithm
- Reduced transmit power when more restrictive EcI0 threshold
 - Maximum power approaches UE power limit

EcIO Threshold – Rural Scenario (contd.)



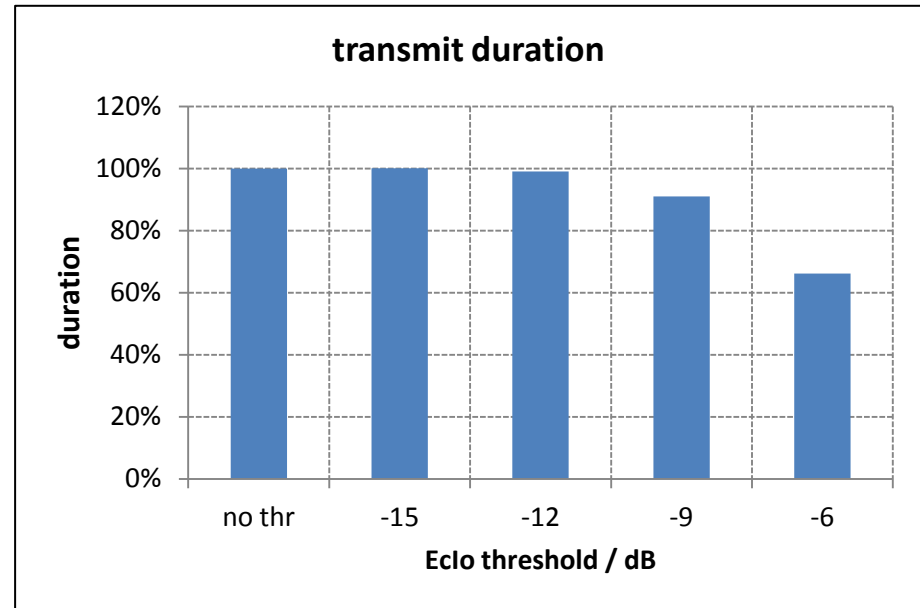
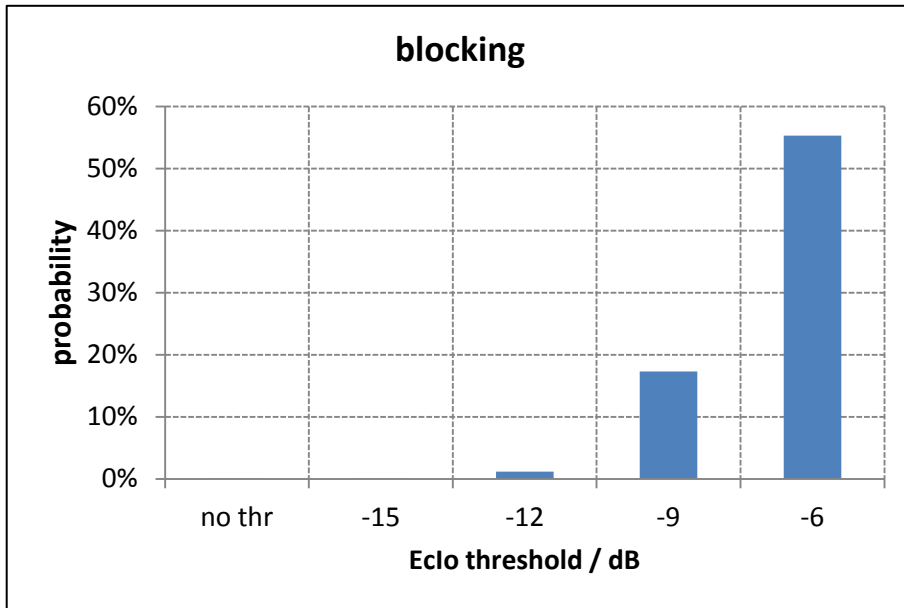
- Algorithm starts blocking transmission attempts when EcIO below the threshold
- Lower duration for active data transmission
 - Amount of retransmissions at high BLER decreased
 - Reduced energy consumption

EcIO Threshold – Urban Scenario



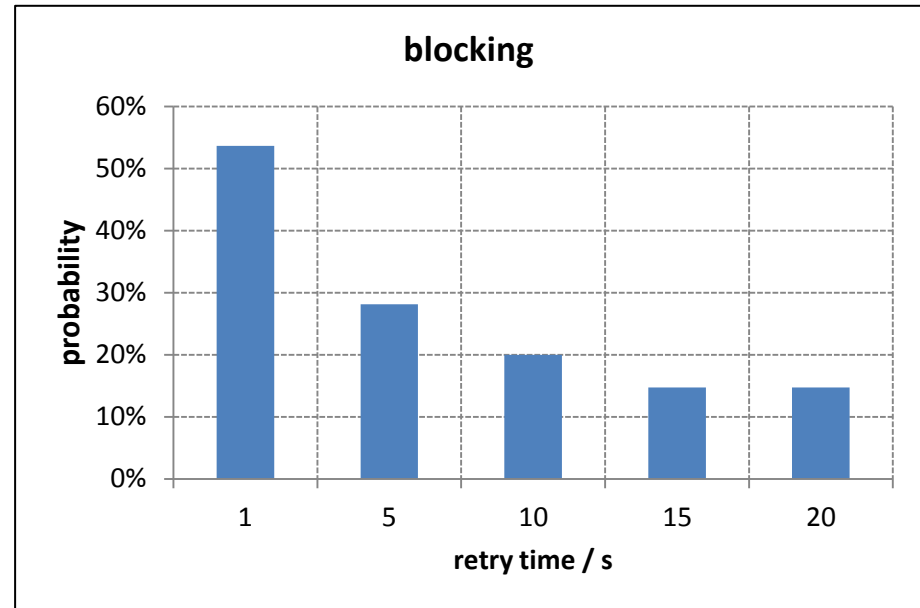
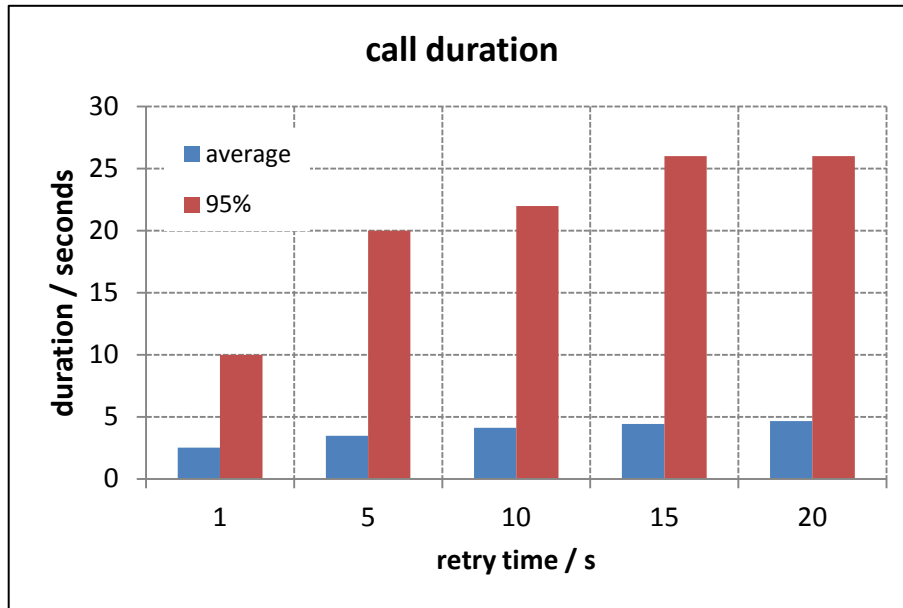
- Increased call duration at higher EcIO threshold
 - Better EcIO conditions than in rural scenario
- Reduced transmit power when more restrictive EcIO threshold
 - Total power lower than in rural scenario

EcIO Threshold – Urban Scenario (contd.)



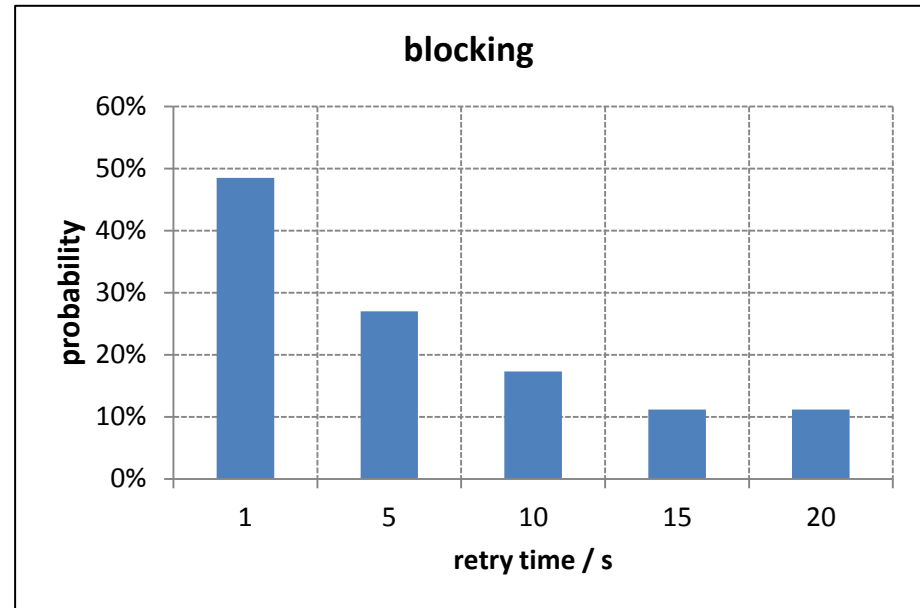
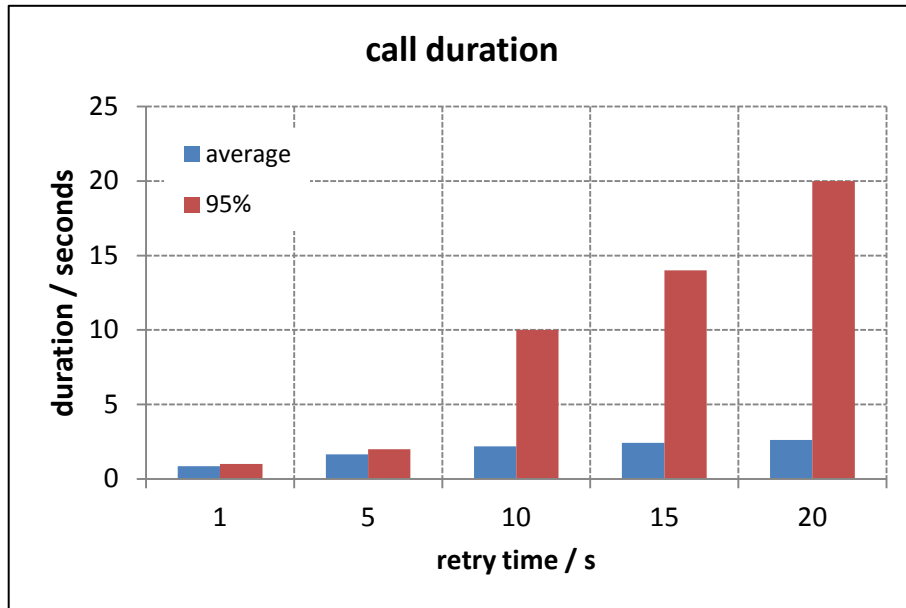
- Effect of blocking similar to rural scenario
 - Overall blocking slightly lower in urban scenario
- Effect of duration lower than in rural scenario
 - BLER already lower in urban scenario
 - Reduced energy consumption

Retry Waiting Time – Rural Scenario



- Longer waiting time reduces the blocking of the algorithm
 - Call duration increased especially at maximum
- Only small impact on transmission power and active transmission duration in rural scenario

Retry Waiting Time – Urban Scenario



- Waiting time impacts blocking and call duration
 - Overall values somehow lower than in the rural scenario
- Only small impact on transmission power and active transmission duration also in urban scenario

Conclusions/ Outlook

- Application of a power efficient reporting algorithm for M2M communication in a mobile environment
 - Transmission attempts only performed in good quality conditions
 - Useless transmissions avoided when in bad situation
 - Criterion based on a check of the E_c/I_0 against a threshold
- Performance studied by means of UMTS system simulations
 - Trade-off between the reduction of transmit power and an increase of the transmission delay
 - Tunable performance by adjusting the E_c/I_0 threshold and the retry waiting time
- Future work
 - Application of other measurement values for different conditions
 - Improvement of the algorithm: parameter adaptation

Thank You !

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