

Overview of the Aalborg University Network Coding Research and Demonstrators

Life without network coding is possible, but not desirable!

Frank Fitzek
Aalborg University
(CodeOn/Steinwurf)

Our motivation back in 2004



Our solution ... Mobile Clouds



Network Coding

Digital Network Coding (bits and packets)

Inter-flow network coding

XOR type of coding

COPE, CATWOMAN

Intra-flow network coding

RLNC type of coding

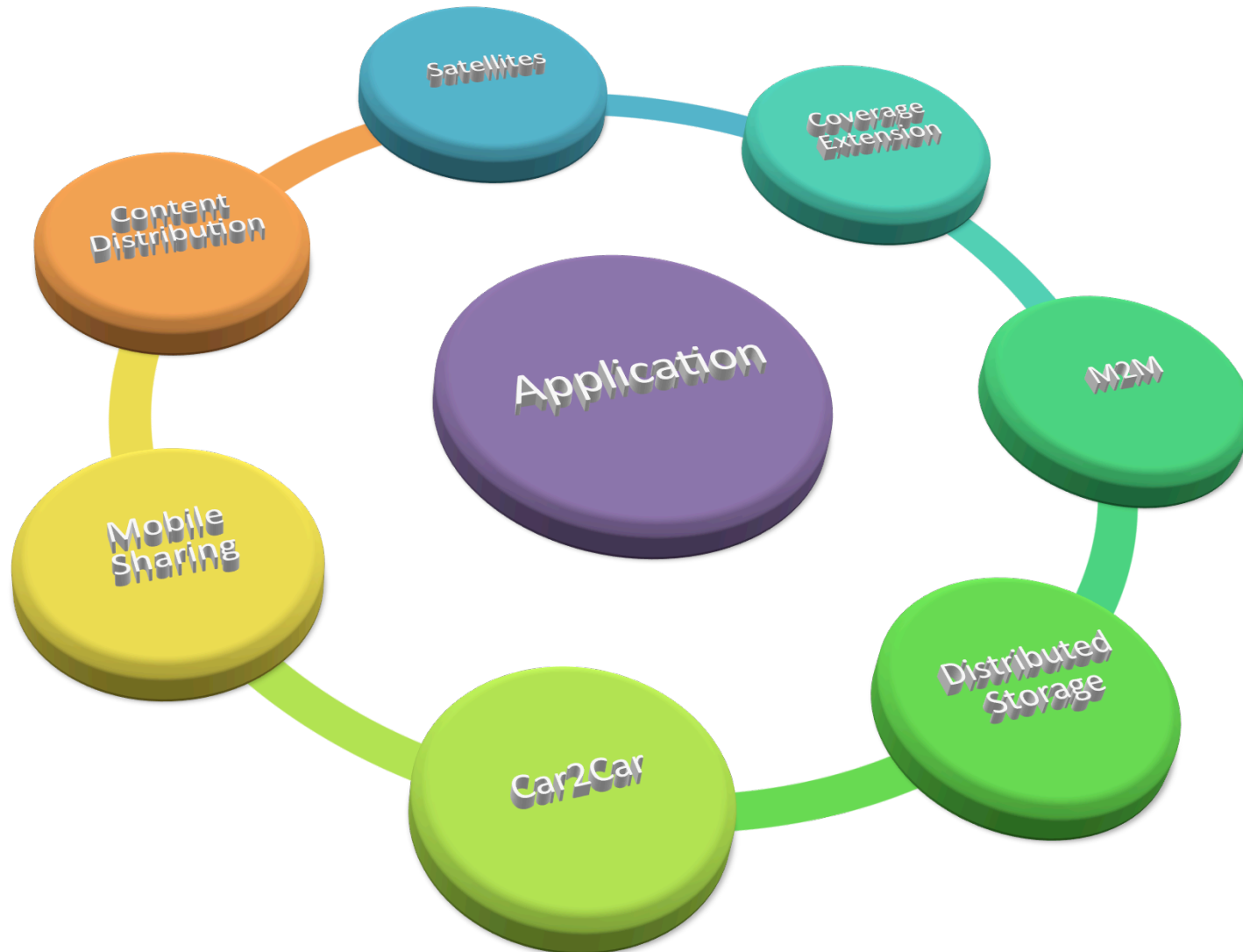
MORE

Combination of Inter-flow and Intra-flow network coding

CORE

Analog Network Coding (signals)

Application



Why are we here?

- Exchange of ideas with colleagues with the interest
- Show some mature demonstration results in different areas
- Convey the pitfalls of network coding (we did a lot of mistakes, but we learned from them)
- Cross over from research to industry, we the first steps, but need more impact

Where is network coding located?

Application Layer

Transport Layer

Network Layer

Data Link Layer

Physical Layer

<http://www.youtube.com/watch?v=OnqGO7AWwxc>



ANDROID



Where is network coding located?

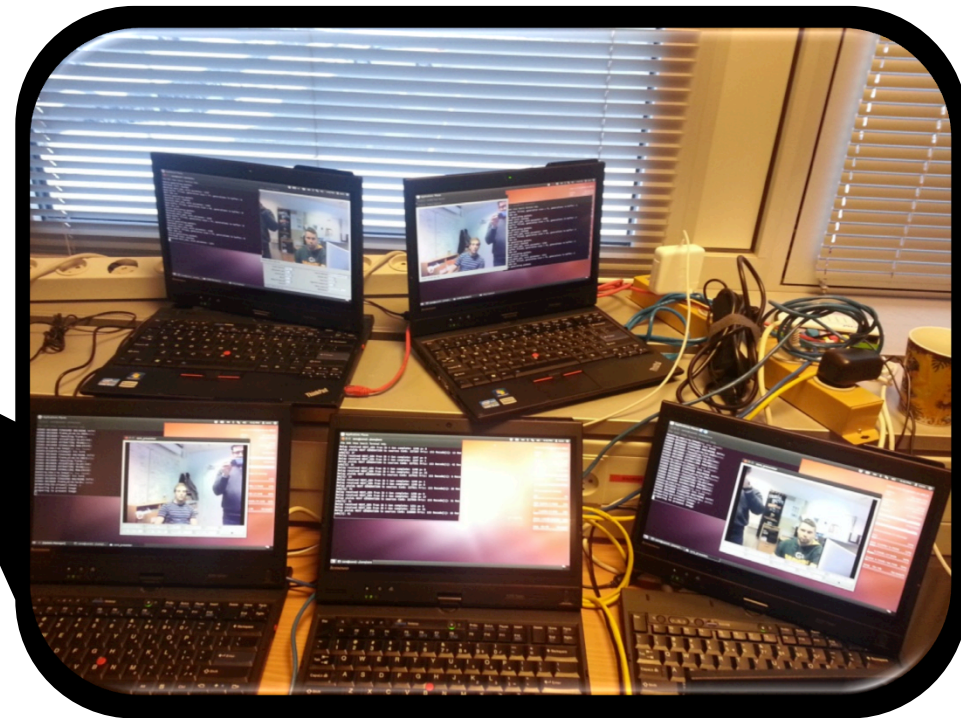
Application Layer

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Where is network coding located?

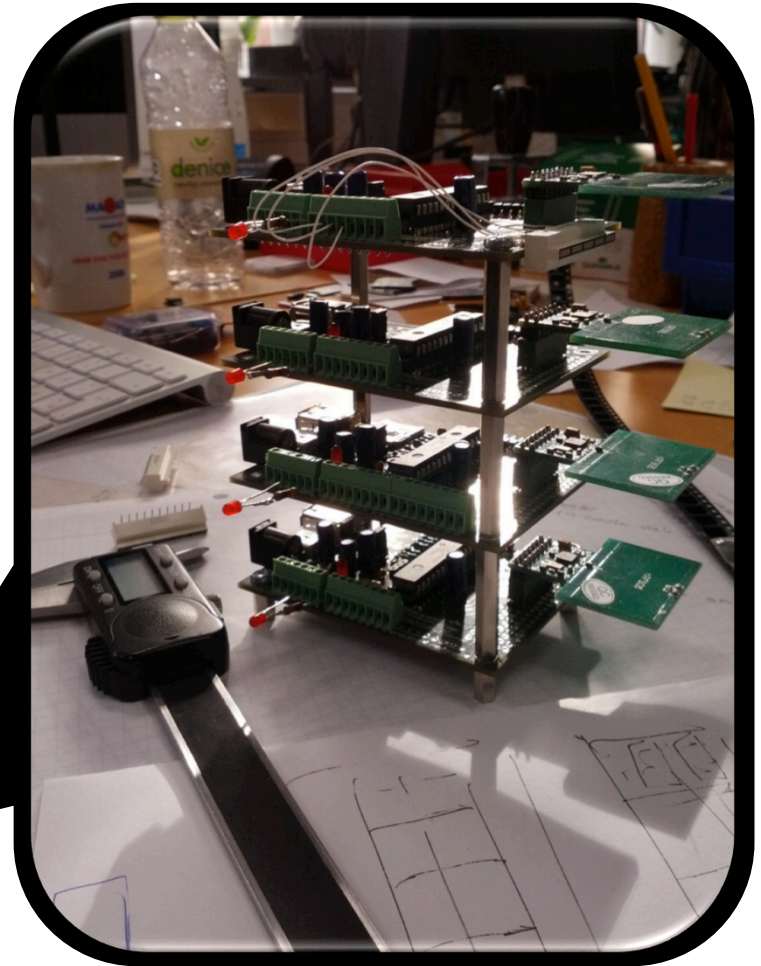
Application Layer

Transport Layer

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Data Link Layer

Physical Layer



CATWOMAN (2011)

- Multihop network based on B.A.T.M.A.N. routing (draft RFC)
- Implementation of network coding on real WiFi access points
- Multi hop
- Available via BATMAN distribution (just inter flow for the time being)

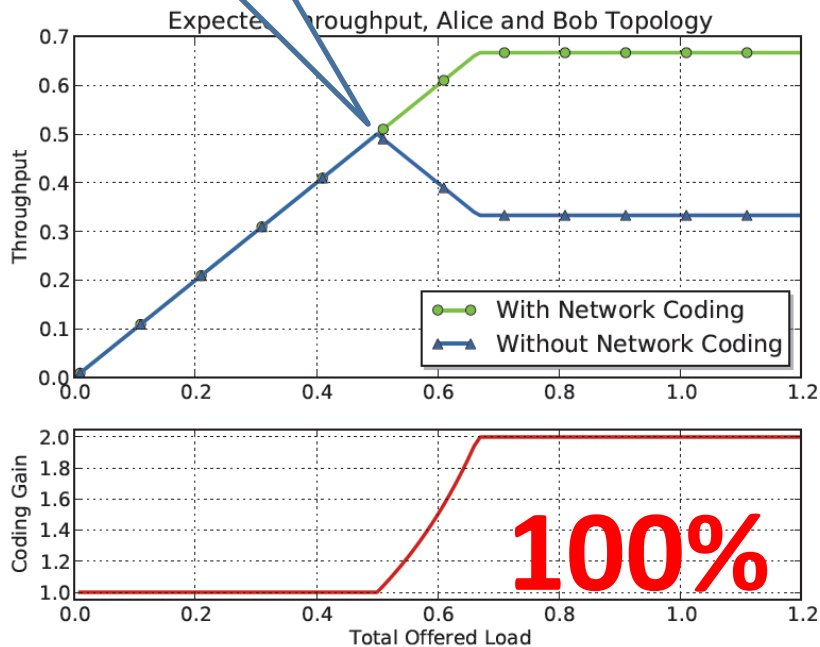


Steve Song, VillageTelco

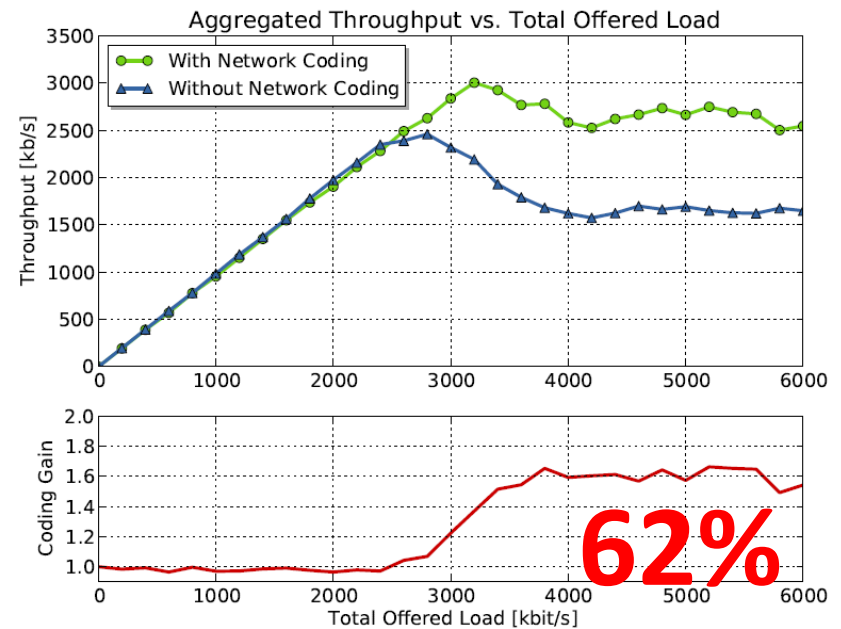
Blame the IEEE 802.11 ...

Alice and Bob

Model



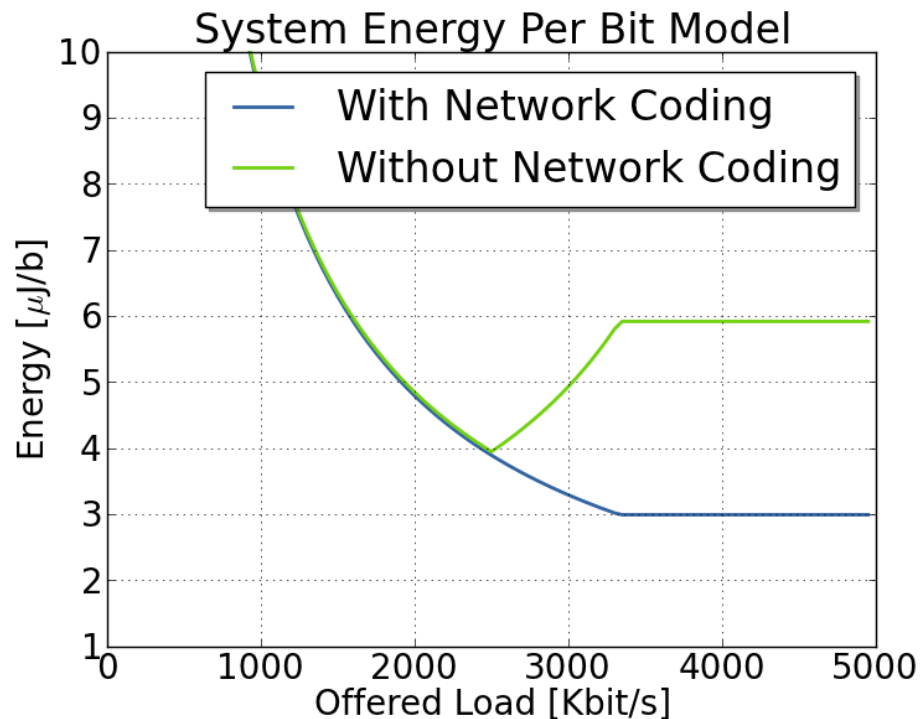
Measurements



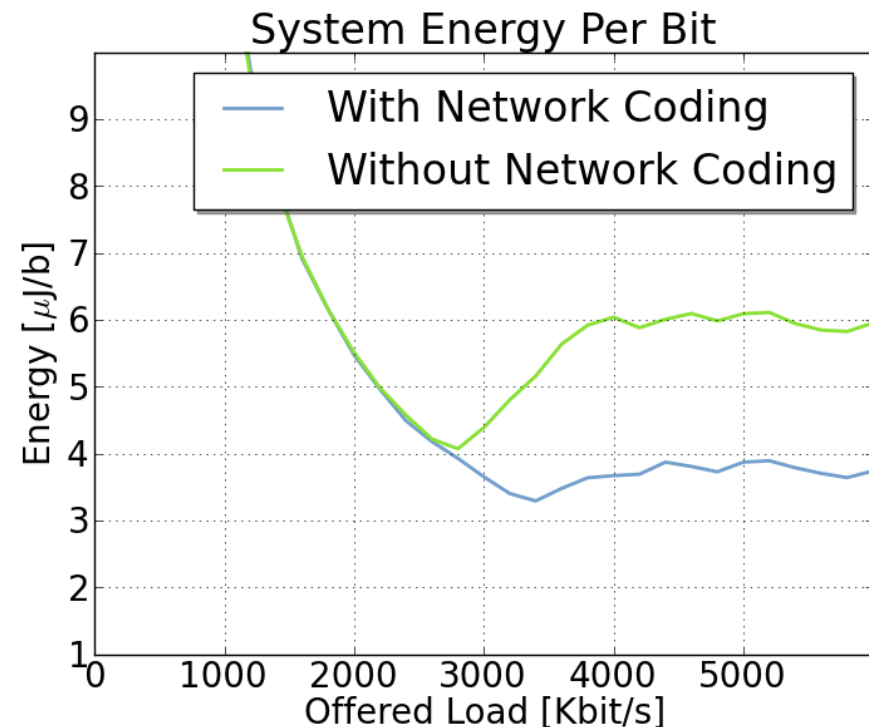
M. Hundeboll and J. Leddet-Pedersen and J. Heide and M.V. Pedersen and S.A. Rein and F.H.P. Fitzek. **CATWOMAN: Implementation and Performance Evaluation of IEEE 802.11 based Multi-Hop Networks using Network Coding.** 2012. in *IEEE VTS Vehicular Technology Conference. Proceedings.* IEEE

Green Mobile Clouds

Model



Measurements



A. Paramanathan and U. Wilken Rasmussen and M. Hundeboll and S.A. Rein and F.H.P. Fitzek and G. Ertli. **Energy Consumption Model and Measurement Results for Network Coding-enabled IEEE 802.11 Meshed Wireless Networks.** in *IEEE International Workshop on Computer-Aided Modeling Analysis and Design of Communication Links and Networks (CAMAD)*. Barcelona, Spain.

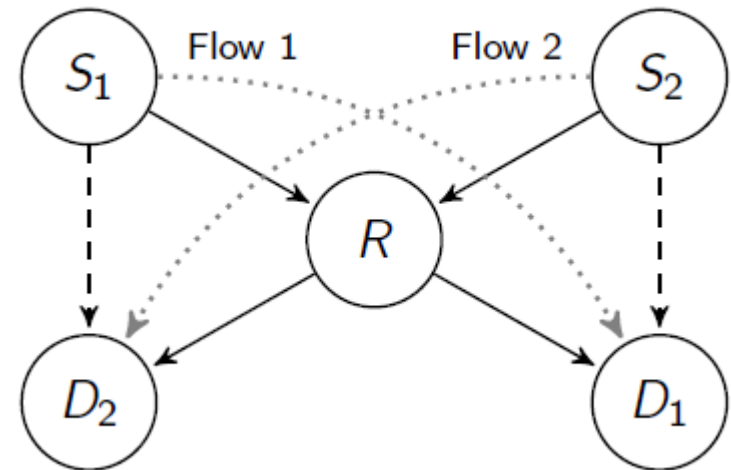
Why intra flow coding?

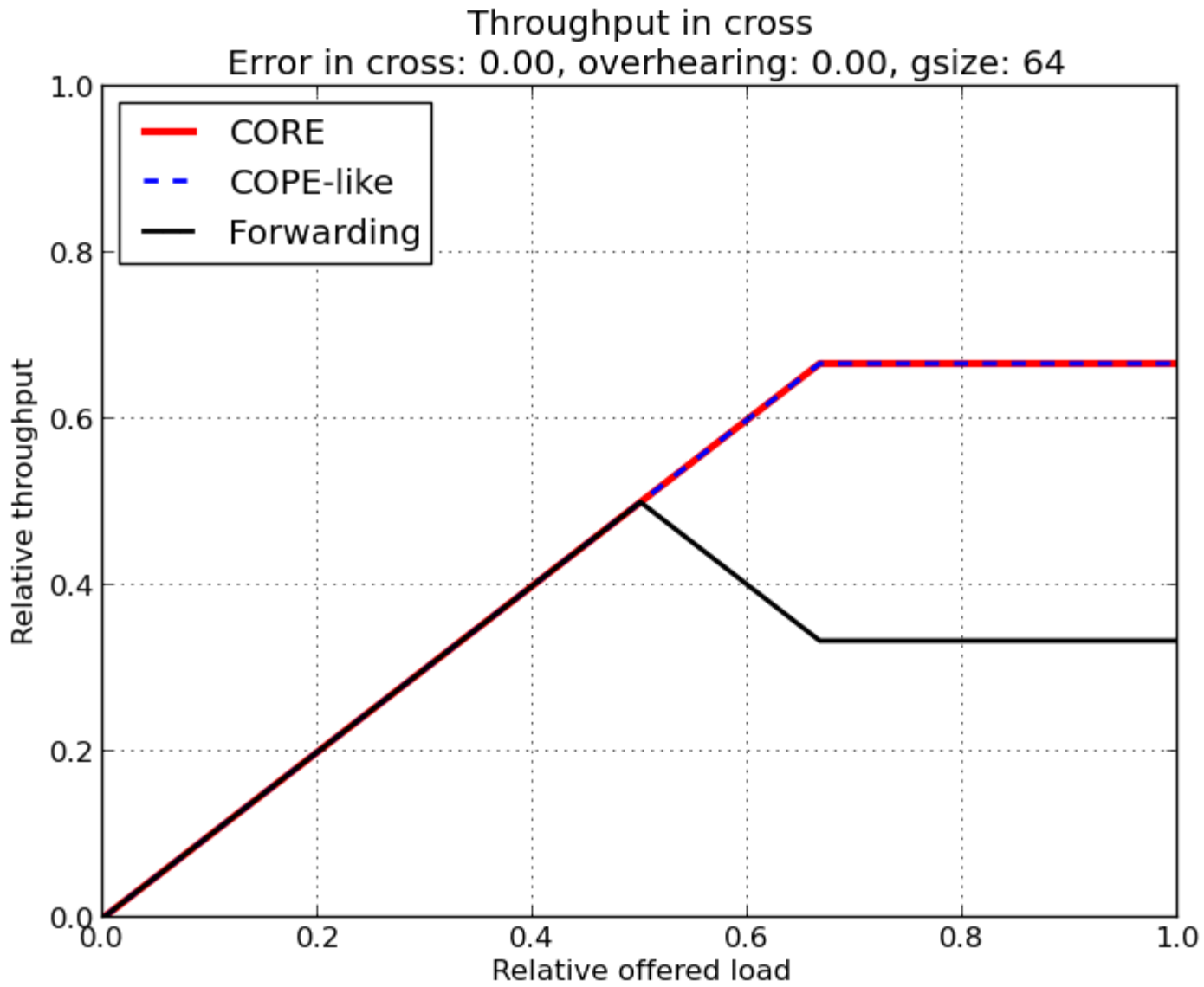
- Inter flow is powerful in some scenarios, easy to implement, no complexity, but needs control messages
- Intra flow is easier to handle
 - Regeneration of distributed clouds
 - Meshed networks with large degree and mobility
 - Reduced signaling needs
- Complexity? Morten says no
- Some researchers had problems to implement ...
 - It is not E2E anymore
 - Timing is important ...
 - Randomness



CORE = COPE + MORE

- Wireless links are error prone
 - Traffic
 - Overhearing
- RLNC ensures reliability
- XOR is handling the MAC





More information

- Frank Fitzek
- www.fitzek.net