

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

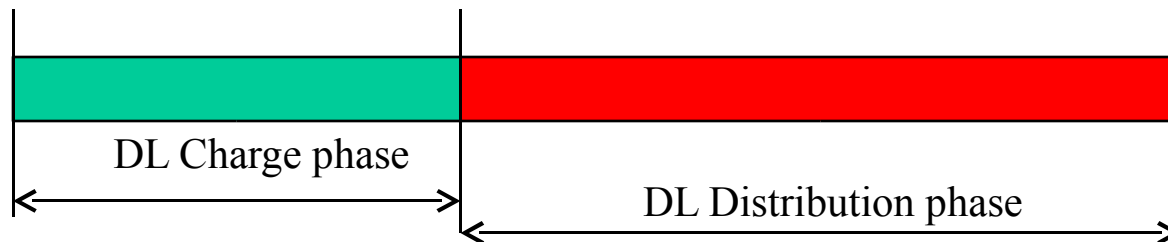
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Phases relay operation

- “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



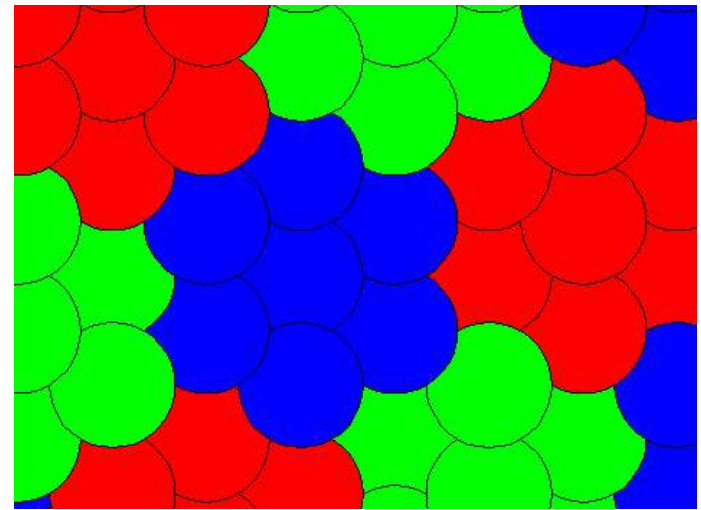
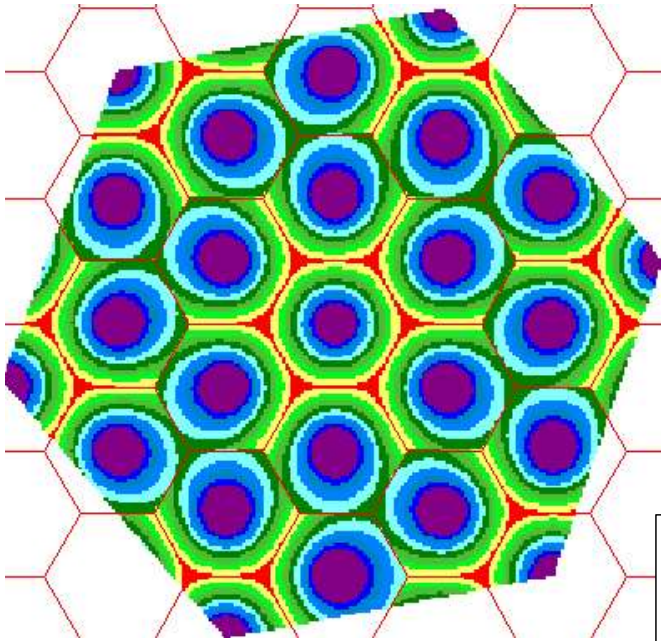
Which transmitters might produce interference at SS receiver ?

- 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

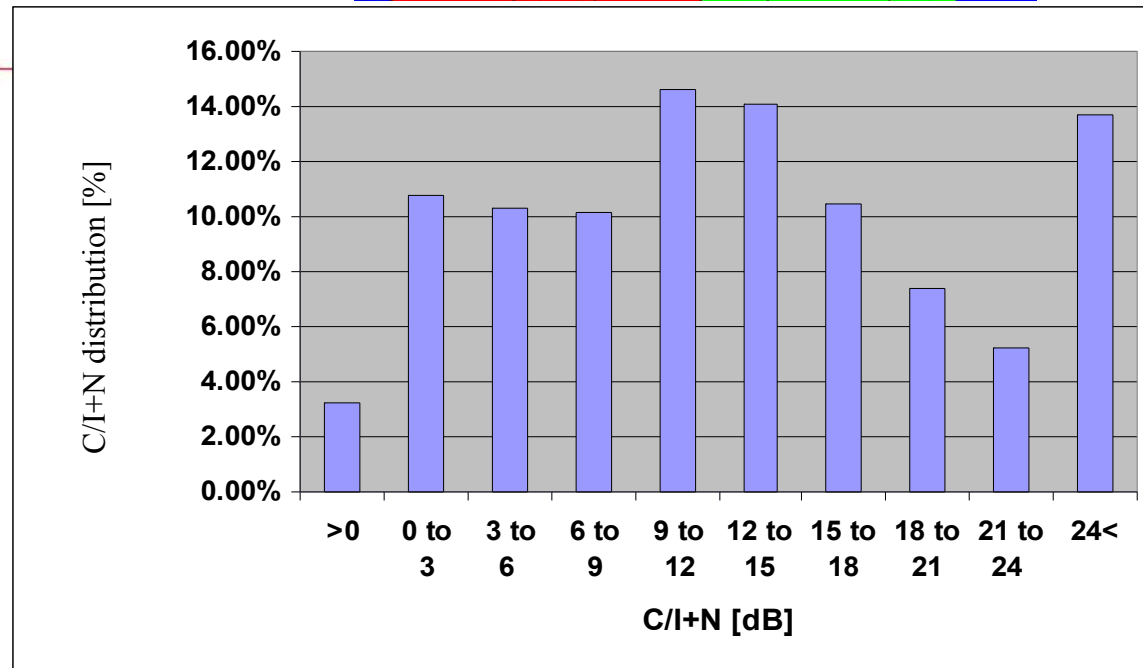
Coexistence “neighborhood”



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**

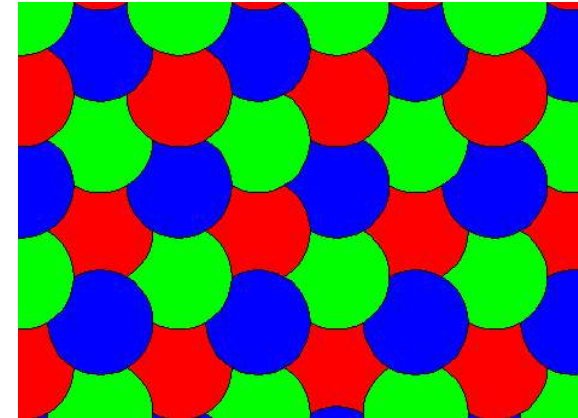
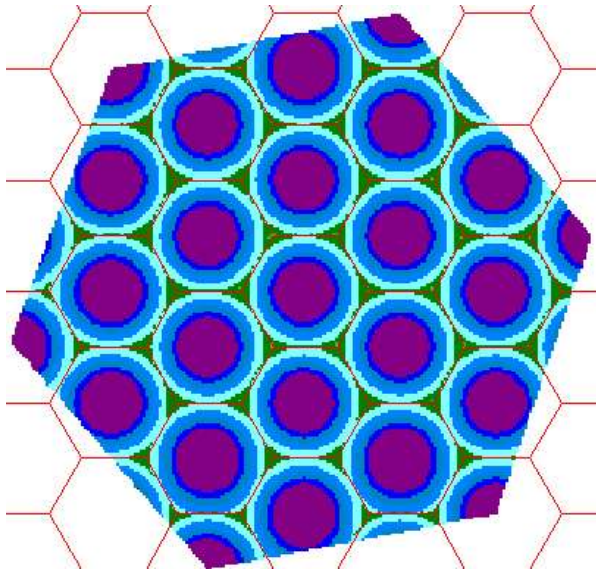
Different frequency pattern



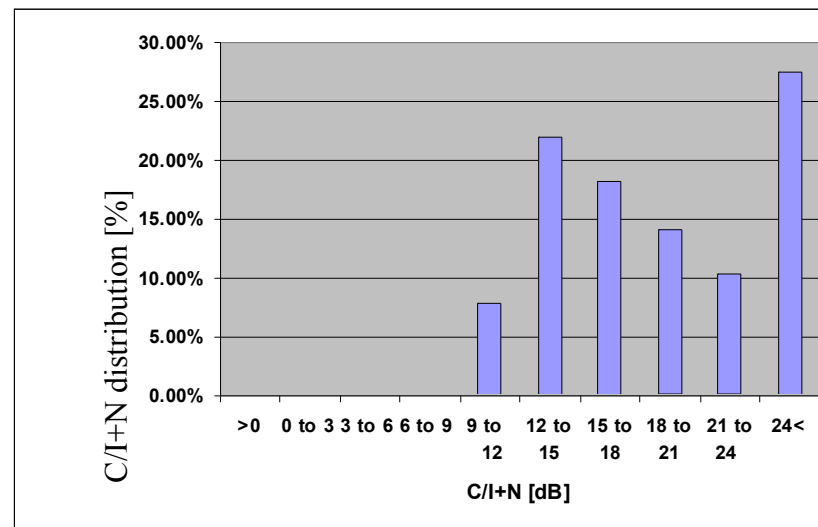
Characteristics of the new frequency pattern

- 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**

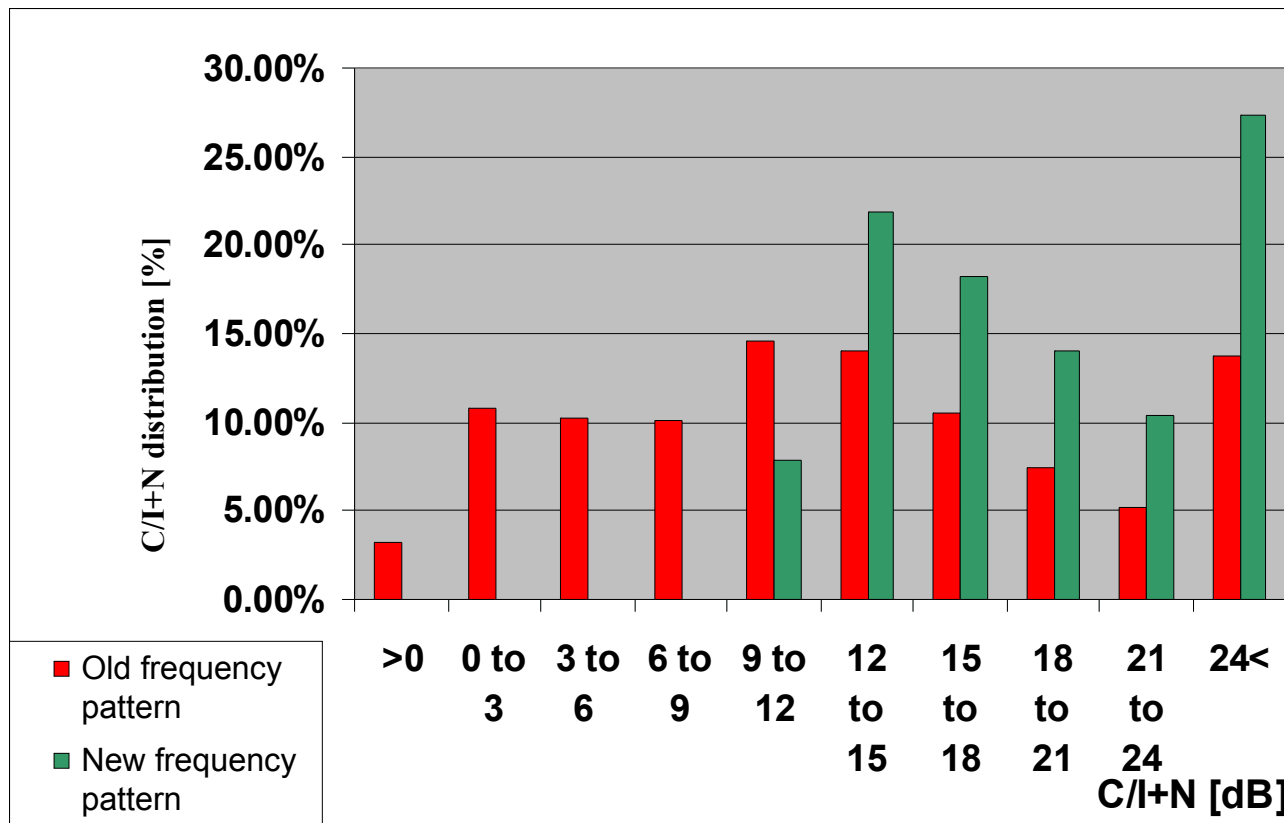
Performance of the new frequency pattern



| | | | | |
|------|----|------|--|----------|
| 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 802.16h 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