

Title: Advantages of a Coexistence Protocol for Relay Operation

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

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Advantages of a Coexistence Protocol for Relay operation

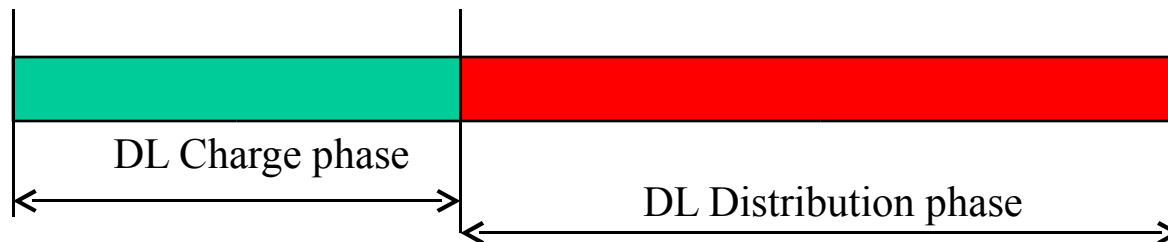
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Phases relay operation

- “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



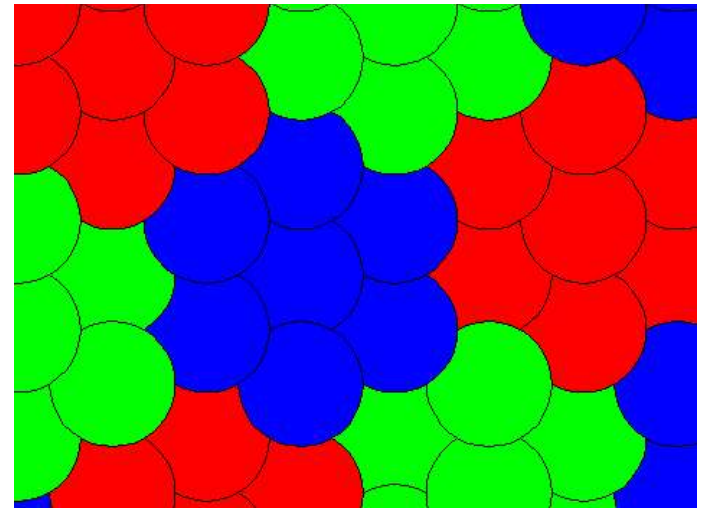
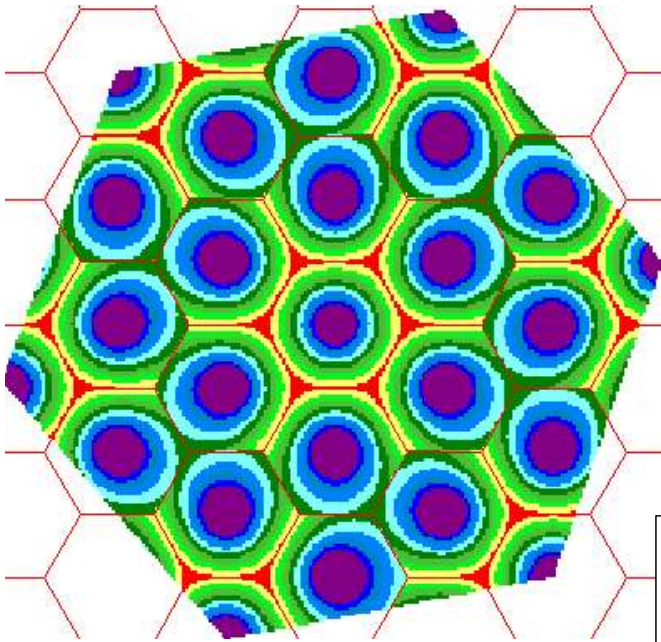
Which transmitters might produce interference at SS receiver ?

- 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

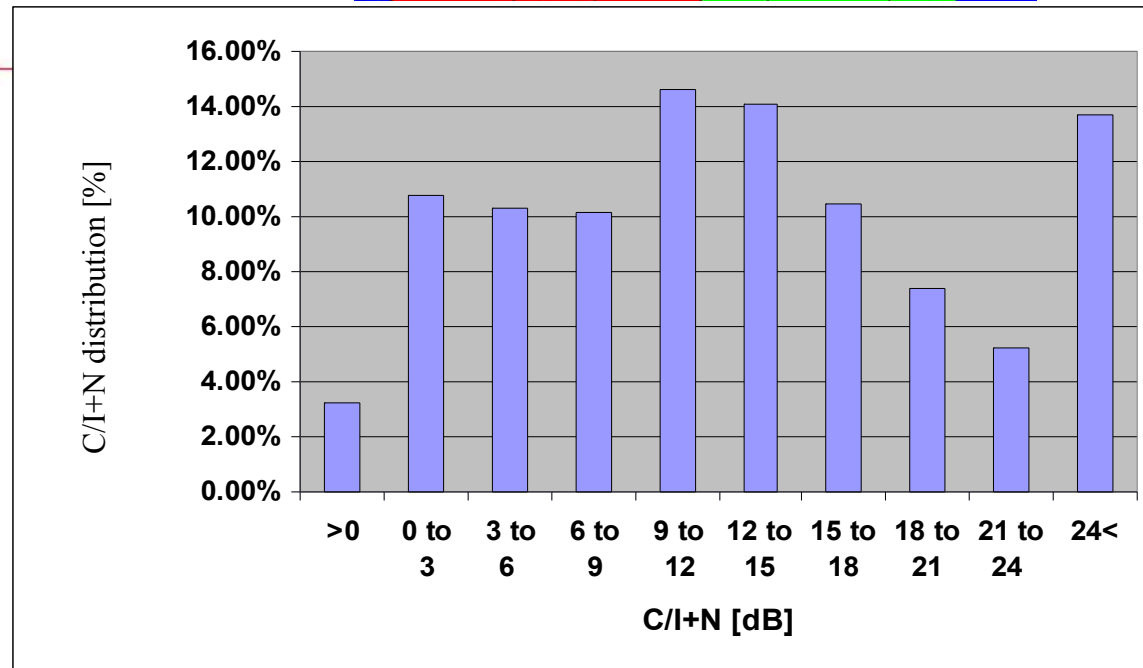
Coexistence “neighborhood”



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**

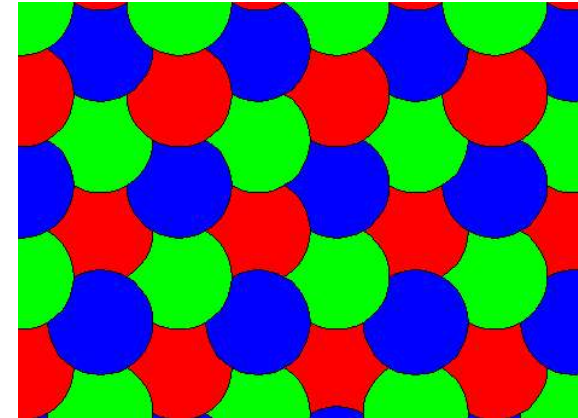
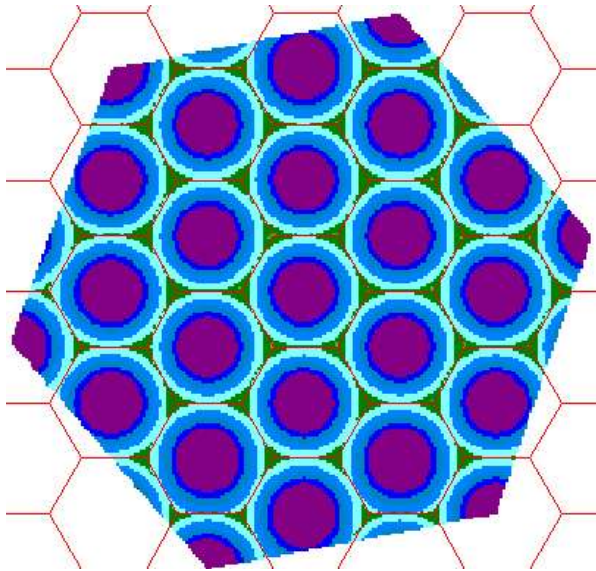
Different frequency pattern



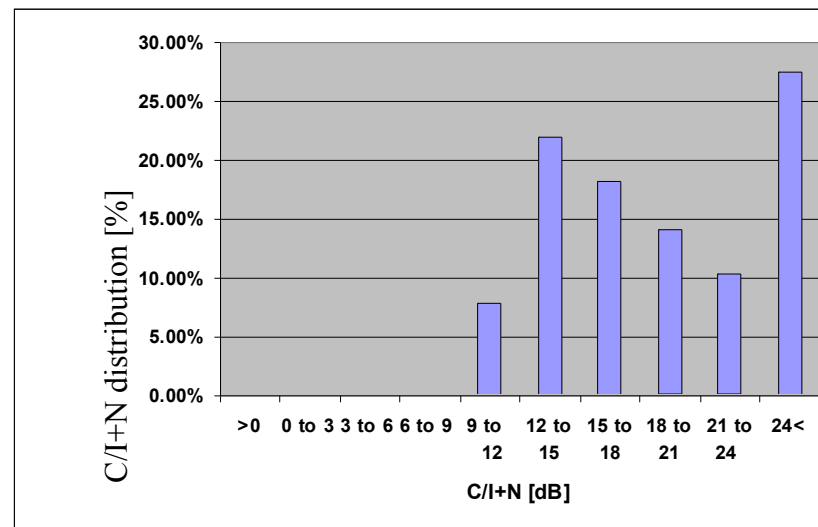
Characteristics of the new frequency pattern

- 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**

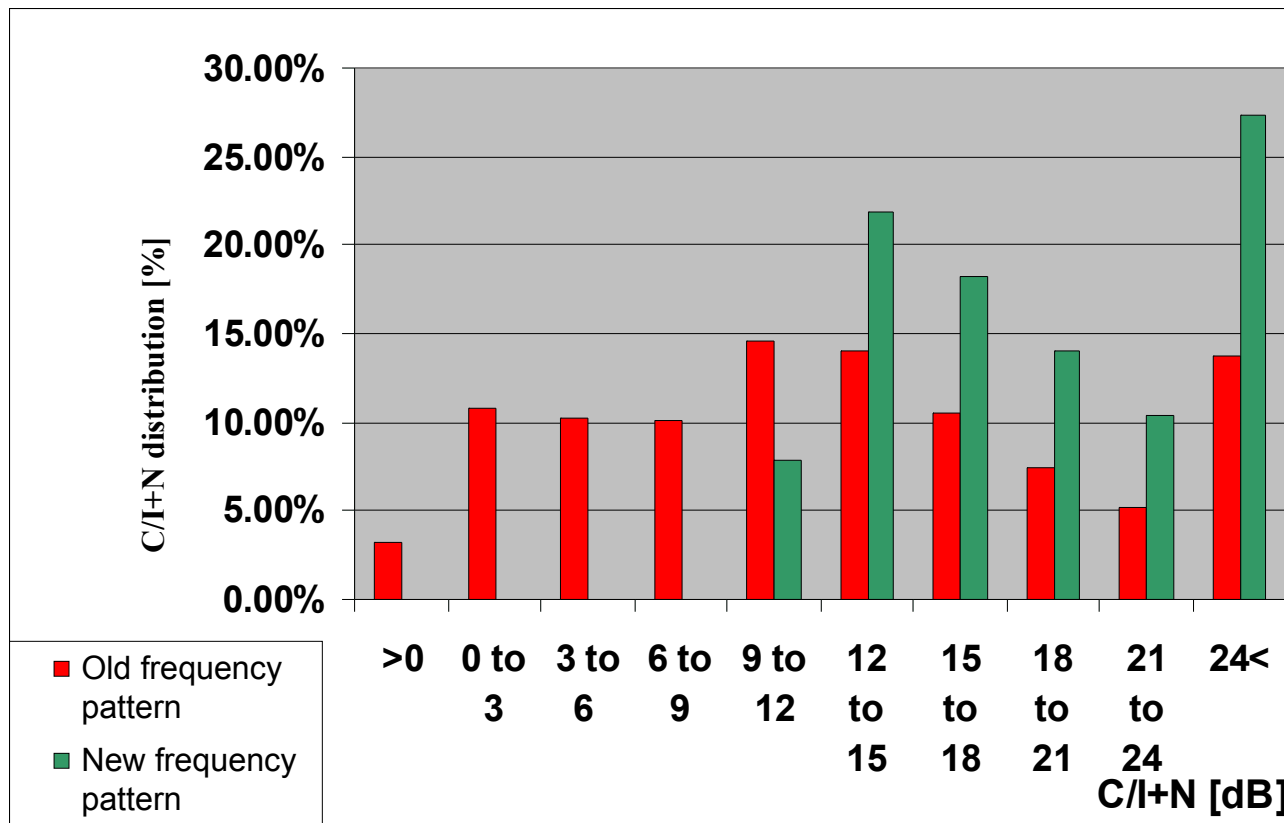
Performance of the new frequency pattern



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

Extending the concept

- Every frequency may be thought as a bunch of sub-channels
 - OFDMA/OFDM modes
- Negotiating the allocation of sub-channels per “bunch”
 - Depending on traffic amount
 - Flexibility on assignments
 - Token-based protocol, developed in 16h, may apply

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

- Opt. 1:
 - To include:
 - “higher layer mechanisms, as Coexistence Protocols”
- Opt. 2:
 - To create a new PAR (after 802.11h is done)
 - “extension of the protocol-based coexistence for Relay operation”
 - Keeps the 802.16h expertise center

Drafting an 802.16 Coexistence Protocol

- Already started for 802.16h
 - First application: License Exempt use
 - Other applications:
 - Relays
 - Light-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