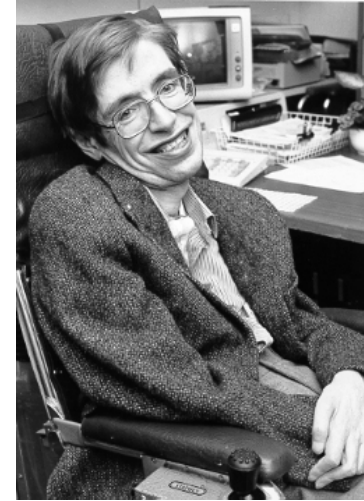


# Viral Loops for Mobile Clouds

Frank Fitzek

Aalborg University

Stephen Hawking, A Brief History of Time (1988)



**SOMEONE TOLD ME THAT EACH  
EQUATION I INCLUDED IN THE BOOK  
WOULD HALVE THE SALES. I THEREFORE  
RESOLVED NOT TO HAVE ANY  
EQUATIONS AT ALL.**

# Outlook

- Short definition
  - Viral loop
  - Mobile clouds
- Role of network coding
- Example of sharing

# Why Viral Loops?

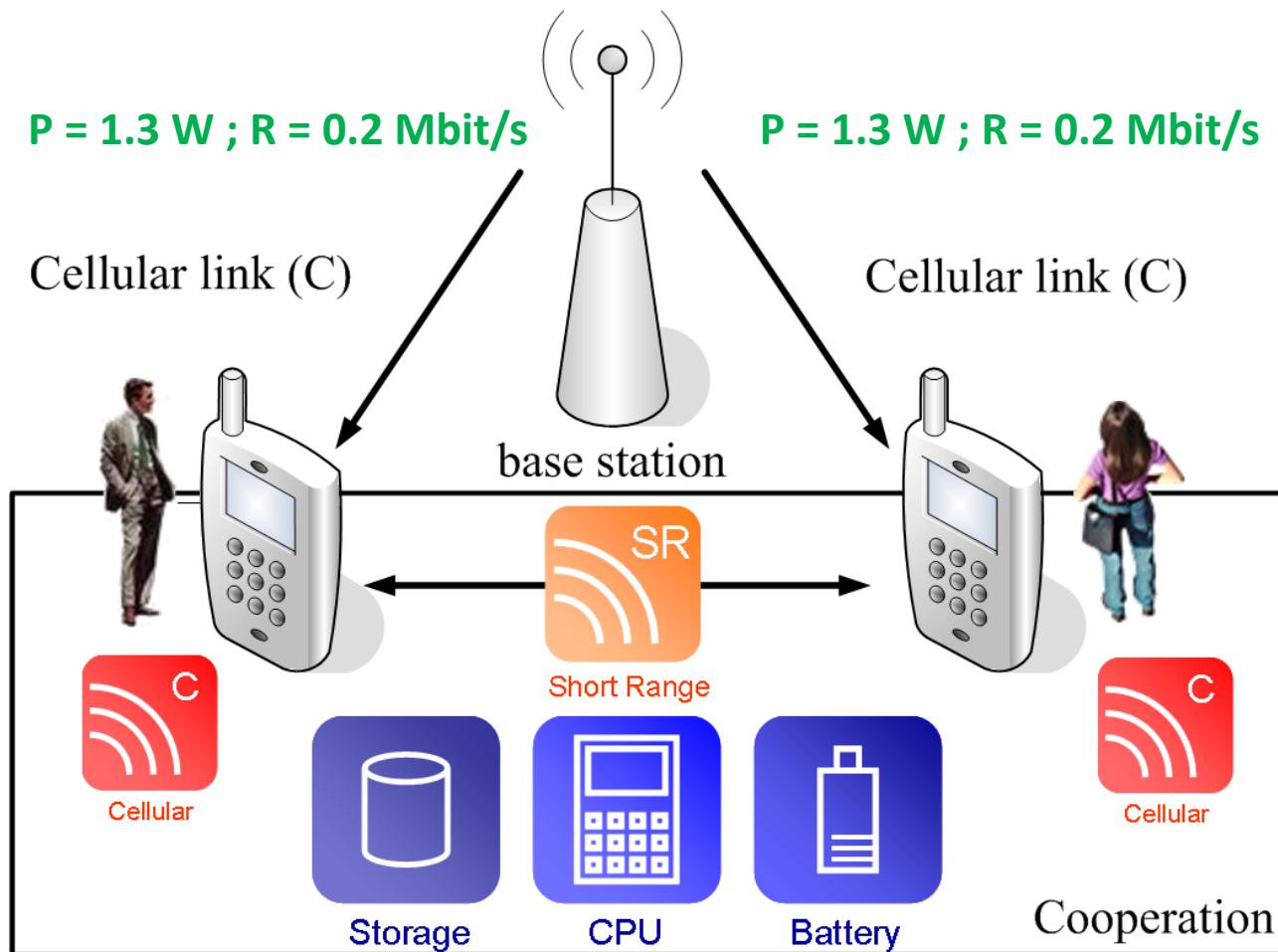
- One of the most important issues nowadays is how to get enough attention for novel products, services, etc
  - Advertisement is expensive
  - There is a lot of noise out there
    - 400.000 apps in each store
    - Youtube
  - What counts are recommendations preferable by people we know .... or people nearby you ...
- Mouth to mouth propaganda on steroids
- Sharing experience is great if it happens simultaneously

*Data deluge problem by TechniColor*

# Why Mobile Clouds?

- Crowd sourcing
  - Global
  - Proximity
- We are now always connected! Why proximity?
  - Energy
  - Sharing experience (Soccer on mobile)
  - Social filter on time and place
  - We love to collect ....
- Why mobile at all ?
  - Facebook consider themselves as web company but has currently a 50/50 split

# Mobile Clouds

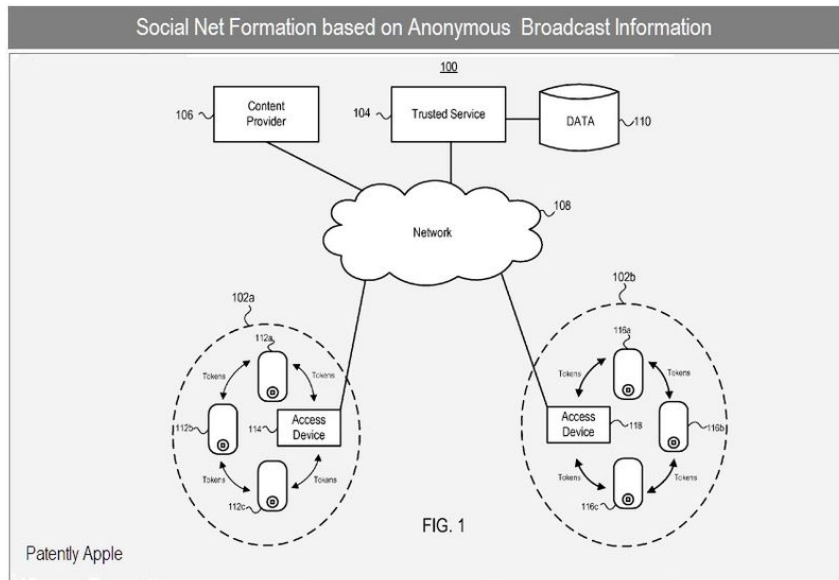


$P = 1.6 / 1.3 \text{ W}$  ;  $R = 5 \text{ Mbit/s}$

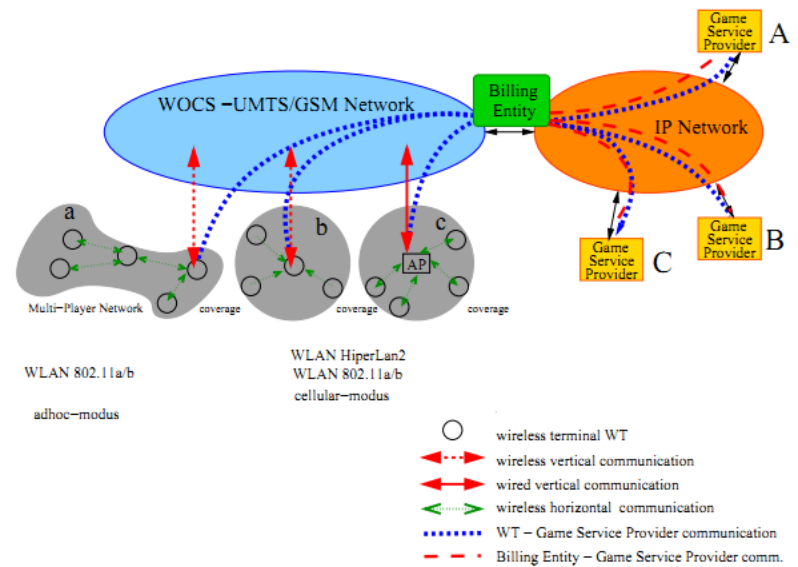
**ENERGY PER BIT COUNTS**

# Interesting for industry?

## Apple 2008



## FITZEK 2003

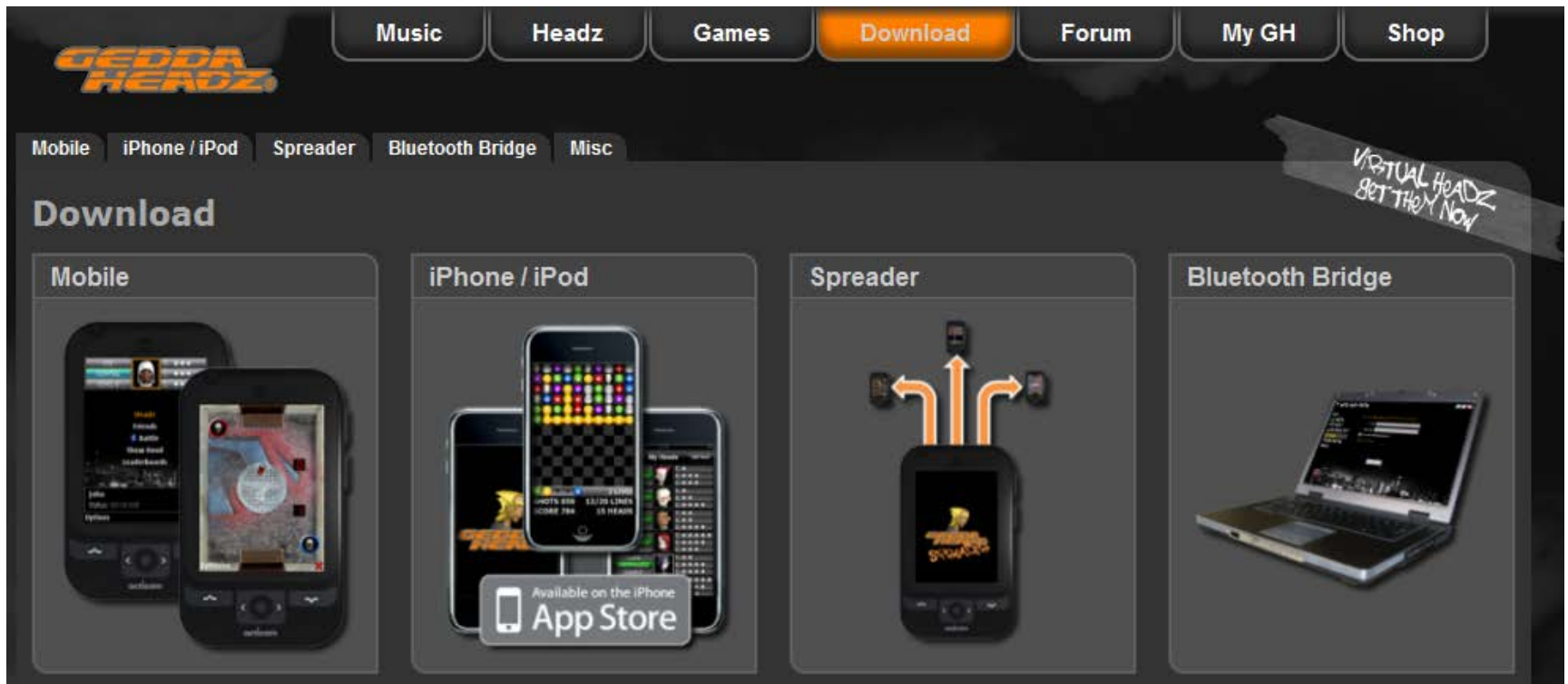


# What should we share in proximity?

- Streaming content:
    - IPTV towards multiple cooperative devices yields energy savings for the devices and the network operator (also bandwidth gain).
- 
- Apps:
    - Installing one application from one device to another avoiding the stores (surprise Apple has a patent on that too)
  - Content:
    - Pictures, videos, links, data in terms of storage
  - Presence
    - Aka aki



# Sharing apps



# Sharing presence



## no more missed chances

because aka-aki remembers who has crossed your path recently. you will see who has been nearby and when. afterwards you can easily get in touch with them. thats your second chance! or the replacement of the business card.



## on the go with your friends

with aka-aki your friends are always with you. you can send and receive free text messages on your mobile or using the website. your status updates show the others what you are up to and can also be twittered automatically.



## use aka-aki for free

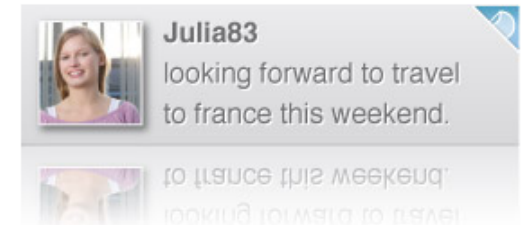
you don't have to pay a thing, neither for the aka-aki apps nor for your membership. aka-aki just requires an internet connection that might cause additional costs. soon you can also add exclusive premium features to your account for a small fee.



## "all actual life is encounter"

*martin buber, philosopher*

aka-aki lets you discover new and interesting people everywhere. it shows you the pictures, common friends and interests of the people nearby. instantly on your iPhone, iPad, iPod, android phone or your notebook!



## aka-aki is international

aka-aki apps today already speak german, french, spanish, english and italian. soon there will be more languages added and our website will become more international, too. for those projects we are supported by our translation agency **easytrans24.com**

**.... I TALK ABOUT CONTENT  
SHARING TODAY**

# How to support this?

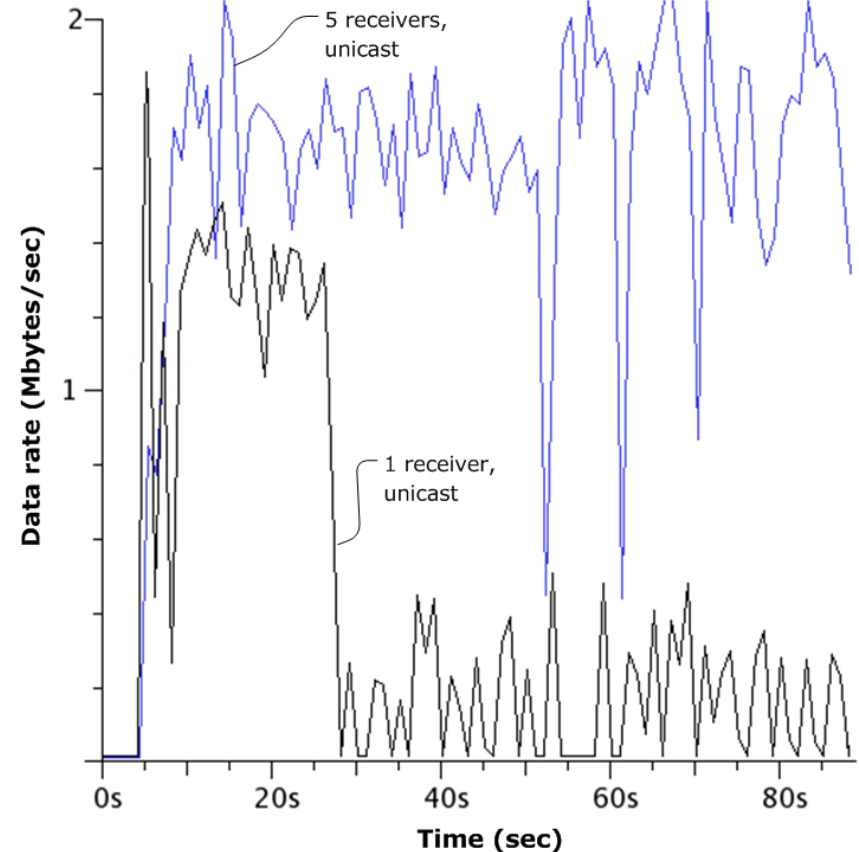
- In order to enable the exchange of any content among mobile users we need several ingredients, among those are services discovery and efficient transmission strategies.
- For the later one network coding is a viable solution.

# Scenarios

- Sharing content among friends: So one device has it all, there is most probably no mobility involved (demo hopefully 😊) and receiver „sees“ only one sender.
- Sharing content on the fly: One or several devices have the full or partial content and start to share, device might move and connections might be too short to complete full transaction. Multiple senders may be involved.

# Scenario 1: State of the Art

- Several apps are available:  
e.g. AirVideo, TVersity
- These apps are based on a  
webserver
- Separate TCP connection for  
each receiver
- 1 device: fine playback
- 5 devices: stuttering
- They can quickly saturate  
the wireless network



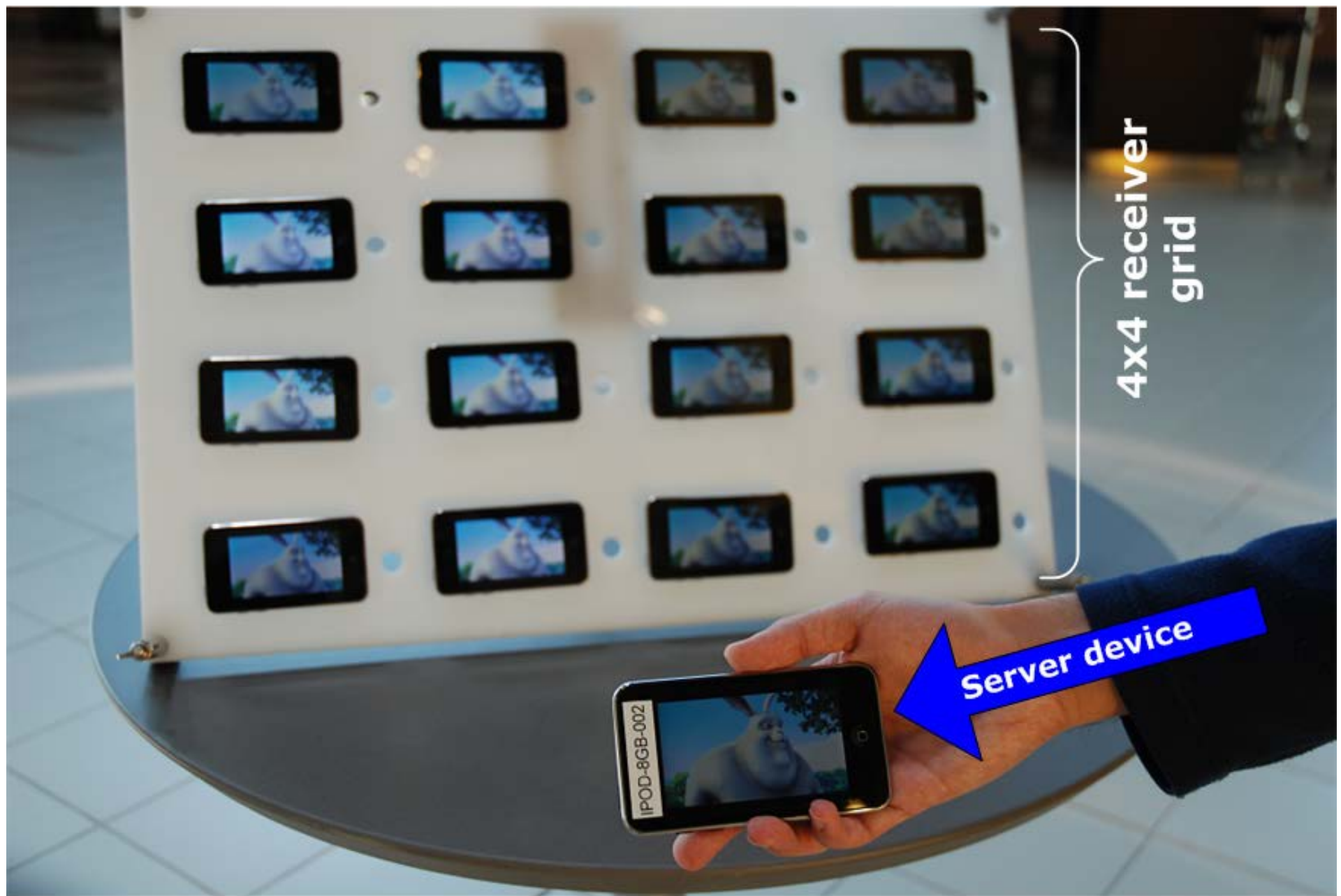




4x4 receiver  
grid

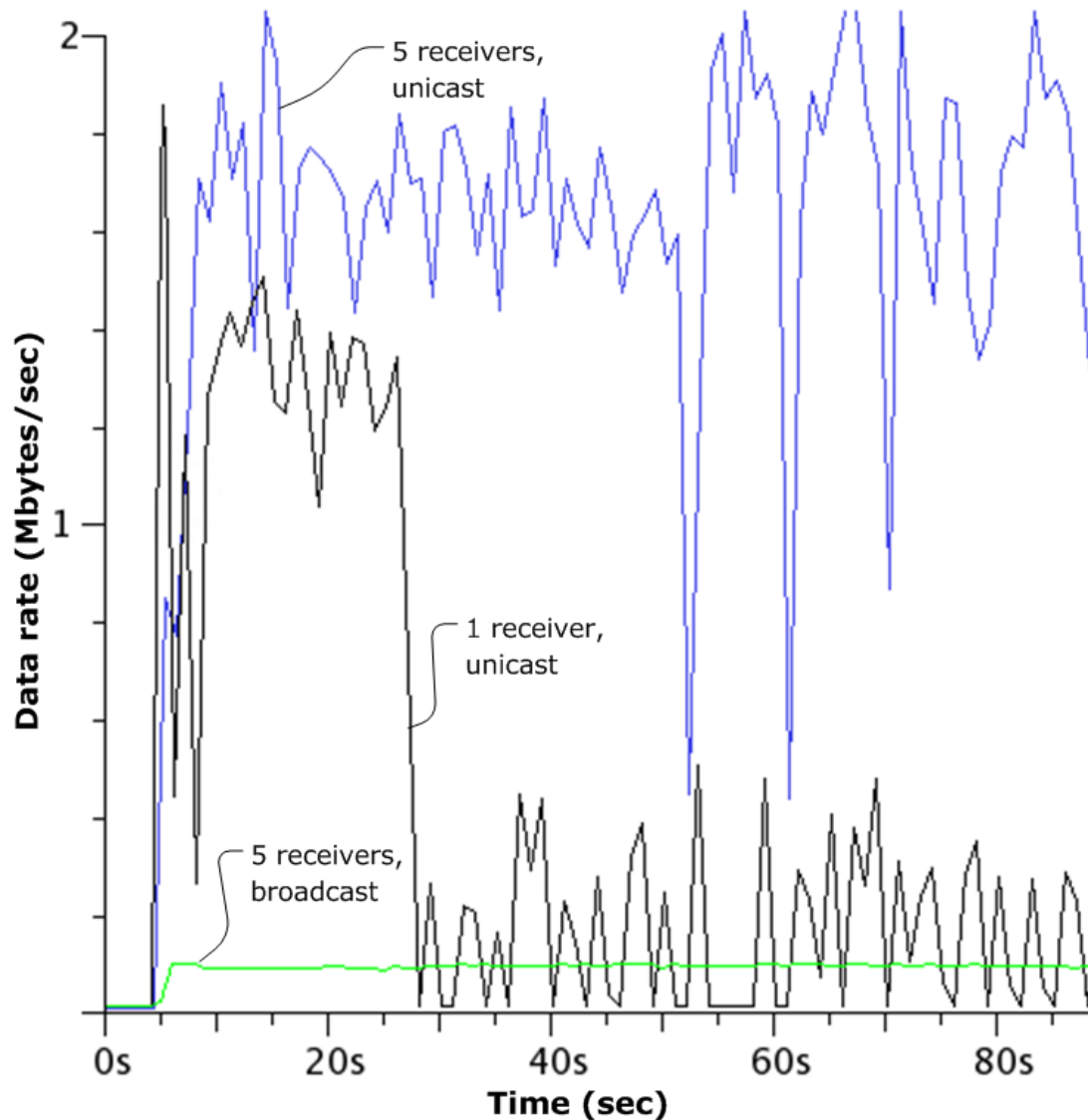
Server device

IPOD-8GB-002





# Result of Proposed Solution



SoA 5 devices

SoA 1 device

Proposed x devices

# Scenario 2: Let them move ...

- Simple example: Mobile devices moving around and one device tries to spread the information to the others.
- Partially connected
- Once the others got pieces they might also start to spread the word

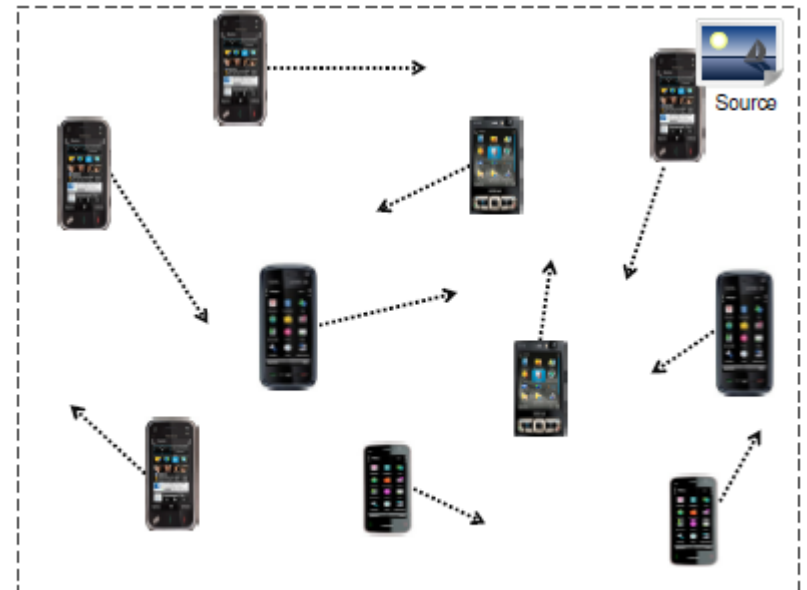
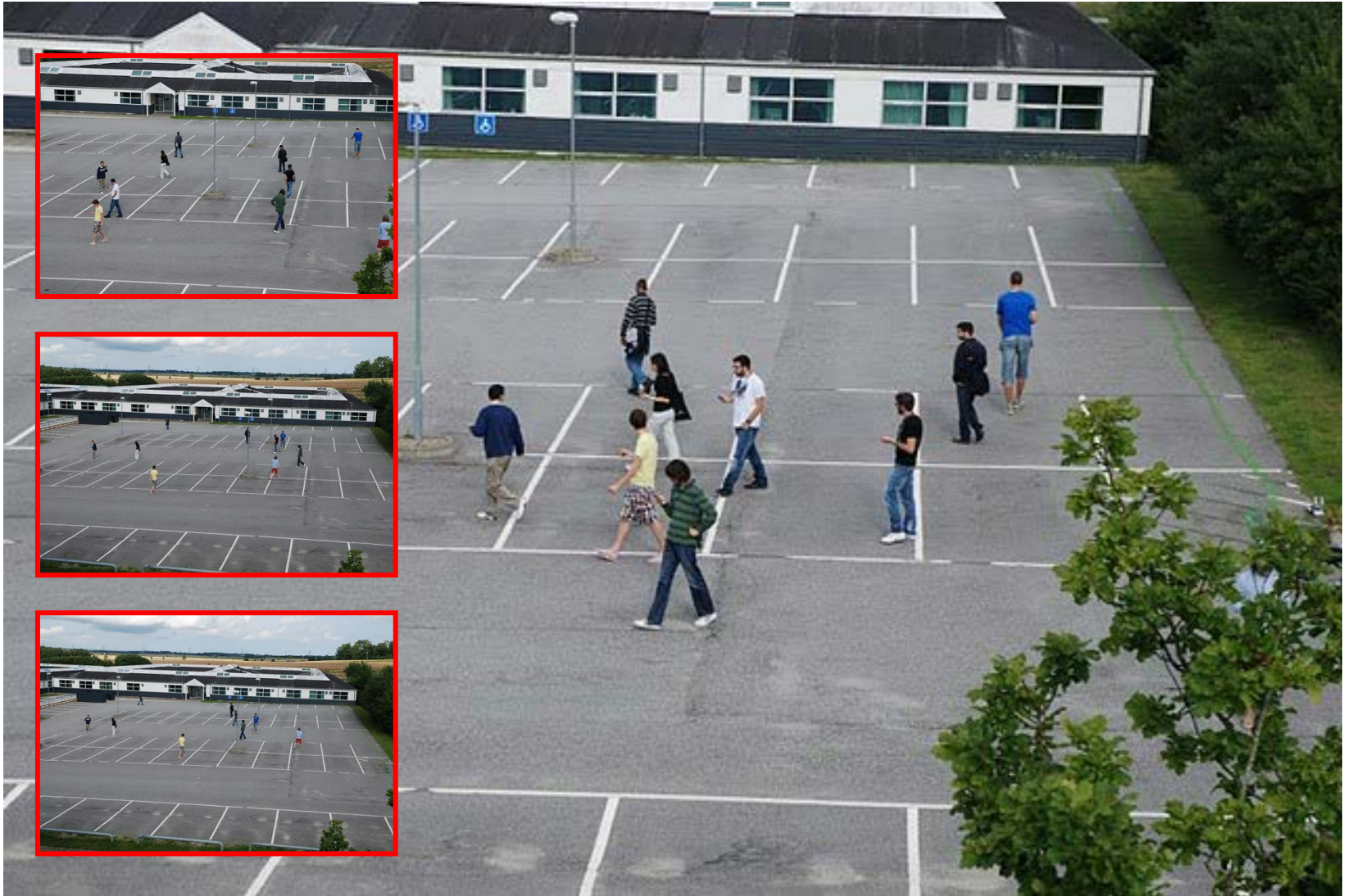


Figure 1. Multimedia exchange scenario with 10 moving devices

# Scenario 2: Measurement Setup





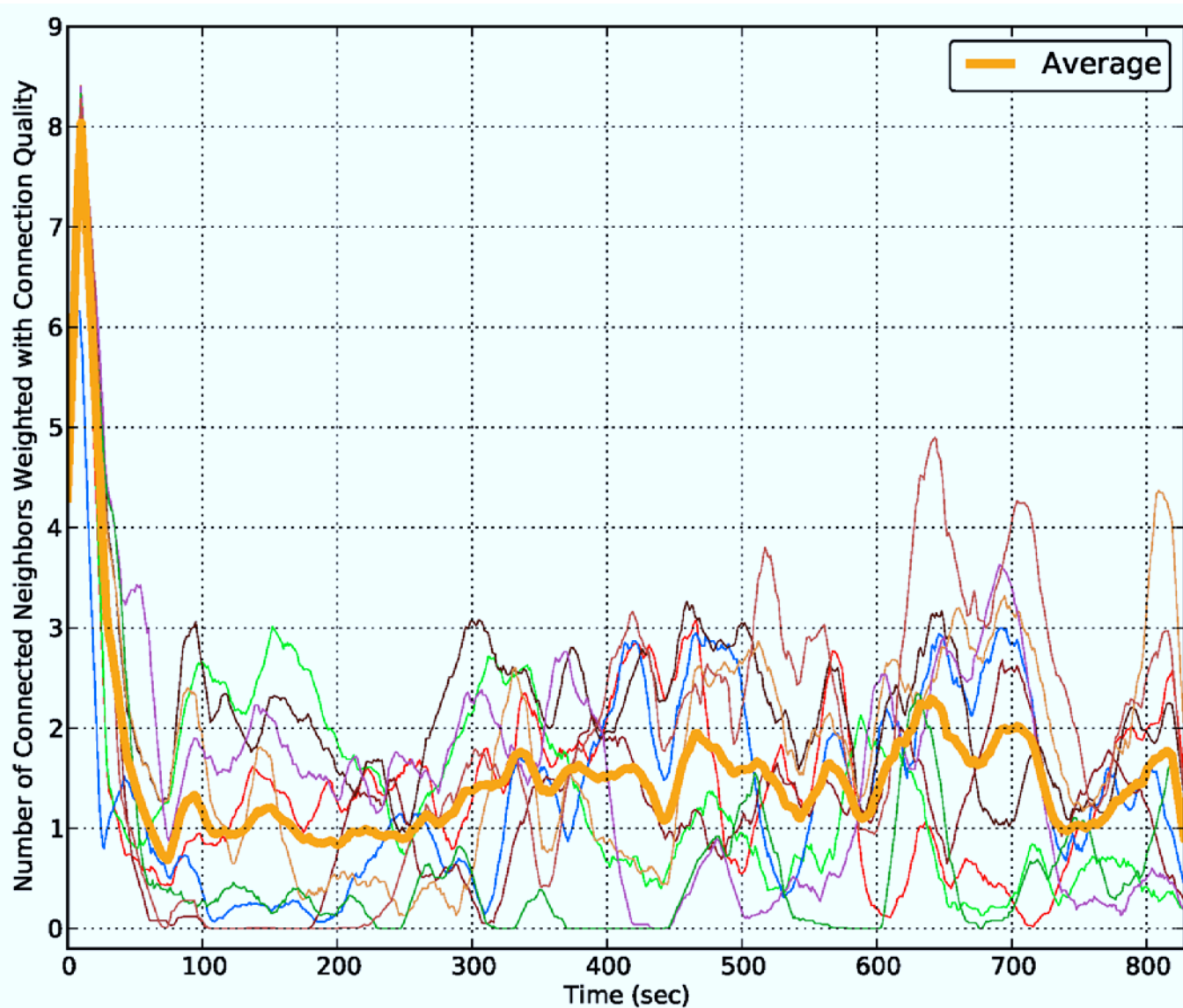
# Scenario 2: Measurement Setup



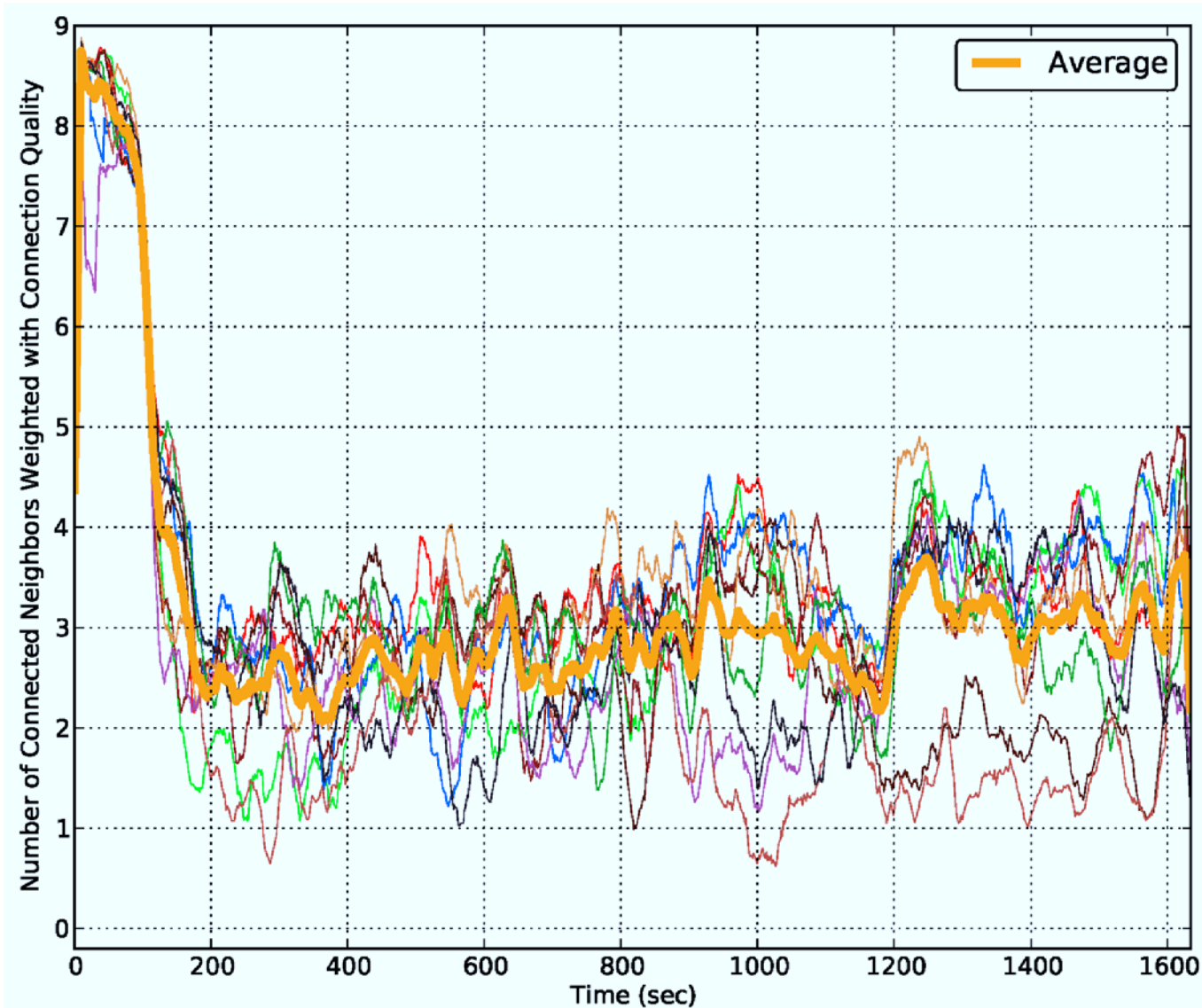
# Scenario 2: Two Strategies under Investigation

- No network coding: Devices resell original packets once they get them. Problem here is the number of supported TCP streams and the collector's problem.
- Network coding: Now coded packets are used among the mobile devices
- Which strategy is the best?

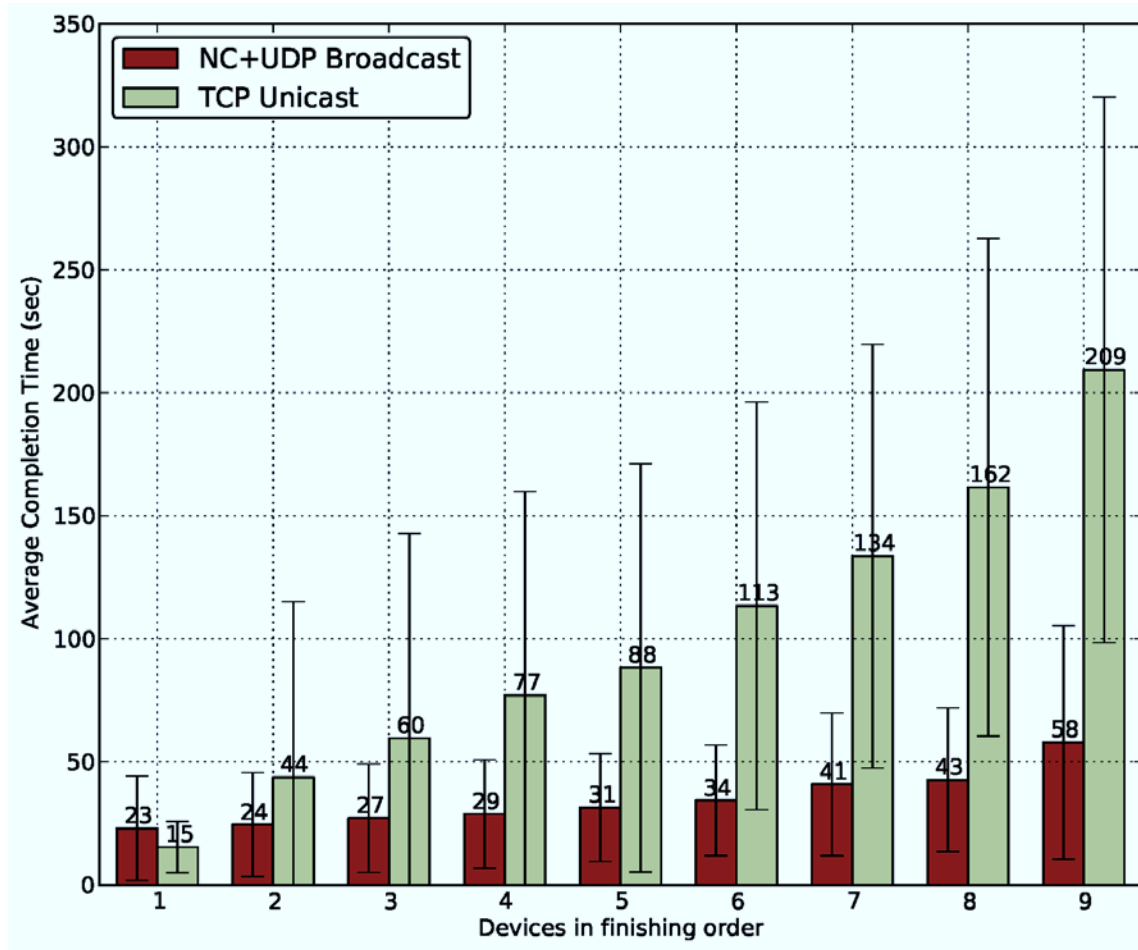
# Scenario 2: Results: Connectivity Outdoor



# Scenario 2: Results: Connectivity Indoor

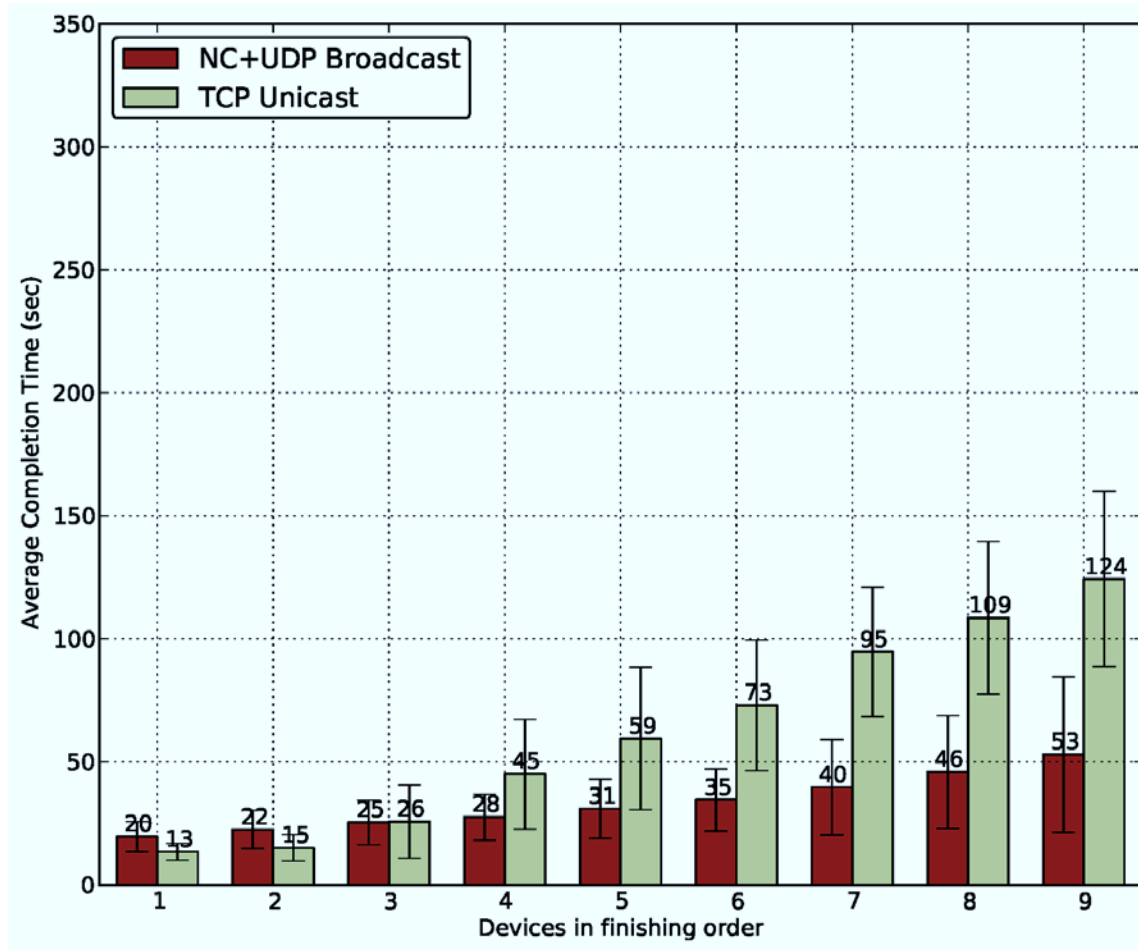


# Scenario 2: Results: Exchange time Outdoor





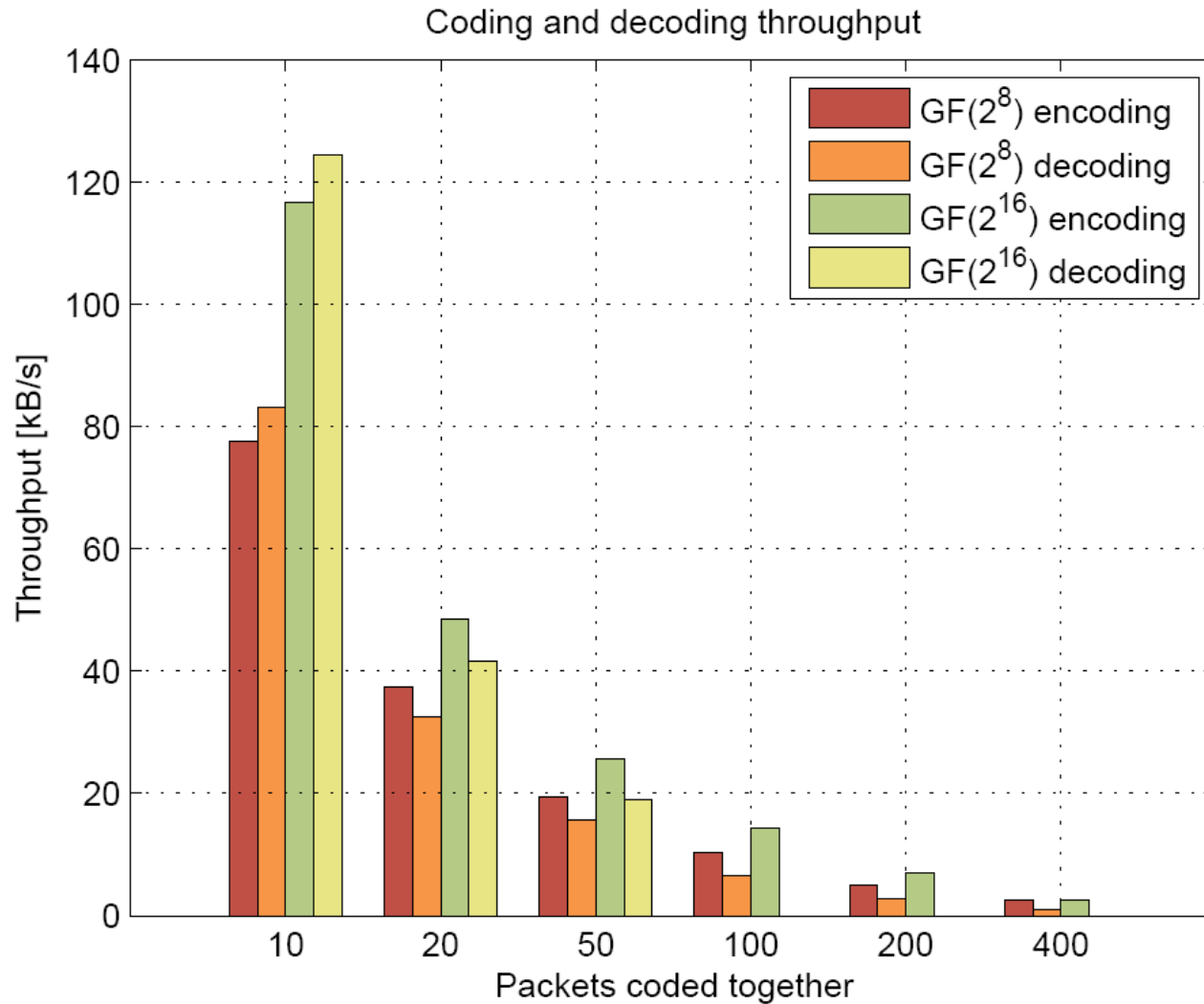
# Scenario 2: Results: Exchange time Indoor



# The technical challenge ...

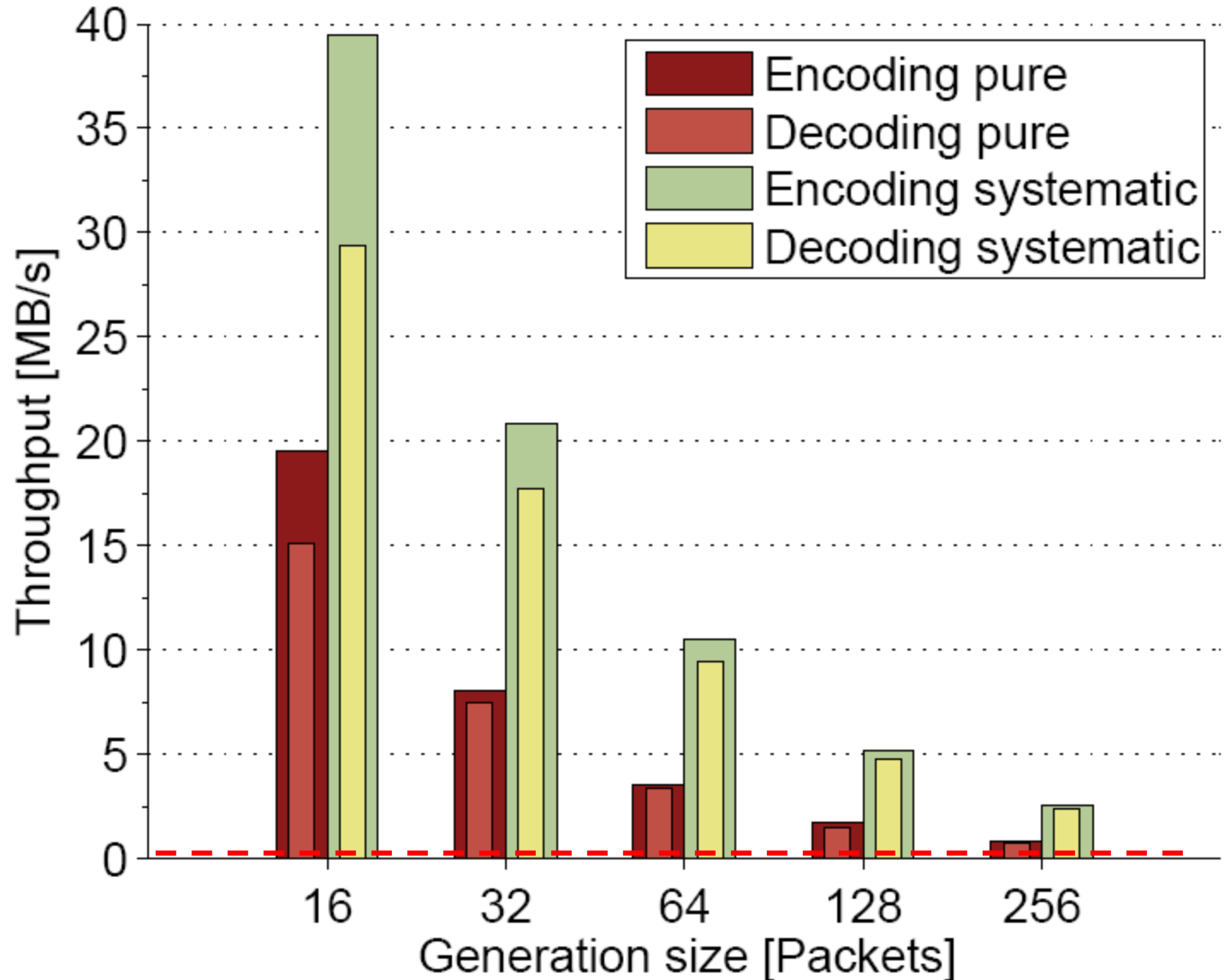
- Just a few words about network coding on mobile devices.
- Different strategies can be implemented
  - COPE
  - RLNC
- RLNC is the way to go ...

# S60 Implementation RLNC



# Coding throughput on Nokia N95

Nokia N95-8GB, ARM 11 332 MHz CPU, 128 MB ram, Symbian OS 9.2



# Why sharing

- Technology enabled: The real egostic behavior is to cooperate. Each party gains instantaneously. 😊
- Socially driven: Connection to the social networks such as Facebook or g+

# Conclusion

- Viral loops are an interesting way to spread the word (or app, or any other content)
- Mobile clouds are an interesting architecture to tackle some of the ongoing research objectives such as green, social etc
- Network coding is the most prominent and important ingredient for both