Network coding on mobile devices

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Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

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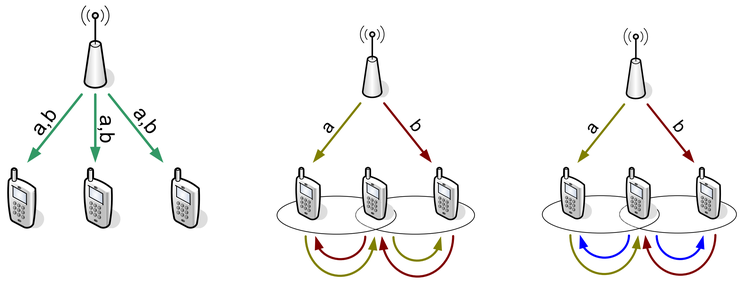
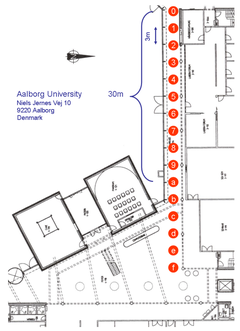
Network Coding Scenarios

Most of our scenarios are focusing on cooperative wireless networking or wireless grids. In those scenarios mobile devices need to establish a cooperative short range communication cluster to exchange data that they received over centralized links with limited capacity.



To understand the potential gain of network coding, we carried out a sophisticating channel and energy measurement campaign on the Nokia N95 for 3G and WLAN technology, where the 3G technology is used to seed packets into the cooperative cluster and WLAN to exchange those seeds among the cooperating mobile devices. For the WLAN case we even looked into the *multicast* and *unicast* transmission options.



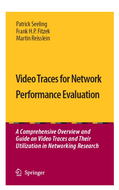
Campaign 1

Campaign 2

Energy Profiler

Publications

- Janus Heide, Morten V. Pedersen, Frank H.P. Fitzek, and Torben Larsen, Cautious view on network coding - from theory to practice, Journal of Communications and Networks (JCN), 2009.
- D.E. Lucani, F.H.P. Fitzek, M. Medard, and M. Stojanovic, Network coding for data dissemination: It is not what you know, but what your neighbors know, in RAWNET/WNC3 2009, June 2009.
- M. Pedersen, J. Heide, F.H.P. Fitzek, and T. Larsen, Network coding for mobile devices - systematic binary random rateless codes, in Workshop on Cooperative Mobile Networks 2009 - ICC09. IEEE, June 2009.
- L. Militano, F.H.P. Fitzek, A. Iera, and A. Molinaro, Evolutionary theory for cluster head election in cooperative clusters implementing network coding, in European Wireless 2009, Aalborg, Denmark, May 2009.
- P. Vingelmann, P. Zanaty, F.H.P.Fitzek, and H. Charaf, Implementation of random linear network coding on opengl-enabled graphics cards, in European Wireless 2009, Aalborg, Denmark, May 2009.



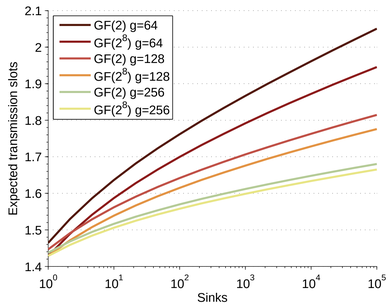
Implementation of NC

Mobile resource constrained platforms e.g. mobile phones, sensors, etc. requires focus on:

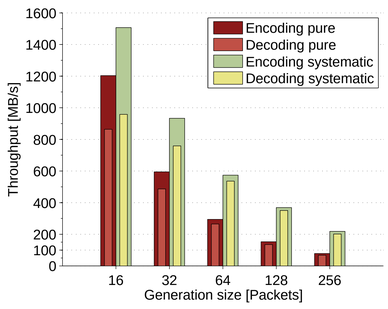
- Computational power.
- Memory constraints.
- Energy consumption.

GF(2) on the CPU

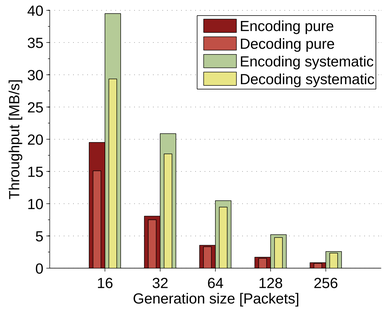
- Faster arithmetics when the binary field GF(2) is used.
- Progressive decoding distributes the computational load
- Systematic codes reduce the necessary amount of coding.
- Higher probability of linear dependency compared to higher field sizes.



Network performance



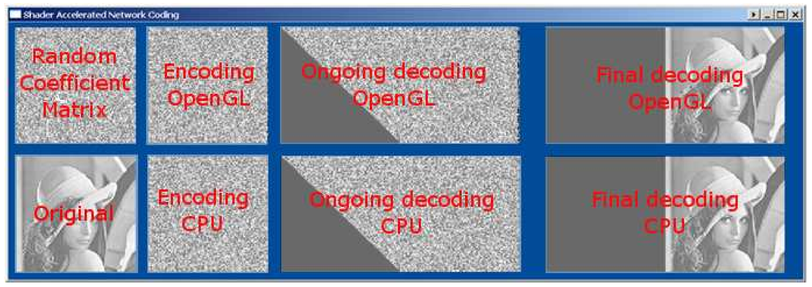
Laptop: Intel Core2Duo 2.5 GHz, 2 GB RAM



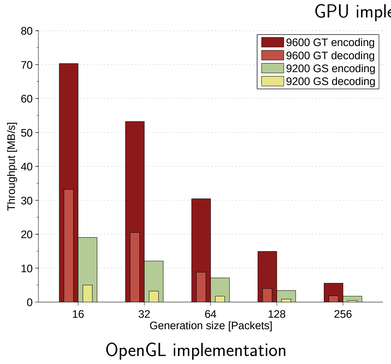
Mobile Phone: 332 MHz, 128 MB RAM

GF(2^8) on the GPU

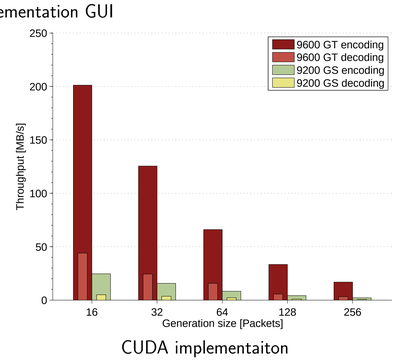
- Programmable parallel processors with high computational capabilities.
- High coding throughput compared to similar implementations on the CPU.



GPU implementation GUI



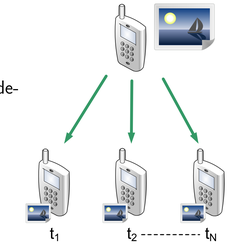
OpenGL implementation



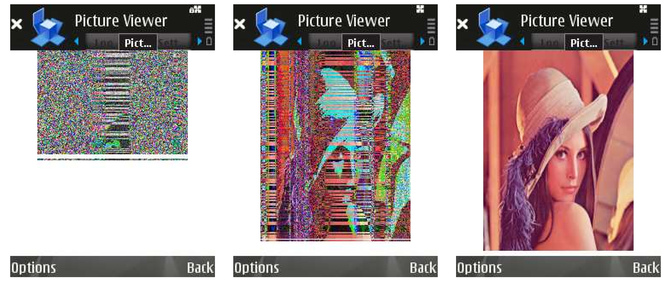
CUDA implementaiton

PictureViewer

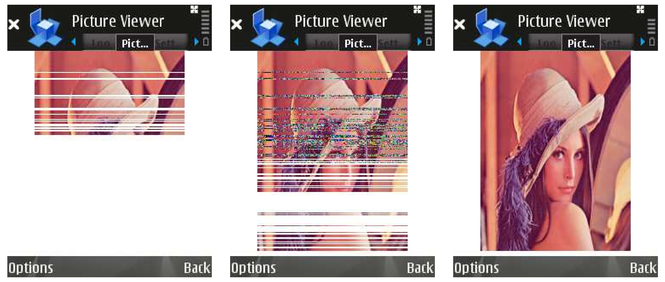
- 802.11 b/g ad hoc broadcast
- Reliable single-hop multicast.
- Convey pictures from your mobile phone to several neighboring devices.
- Network coding at the application layer.



Pure coding

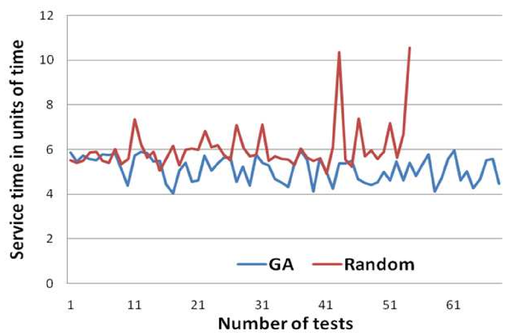


Systematic coding



Genetic Algorithms for NC

- Seeding strategies for combined cellular and local networks
- Genetic algorithms trains the network for good performance
- Outperforms a random approach
- Quickly finds a good solution, also in a dynamic environment



Acknowledgements

We thank our students and colleagues working with us every day on the mobile phones research activities and we hope to continue in the future. Furthermore we would like to thank the following institutions:

Forum NOKIA Driving mobile innovation
Aalborg University Denmark
CTiF Center for TeleInFrastruktur
symbian Academy