Channel Estimation and feedback report for OFDM AAS

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Purpose:

Channel Estimation and feedback report for OFDM AAS

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Channel Estimation and Feedback in AAS

- Channel feedback is used to provide support to DL beamforming.
  - SS measures the channel response and reports to BS
  - BS uses the information to improve beam forming towards the SS.
- Crucial for FDD- No channel reciprocity can be assumed
- Important for TDD- Eases the requirements on matching of RF chains.

Current feedback scheme

- Uses AAS-FBCK-REQ/RSP
- Measurement is performed on DL preamble or data.
  - On the already formed beam.
  - Facilities steepest descent algorithms.
- Mandatory for FDD, optional for TDD.
- Initiated by the BS

Desired improvements

- Direct measurement of the channel response vector
  - Measure the response from each of the antenna elements
  - Not on the already formed beam
  - Allows direct beamforming for faster adaptation.

- Unsolicited reports
  - The SS knows when the channel had changed significantly.
  - Can issue a report.

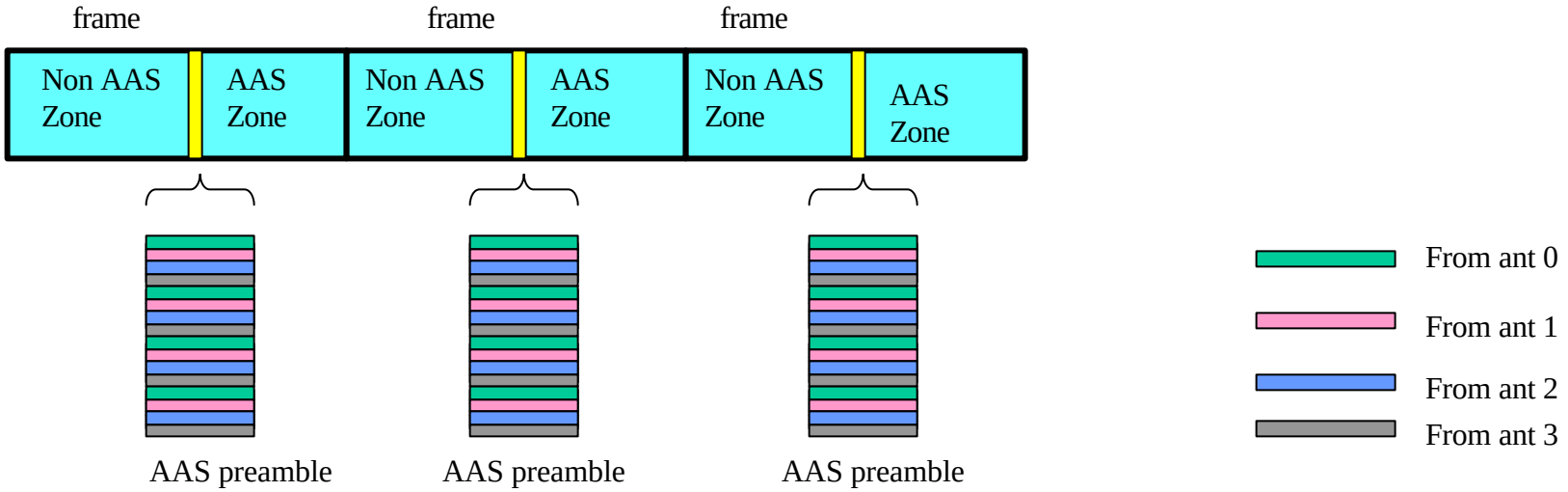
- Reporting CINR and RSSI information
  - Absolute power measurement
  - Available via other messages
  - Beneficial to bundle together with channel feedback report

Network entry problem

- Bootstrap problem
  - Before the link has been established no feedback messages can be used.
  - No beamforming can be performed in response to network entry request.
  - AAS-FBCK-REQ/RSP cannot be used (yet).
- Other problems
  - Format of NW entry requests in AAS.

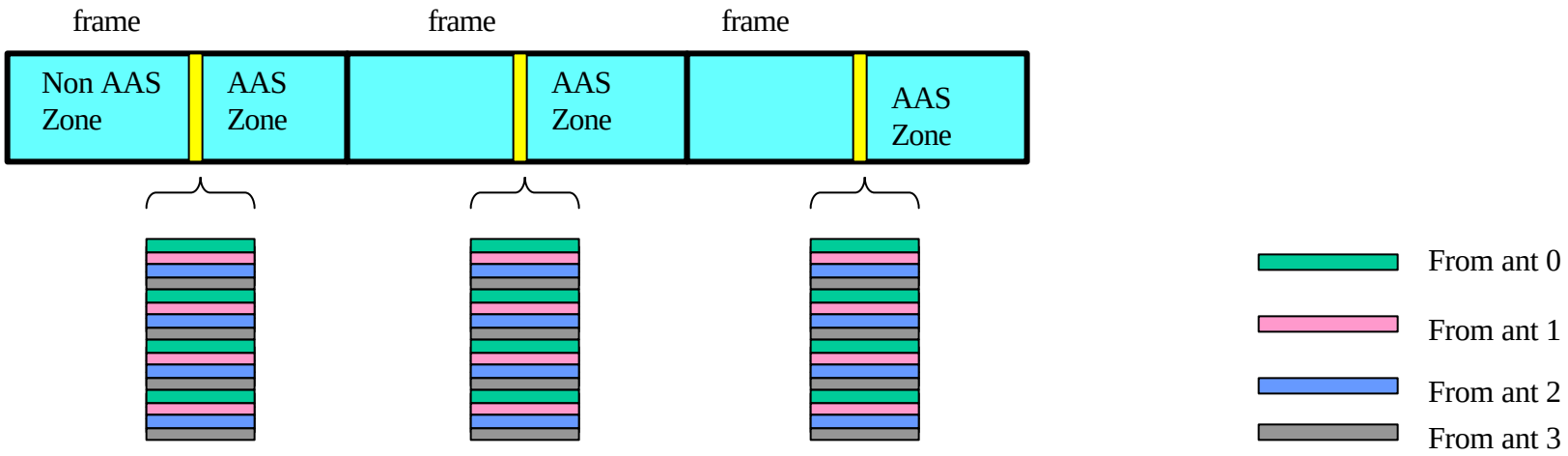
Proposed Approach

- Transmit orthogonal channel sounding waveforms from different beams.
- Transmitted during AAS preamble.
- In each AAS preamble up to four beams may be transmitted.
- The subset of beams may vary from frame to frame.
  - For the case of more than 4 antennas.



Proposed Approach

- AAS preamble has inherent diversity
- AAS preamble is used to
  - Detect AAS zone
  - Improve parameter estimation (frequency-time offset)
  - Estimate vector channel response and preparation of feedback messages



Network entry

- SS extracts channel parameters from AAS-preamble.
- Selects a random code used to identify the request.
- Prepares a short feedback message and sends during NW entry request.
  - Efficiently encoded to fit into a short NW-request message.
- BS responds by forming the beam using the parameters received.
- Request is identified by the code and transmit opportunity.

Network entry

- Two AAS NW entry regions
  - Non subchannelized AAS SSs
  - Subchannelized AAS SS.

- Non- Subch. AAS network entry is used first.
- Only if SS fails it may use the subchannelized region.
- Subchannelized network entry region is less efficient but is used less often- only for SS at edge of cell.

AAS preamble

- Two identical OFDM symbols
- Each divided into 4 mod 4 groups
- Each group may be transmitted using different beam patterns
- Low PAPR (3dB) for each of the 4 signals.

Proposed Changes: AAS-FBCK-REQ/RSP

- Add unsolicited response capability
  - All request parameters are include in the response
    - Frame number, type, resolution.
  - Request counter set to zero indicates unsolicited response.
- Mandatory for TDD and FDD
- Add CINR and RSSI

New Message: AAS-BEAM-REQ/RSP

- Measure and report the response from each of the beams used to transmit the AAS preamble.
- Report can include only a subset of the beams.
- Can point to past preambles. (Supporting varying beam patterns).
- Can be transmitted in an unsolicited manner.
- Include RSSI and CINR
- Formatted to support future report elements

Network entry messages

- Message in non-subchannelized region
  - 4x64 preamble
  - 2x128 preamble
  - AAS-NW-ENTRY-REQ message
    - Transmitted on the most robust rate.
    - A single OFDM symbol.

AAS NW ENTRY_REQ

- Network entry code: 4bits.
- Pointer to measurement frame: 4 bits.
- Measured Re/Imag value for each beam: 4x2bytes
  - Single value representing the entire BW response.
  - Low degradation relative to optimal feedback
- RSSI 1byte
- HCS 1byte
- 11 bytes

Network entry in subchannelization

- 4x64 preamble
- 2x128 preamble
- SBCH_AAS-NW-ENTRY-REQ message
  - Transmitted on the most robust rate.
  - On a single subchannel or more subchannels.
  - Up to 5 symbols for the case of a single subchannel.

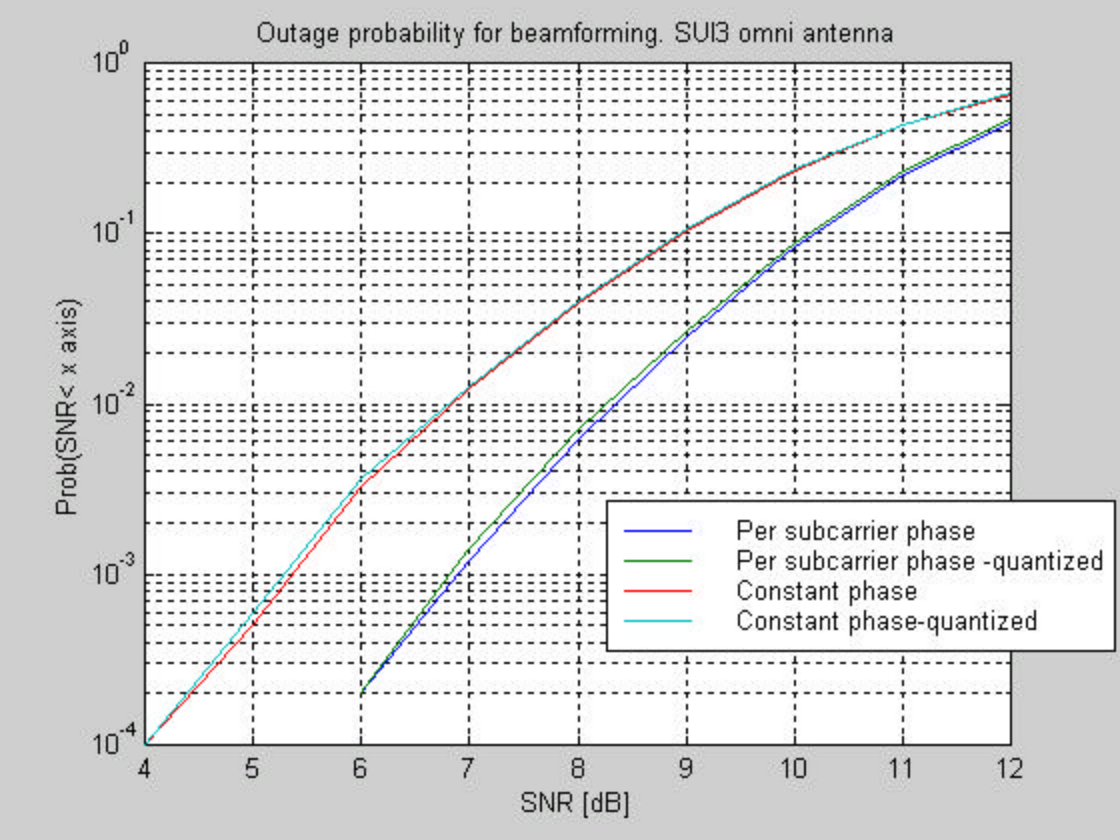
SBCH_AAS NW ENTRY_REQ

- Network entry code: 4bits.
- Phase information from each beam relative to first beam. 3x4bits.
  - Low degradation relative to optimal feedback
- RSSI 5 bits
- Pointer to measure frame 1bits

- Total 22 bits

Simulation results
Short feedback report elements

- SUI3, independent antennas
- Optimal per frequency beam forming and constant (over BW) beamforming.
- 1.5dB difference.



Thank you