

Title: Advantages of a Coexistence Protocol for Relay Operation

Document Number:

IEEE C8021mmr-05/020

Date Submitted: 9 November 2005

Source:

Mariana Goldhamer

Voice: +972 3 645 6241

mariana.goldhamer@alvarion.com

Yaron Alpert

Voice: +972 3 766 1616

aron.alpert@alvarion.com

ALVARION

21a HaBarzel Street, Tel Aviv, Israel

Venue:

Meeting: IEEE 802.16 Session#40, Vancouver, Canada

Base Document:

Purpose: Present the advantages of using coexistence protocols in Relay/Cellular operation and propose text for PAR

Notice:

This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change

in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release:

The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.

IEEE 802.16 Patent Policy:

The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <<http://ieee802.org/16/ipr/patents/policy.html>>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <<mailto:chair@wirelessman.org>> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <<http://ieee802.org/16/ipr/patents/notices>>.

Advantages of a Coexistence Protocol for Relay operation

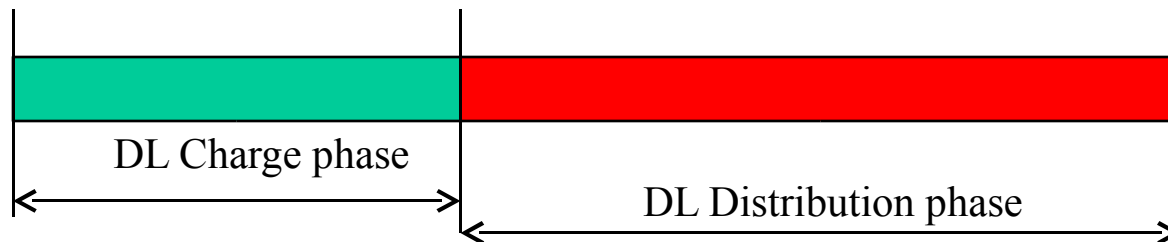
Mariana Goldhamer

Yaron Alpert

ALVARION

Phases relay operation

- “Charge” phase
 - BS -> RS (Relay station)
- “Distribution phase”
 - RS (Relay station) -> SS/MSS
- “Collection” phase
 - SS/MSS -> Relay station
- “Discharge” phase
 - RS -> BS
- **This presentation addresses mainly the collection/distribution phase**



Reducing the interference

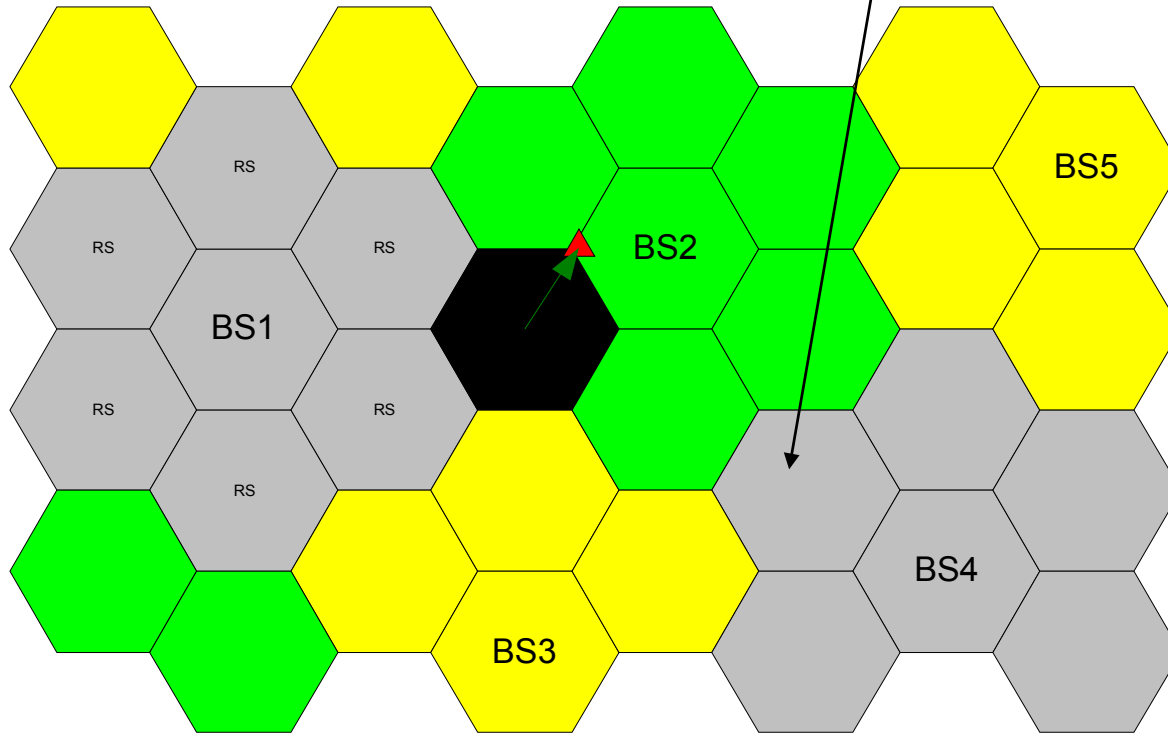
- May significantly increase the spectral efficiency
 - 36% throughput improvement with relays implementing “beam forming” – see IEEE C80216mmr-05_008r3
 - May be too expensive
- This contribution will investigate how a “coexistence protocol” can produce similar results

Assumptions for the following study

- The antennae on BS and RS are omnidirectional
- Same basic topology as in C80216mmr-05_008r3
- The operator uses 3 frequency channels
 - The rejection of the adjacent channel is 30dB
- The reference case: the BS and associated relays use the same frequency channel
- The improvement: due to assignment of different channels to interfering cells

Reference case

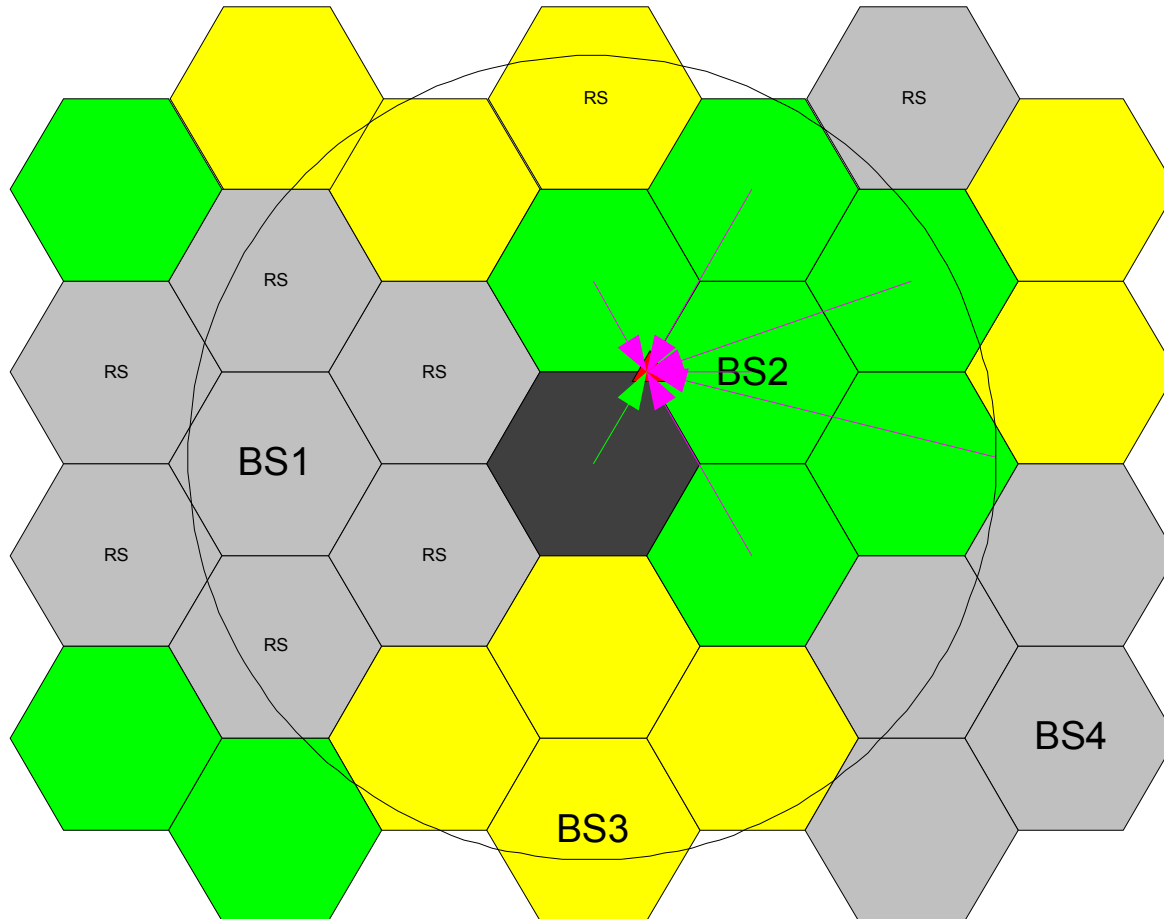
Interference victim



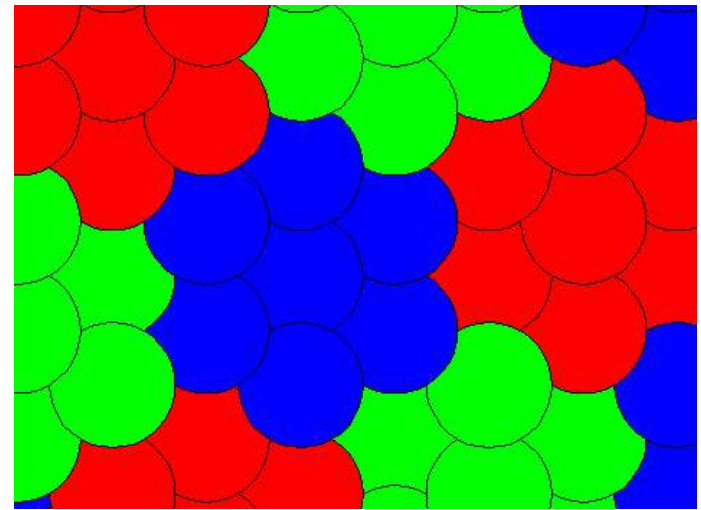
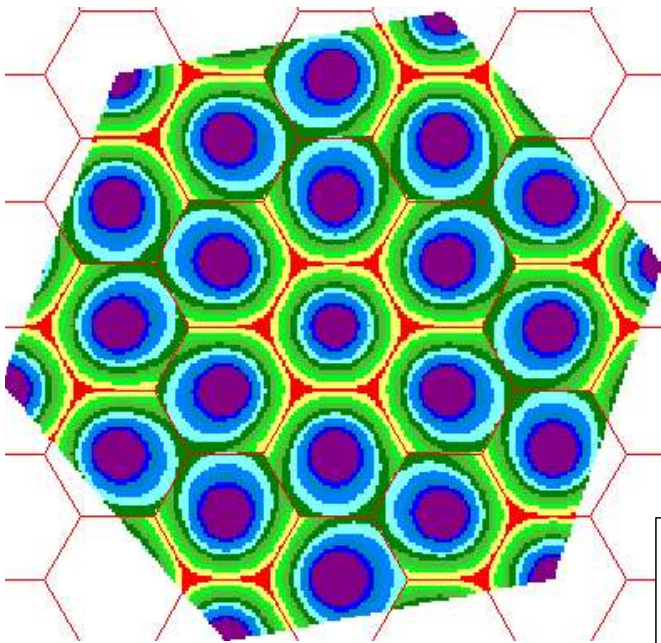
Which transmitters might produce interference at SS receiver ?

- Those having the signal strong enough, in the LOS conditions
 - We group those transmitters in a “Coexistence Neighborhood”
 - Assume that all the transmitters (BS and RS) use the same transmit power
 - Short lines in the next figure involve high interference

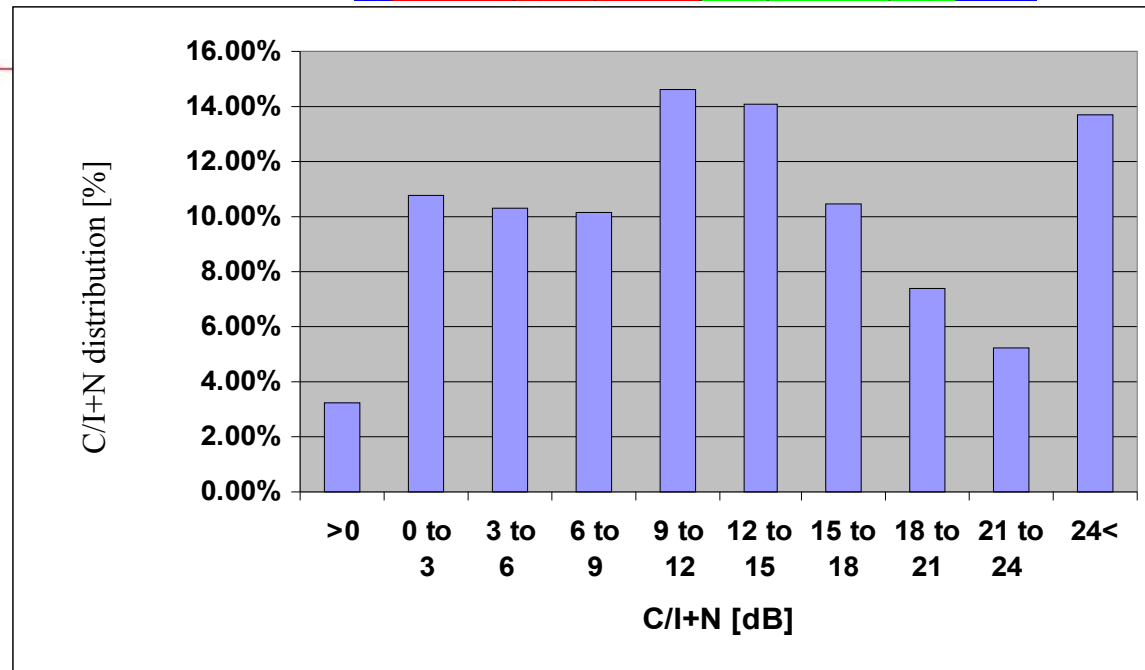
Coexistence “neighborhood”



C/I Distribution for the reference case



Min	to	0dB	3.214 %
0dB	to	3dB	10.756 %
3dB	to	6dB	10.284 %
6dB	to	9dB	10.151 %
9dB	to	12dB	14.636 %
12dB	to	15dB	14.057 %
15dB	to	18dB	10.458 %
18dB	to	21dB	7.377 %
21dB	to	24dB	5.372 %
24dB	to	Max	13.689 %



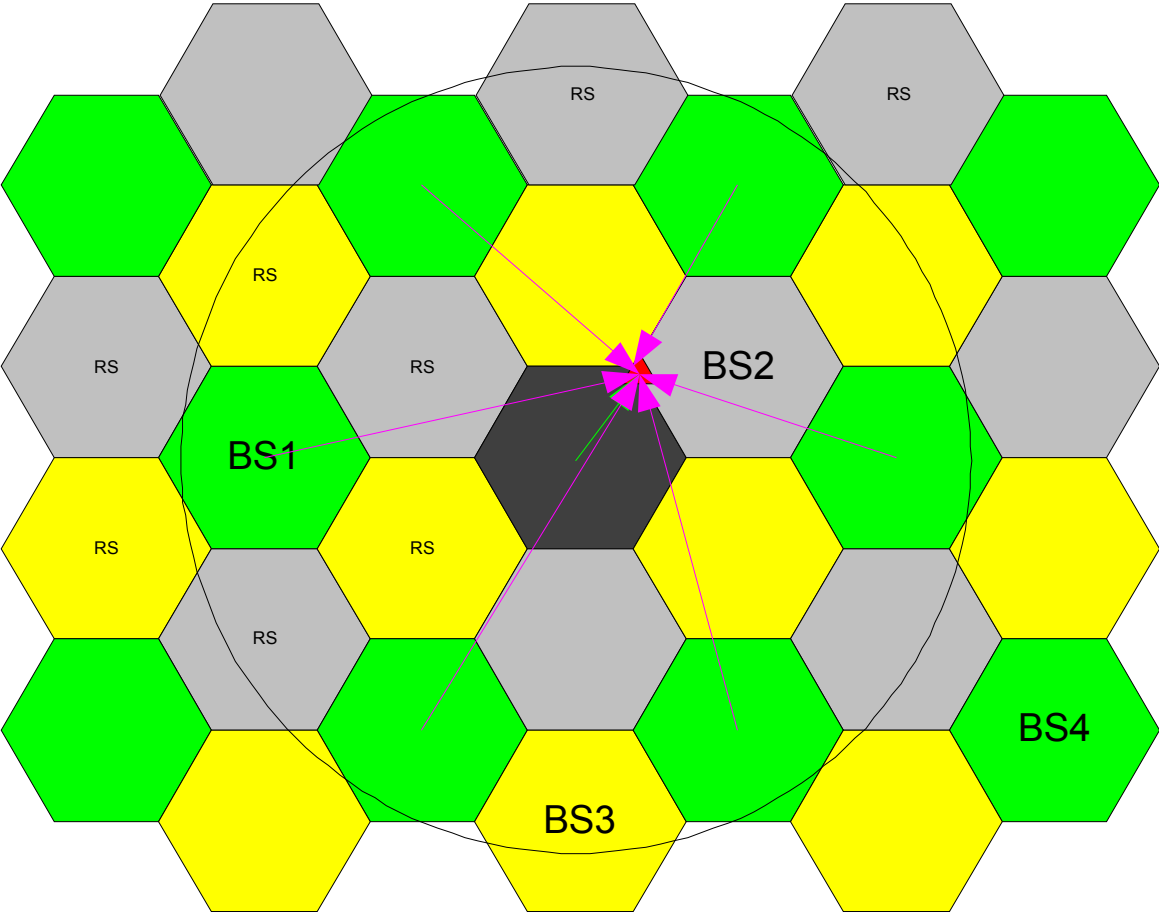
How to reduce the interference ?

- Every RS uses a different sub-channel
 - **limited throughput**
- Every RS uses a full channel and BS schedules the transmitted powers for all the Relays such that the interference will be lower when sending the info for the target SS/MSS
 - **Very complicated exercise, may not work for all the links**
 - **Limited throughput**
 - **Requires use of low MCRs**
 - **Long transmission times -> high power consumption from the MSS**

Changing the frequency patterns

- Use another frequency pattern in the distribution phase
- Advantage
 - **Drastically reduce the interference (see figures)**
- Disadvantage
 - **Needs frequency assignment**

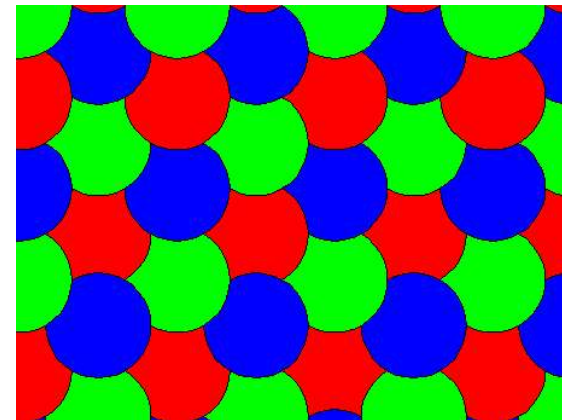
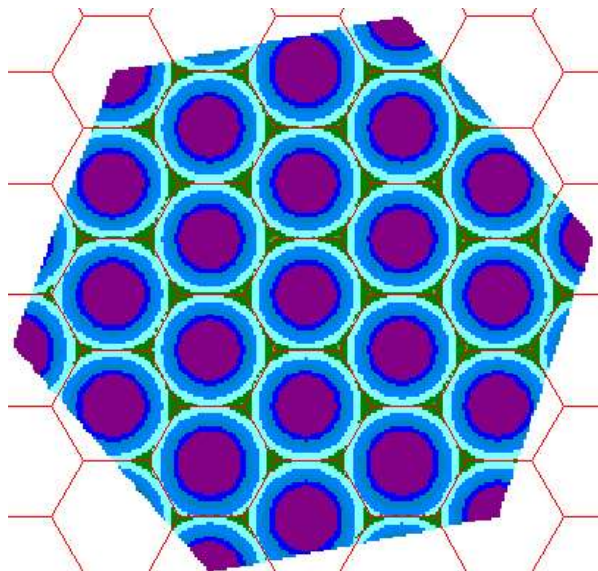
Different frequency pattern













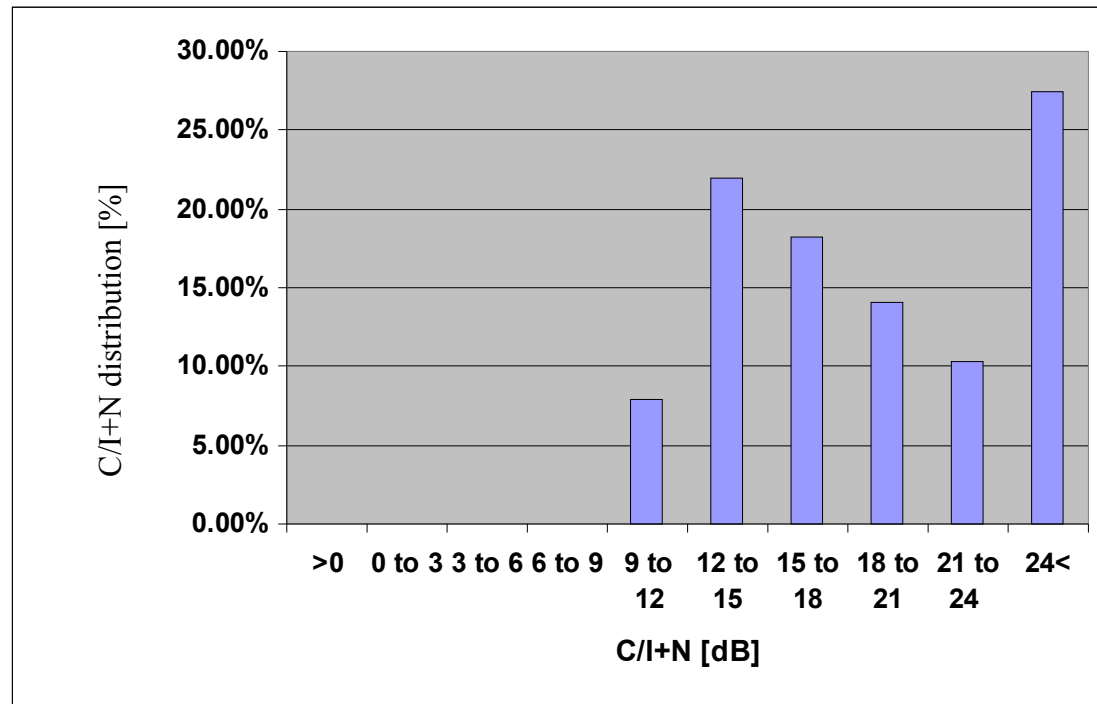
Characteristics of the new frequency pattern

- Same number of interferers in the “Coexistence neighborhood”
- No adjacent interfering relays
 - **All the interferers are more distant**
- The cumulated interference is lower
 - **Higher MCRs can be used**
 - **Lower MSS required transmission time and power consumption**

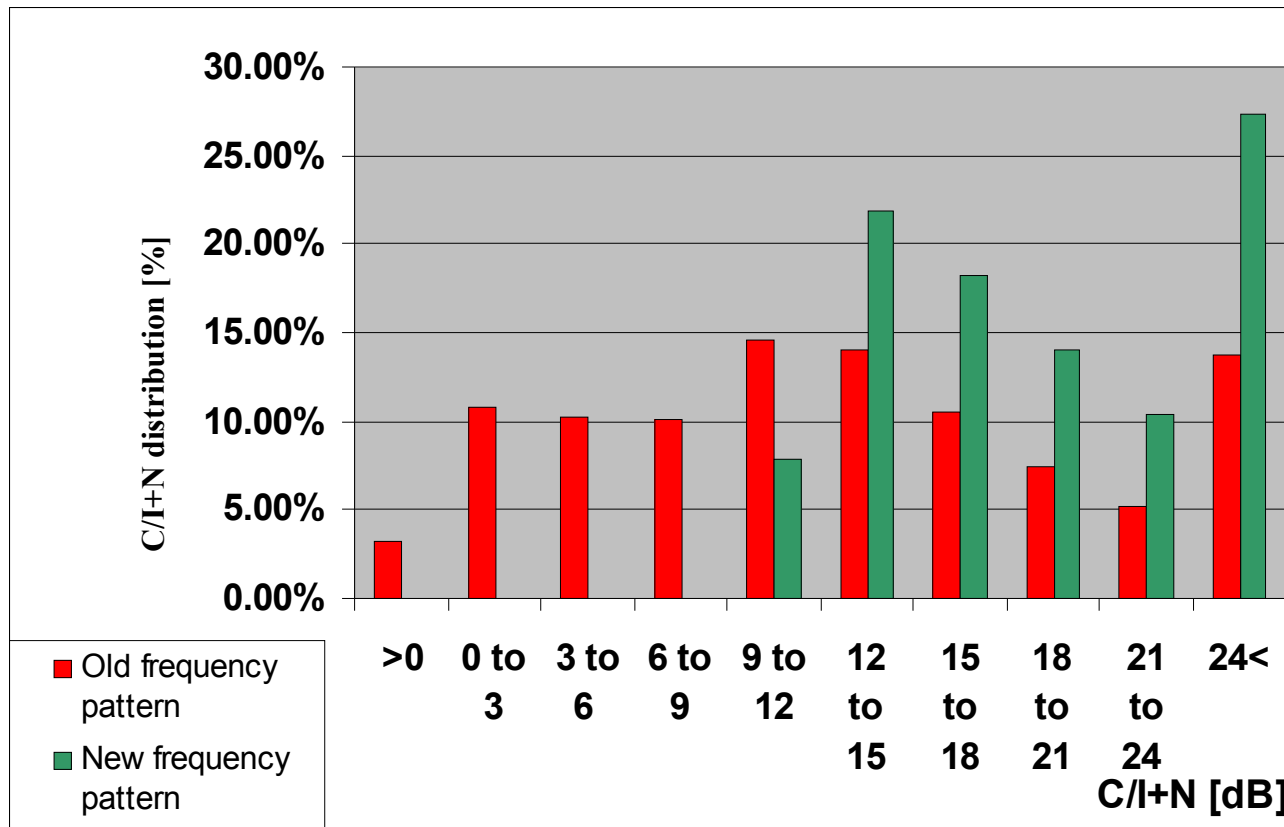
Performance of the new frequency pattern



Min	to	0dB		0 %
0dB	to	3dB		0 %
3dB	to	6dB		0 %
6dB	to	9dB		0.098 %
9dB	to	12dB		7.852 %
12dB	to	15dB		21.928 %
15dB	to	18dB		18.266 %
18dB	to	21dB		14.088 %
21dB	to	24dB		10.373 %
24dB	to	Max		27.392 %



Comparison of C/(I+N) distributions



How to obtain the frequency assignment?

- Using 802.16h approach:
 - Data base:
 - GPS position of the Relays and BSs
 - IP Address
 - BSIDs
 - Sending the Radio Signature by RSs/BSs
 - Every SS/MSS/RS/BS can evaluate the interference
 - The information is centralized by the BS
 - Through **BS-BS distributed communication** the systems in Community may learn the interference and the interferers
 - Frequency channel selection procedures

Distributed power control

- Protocol based coexistence in 802.16h:
 - every NETWORK will have the possibility to use max. power at pre-defined time intervals
 - High spectral efficiency
 - Links not creating interference may work in parallel
- Protocol-based coexistence for cellular deployment:
 - Systems using a given FREQUENCY CHANNEL will have the possibility to use max. power at predefined time intervals
 - Allows distributed power management
 - No need for BS Controller
 - Base Stations will be able to control the Relay powers
 - Allows high spectral efficiency

Interference-free operation in cellular networks

- Could be created by coexistence protocols
 - The MSS is able to transmit/receive at higher $C/(N+I)$
 - Same data is handled in much shorter time

Reduces the MSS power consumption!

Relay PAR Scope

- To include:
 - “higher layer mechanisms, as Coexistence Protocols”

Drafting an 802.16 Coexistence Protocol

- Already started for 802.16h
 - First application: License Exempt use
 - Other applications:
 - Relays
 - Light-licensed bands
 - Licensed bands
- Should be formatted as a stand-alone chapter, application independent
- Every application may enhance it and should have a sub-chapter to detail its usage