Transmitter diversity in CDMA systems

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Presentation outline

1. Background and principles

2. System model and implementation

3. Simulations and results

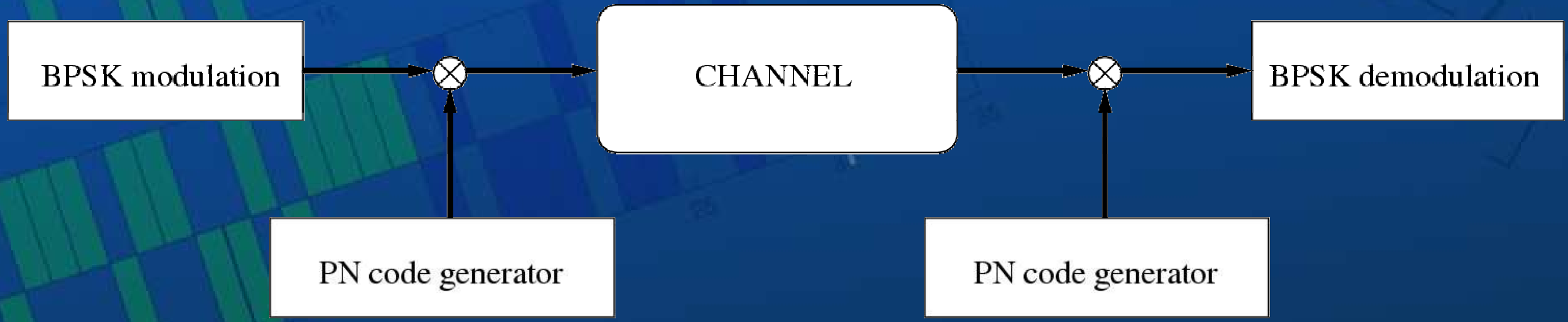
4. Conclusions and further work

1. Background and principles

Framework

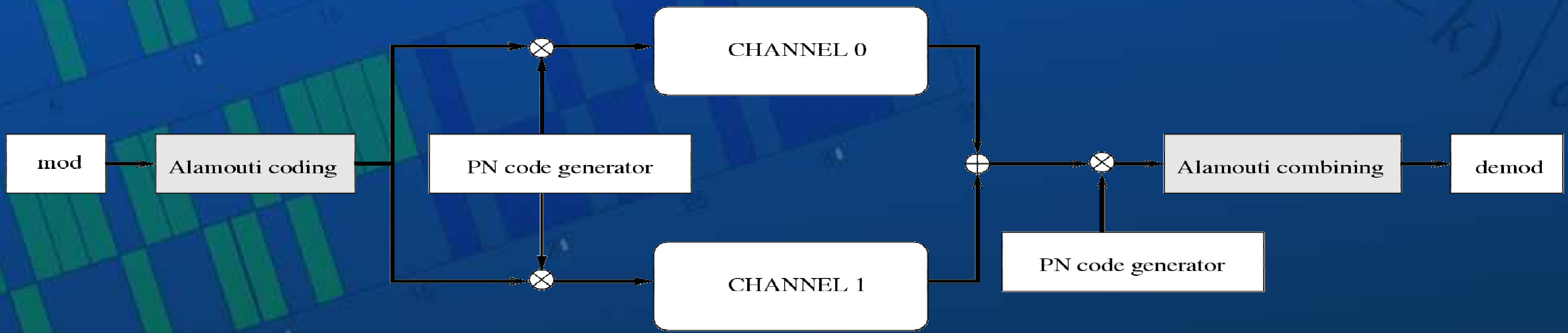
- Cellular DS-CDMA system
- Alamouti code (transmitter diversity)
- Capacity (interference) of
  - Single antenna system (SAS)
  - Simple transmitter diversity (STD)

SAS DS-CDMA link



STD DS-CDMA link

Two transmit antennas



Alamouti's diversity technique

- Transmission

	Antenna 1	Antenna 2
t	S_1	S_2
$t + T_b$	$-S_2^*$	S_1^*

- Reception
  - Combination of signal over 2 symbols
  - Requires channel estimation

2. System model and implementation

System model

- Static users in hexagonal cell(s) - uplink
- Constant Received Power (CRP)
- Slow and fast (Rayleigh) fading
- Interference $\rightarrow$ determines capacity

Implementation

- MATLAB simulation
- Link level (deals with the signals)
  - BPSK, orthogonal codes
  - Transmit/receive all the users' data
- Variable number of cells and users

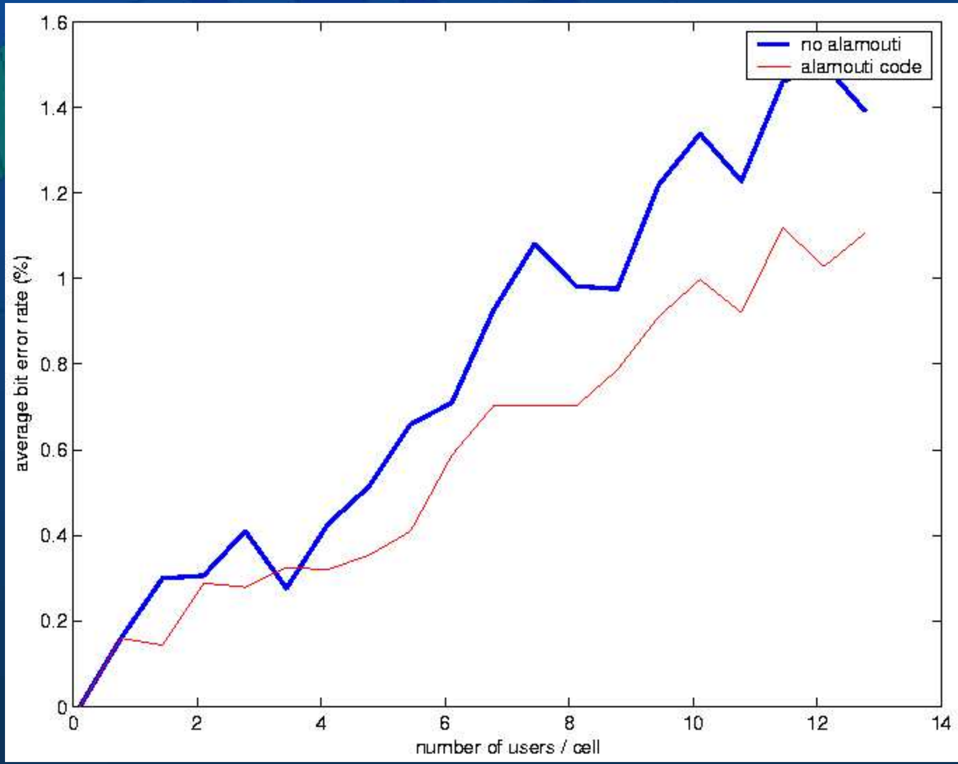
3. Simulations and results

Simulation conditions

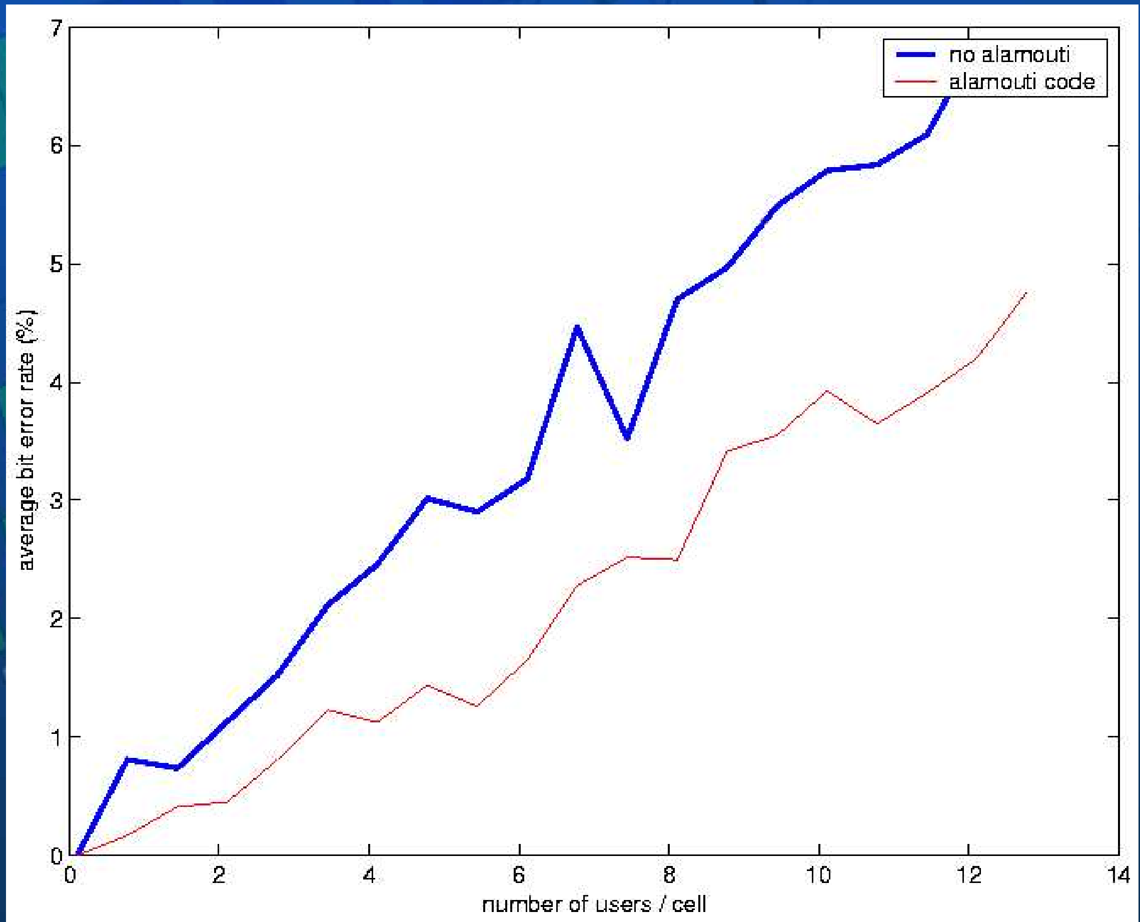
- Measurement : BER (average and CDF)
- Network with 1, 7 or 9 cells
- 1-120 active mobile users
- Synch'd / unsynch'd signals at BS

Synchronous case

- Validate our simulator : 1cell, 64 users
- Average BER for 9 cells

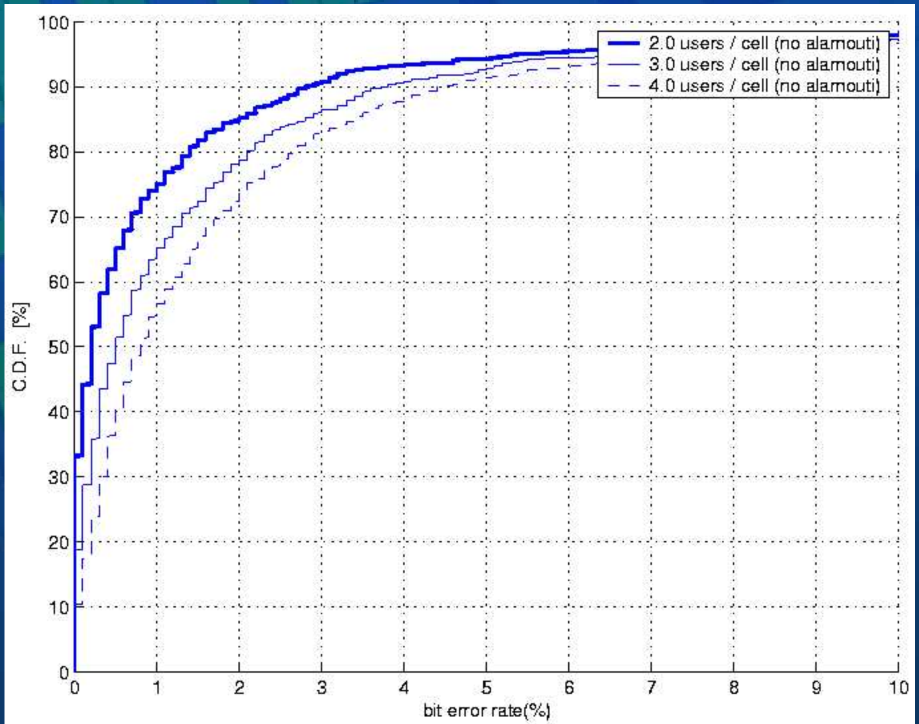


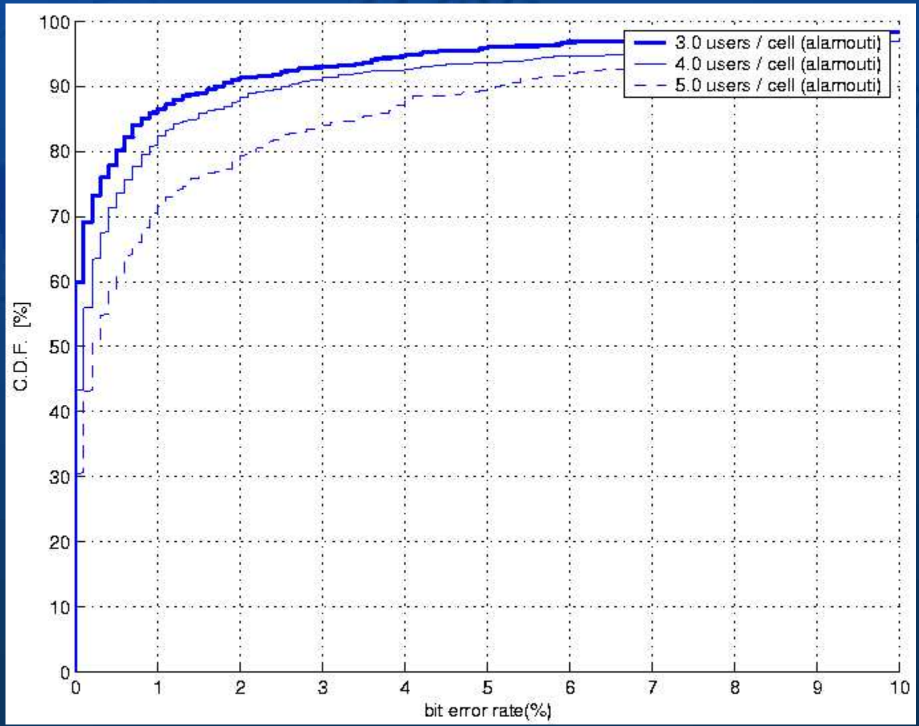
No sync : average BER (9 cells)



Number of users/cell @ 2% BER : SAS 4, STD 6

Outage and capacity (9 cells)





Capacity for 2% BER and 85% availability : SAS 2, STD 4.5

Capacity for 85% availability

- 7 and 9 cells give same results

	1 cell	9 cells
STD	10	4.5
SAS	4	2

4. Conclusions and further work

Conclusions

- Two sources of interference
  - no synch. $\rightarrow$ intra-cell interference
  - multiple cells $\rightarrow$ inter-cell interference
- For both types of interference, STD performs twice better than SAS, both in terms of average BER and capacity

Further work

- Scrambling (long) codes
- Better power control (e.g. DCPC)
- Influence of background noise
- Non-ideal channel estimation would cause additional errors

On the web

A PDF version of the report and the simulator source code are available at:

http://dev.jerryweb.org/projects/cdma-std/