Title: Advantages of a Coexistence Protocol for Relay Operation

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Source:
Mariana Goldhamer Voice: +972 3 645 6241 mariana.goldhamer@alvarion.com
Yaron Alpert Voice: +972 3 766 1616 yaron.alpert@alvarion.com

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

Advantages of a Coexistence Protocol for Relay operation

Mariana Goldhamer

Yaron Alpert

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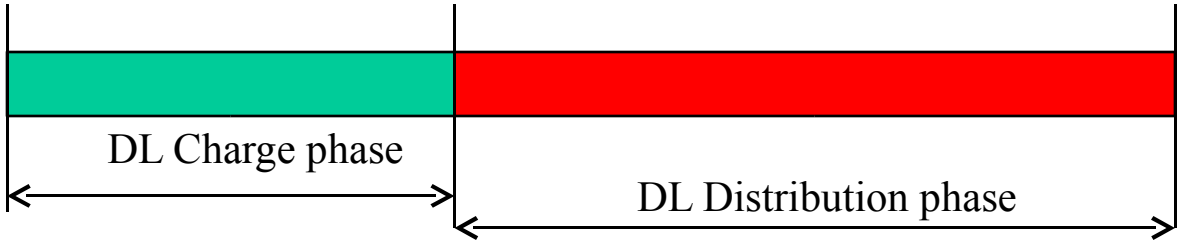
Phases relay operation

- "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**



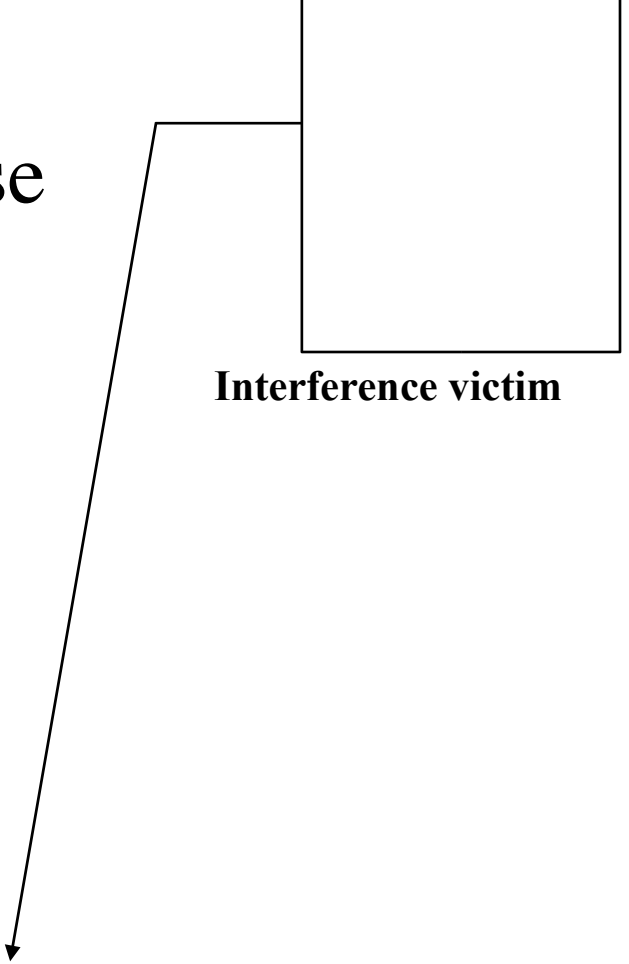
Reducing the interference

- 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

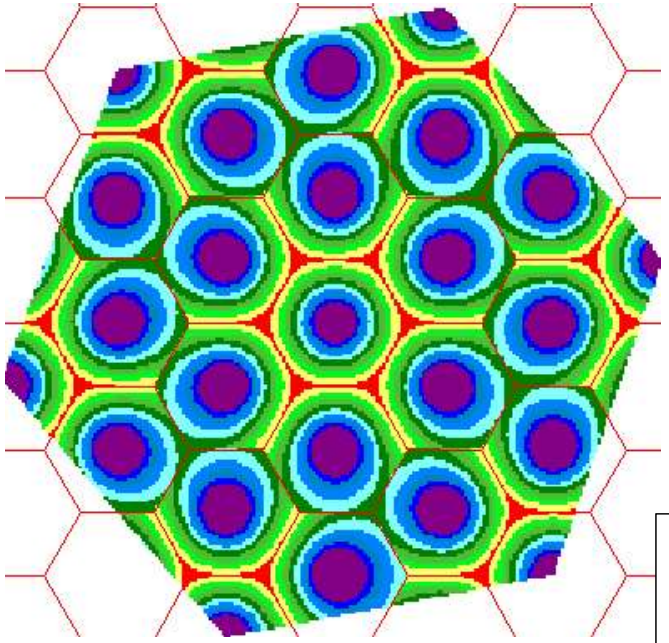


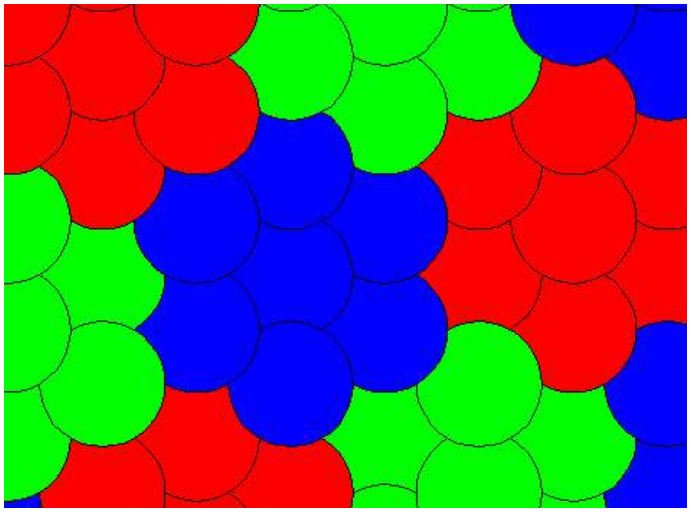
Which transmitters might produce interference at SS receiver ?

- 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

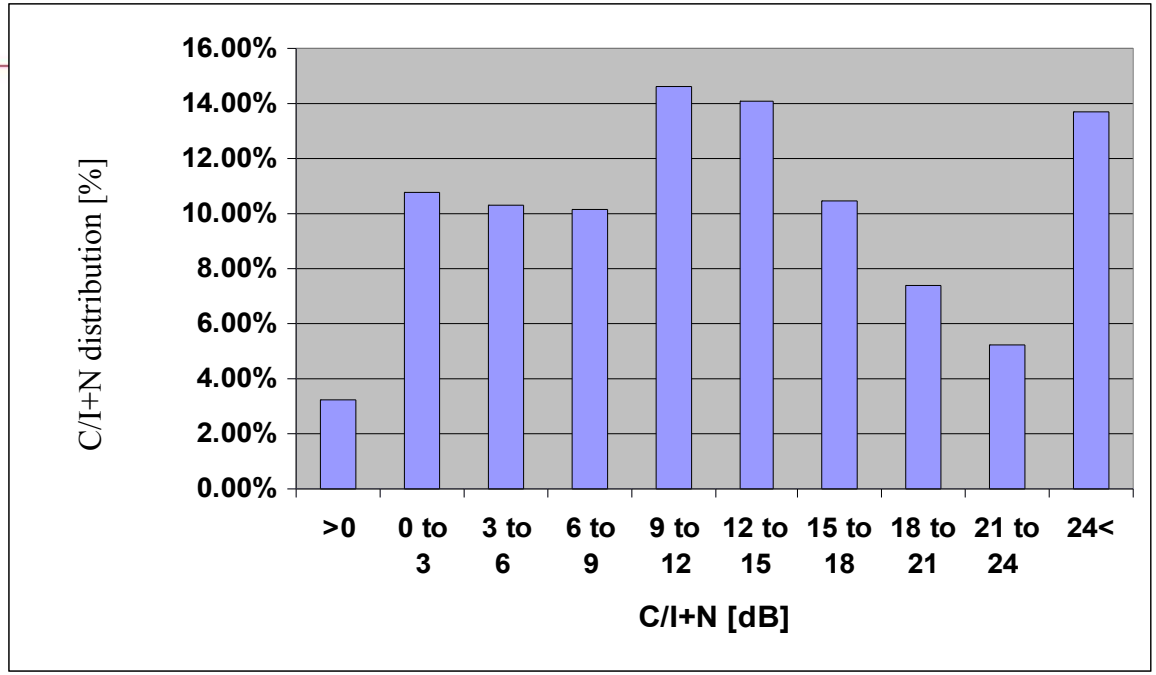
Coexistence “neighborhood”

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

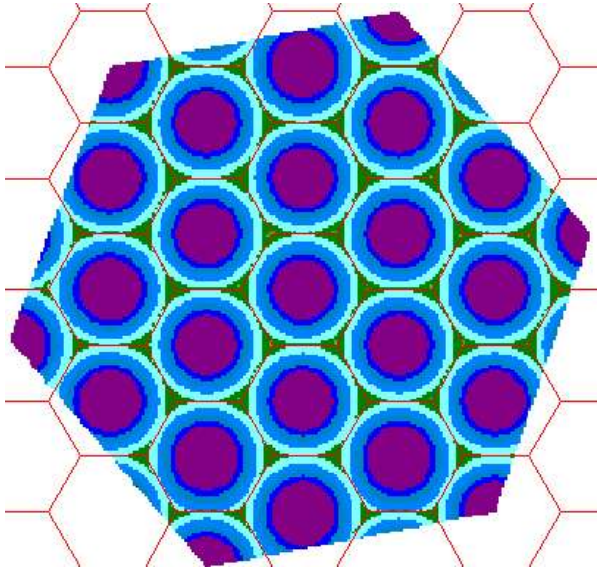
- Use another frequency pattern in the distribution phase
- Advantage
  - **Drastically reduce the interference (see figures)**
- Disadvantage
  - **Needs frequency assignment**

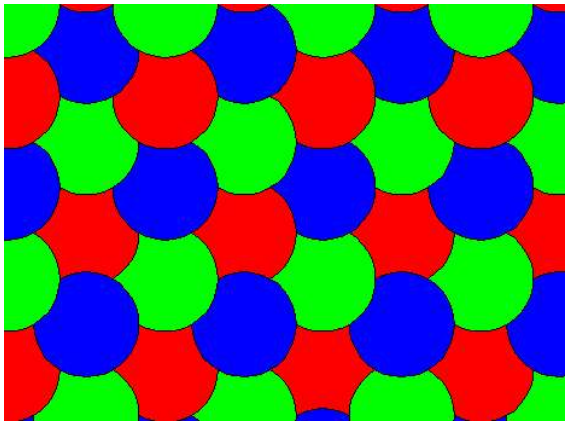
Different frequency pattern

Characteristics of the new frequency pattern

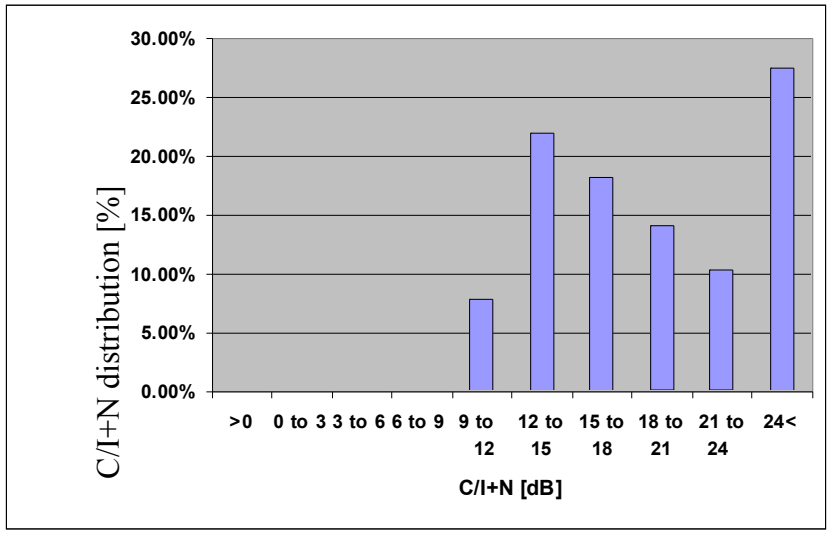
- Same number of interferes in the "Coexistence neighborhood"
- No adjacent interfering relays
  - **All the interferers are more distant**
- The cumulated interference is lower
  - **Higher MCRs can be used**
    - **Lower MSS required transmission time and power consumption**

Performance of the new frequency pattern

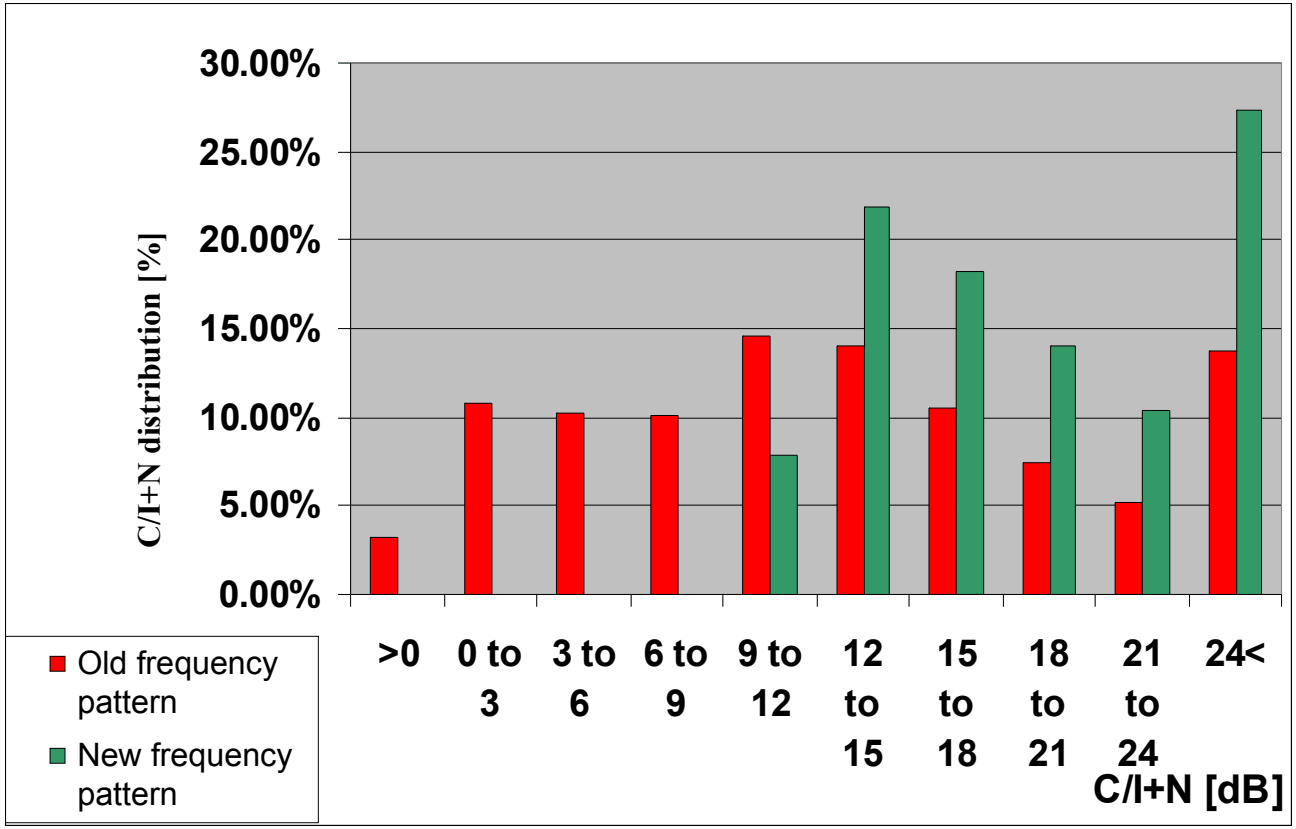




Min	to	0dB	0 %
0dB	to	3dB	0 %
3dB	to	6dB	0 %
6dB	to	9dB	0.098 %
9dB	to	12dB	7.852 %
12dB	to	15dB	21.928 %
15dB	to	18dB	18.266 %
18dB	to	21dB	14.088 %
21dB	to	24dB	10.373 %
24dB	to	Max	27.392 %



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