A Smart Switched Sector Array for Wideband Interference Mitigation in an OFDM-based WLAN

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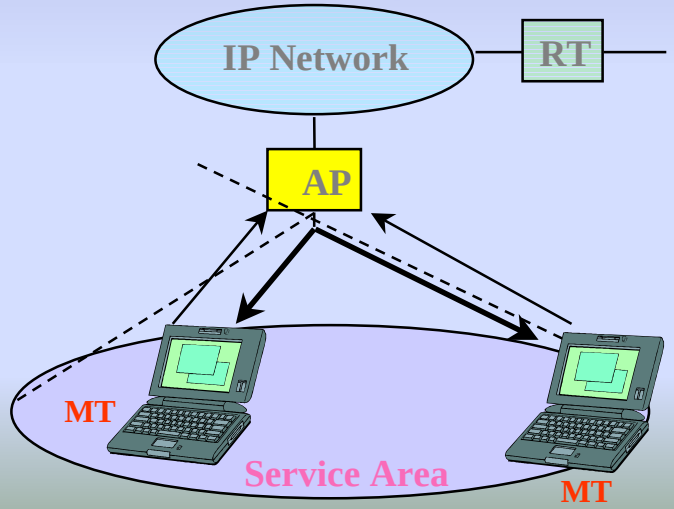
Outline

- Introduction
- Simulation environment
- BER performance with or without interference
- Switching success probability
- Capacity improvement
- Conclusions

Introduction

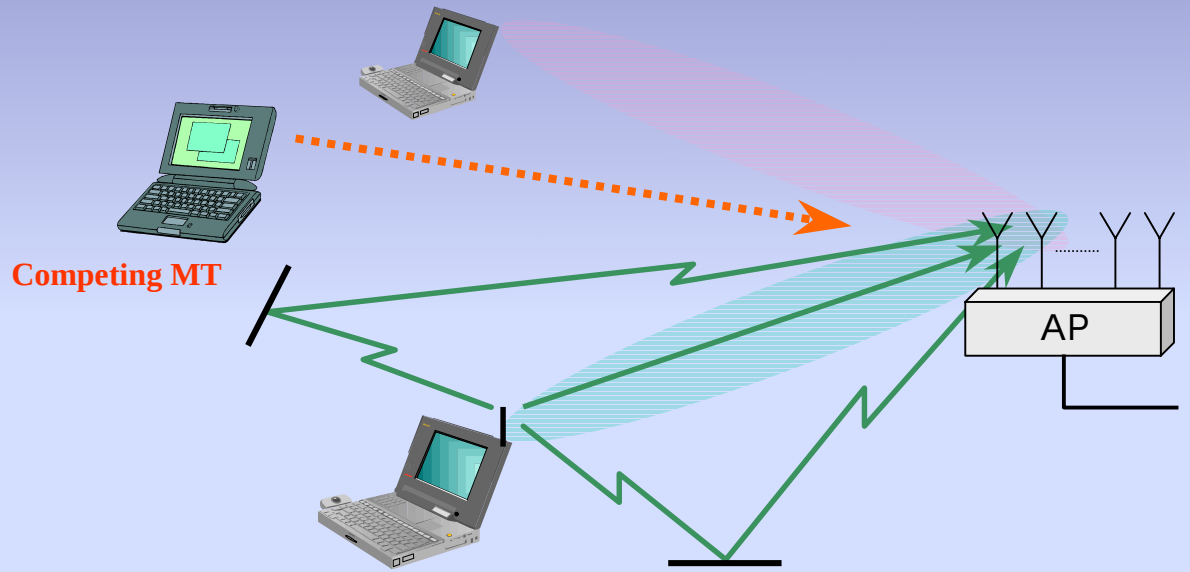
- 2.4GHz and 5GHz WLAN system will provide high-rate data services
- WLAN service area can cover office, home, conference hall, station, airport, etc.
- OFDM-based wireless LAN provides robustness to multipath



Future problem and solution

In the Near Future

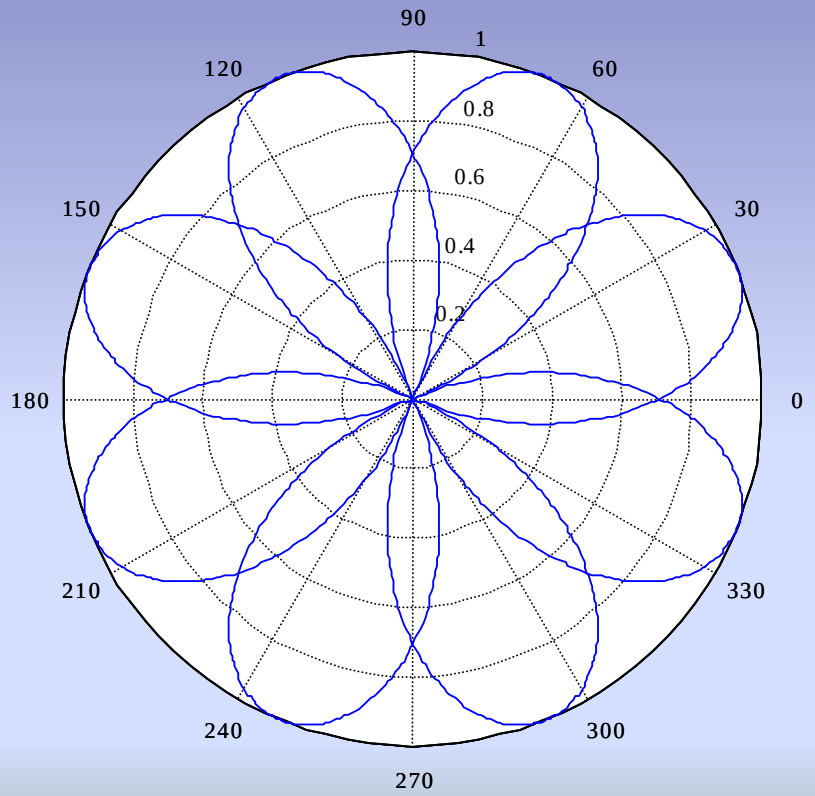
- Due to the limited spectrum allocation and predicted uptake of WLANs, co-channel interference will become an issue

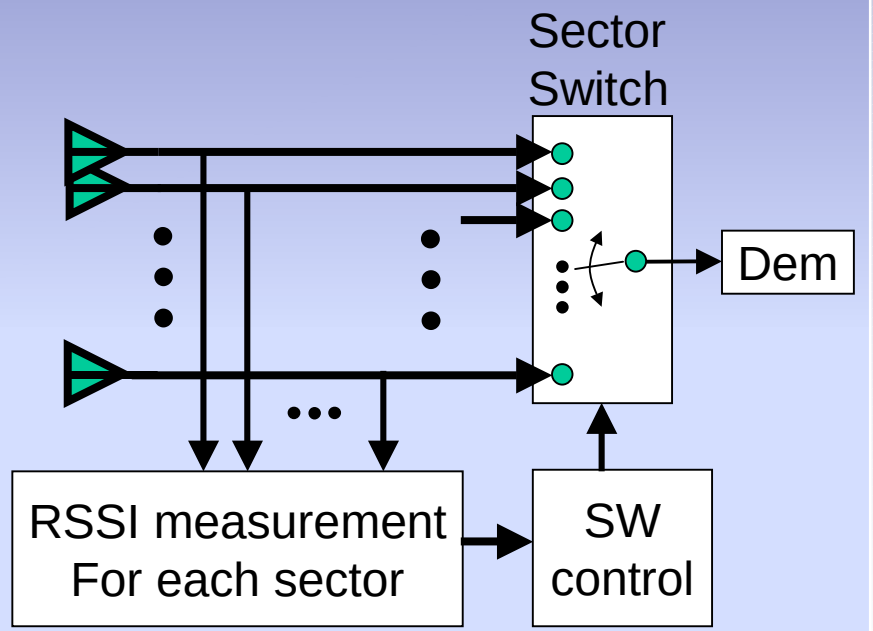


Solution

- Antenna technology for interference reduction
  - Switched sector array (simple structure solution)
  - Beam- and null-forming (good performance)

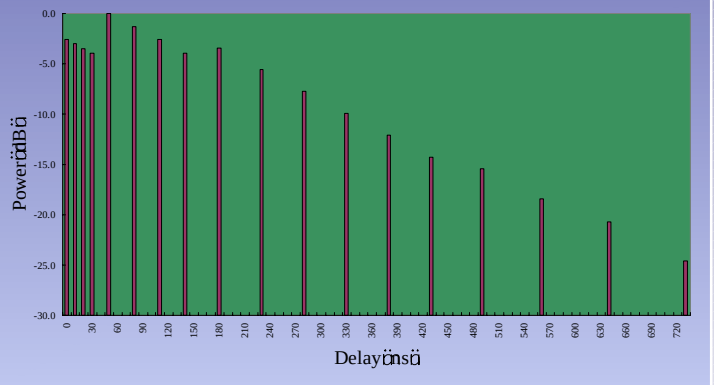
Antenna pattern and Rx structure





Spatial channel model

18 paths are spatially distributed
at random over time (frame by frame)



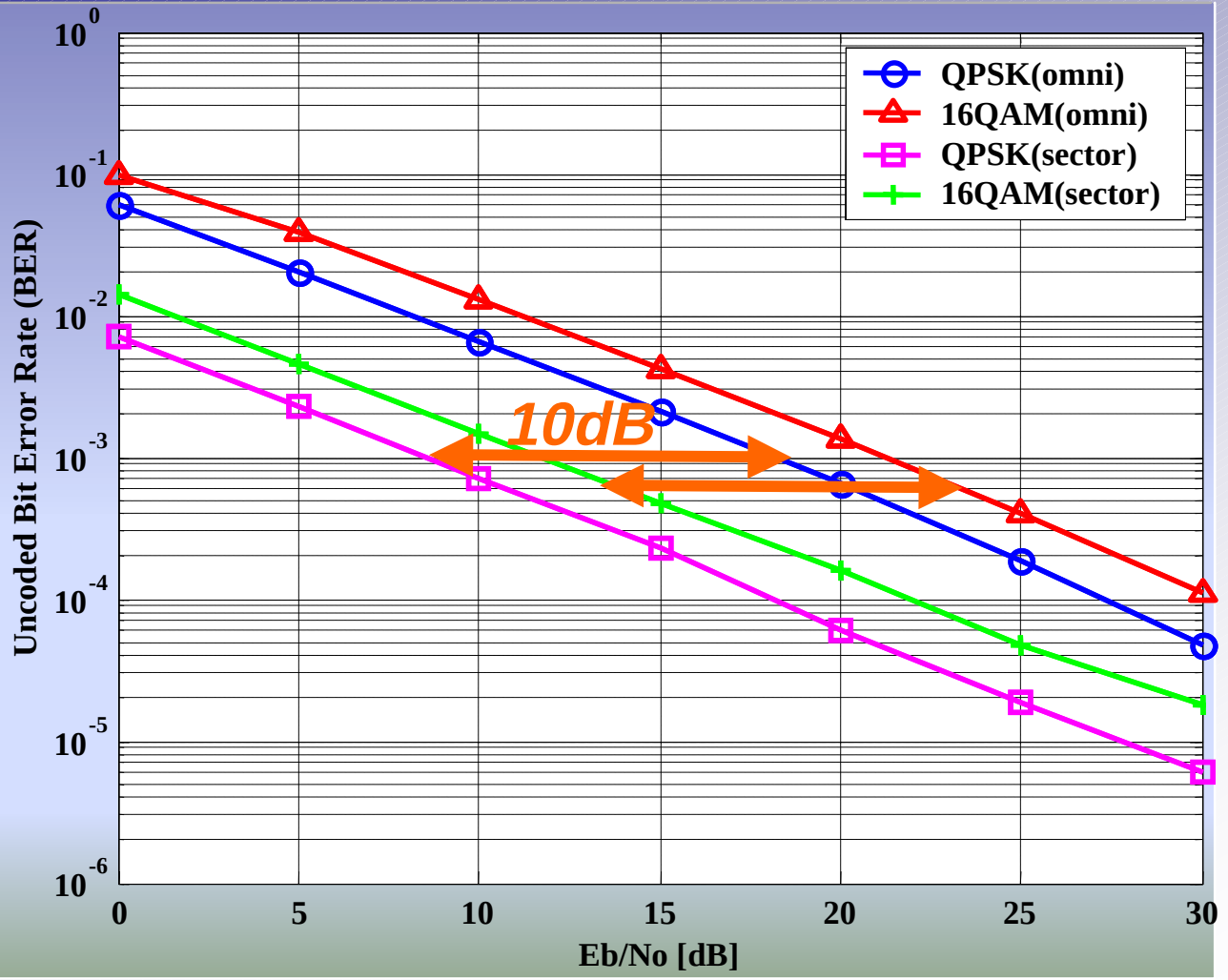
ETSI-B channel model (each path varies based on Rayleigh fading)

Simulation Parameters

Parameters	Value
Modulation scheme	OFDM (Uncoded QPSK and 16QAM for each subcarrier)
Number of subcarrier	52 … 48 (data subcarriers) [No DC component] … 4 (pilot at positions 7, -7, 21, -21)
Symbol interval	4usec (0.8usec cyclic prefix)
Frame structure	Preamble(4symbols) + payload(180symbols)
Subcarrier spacing	312.5kHz
Channel model	ETSI-B (Excess Delay: 720nsec, Delay Spread: 100nsec)
Spatial signal distribution	At random on a frame by frame basis
Antenna array	8 element circular sector array (90^{o} cosine beam)
Sector switching method	Largest measured RSSI selection
Interference	The same channel property as required signals

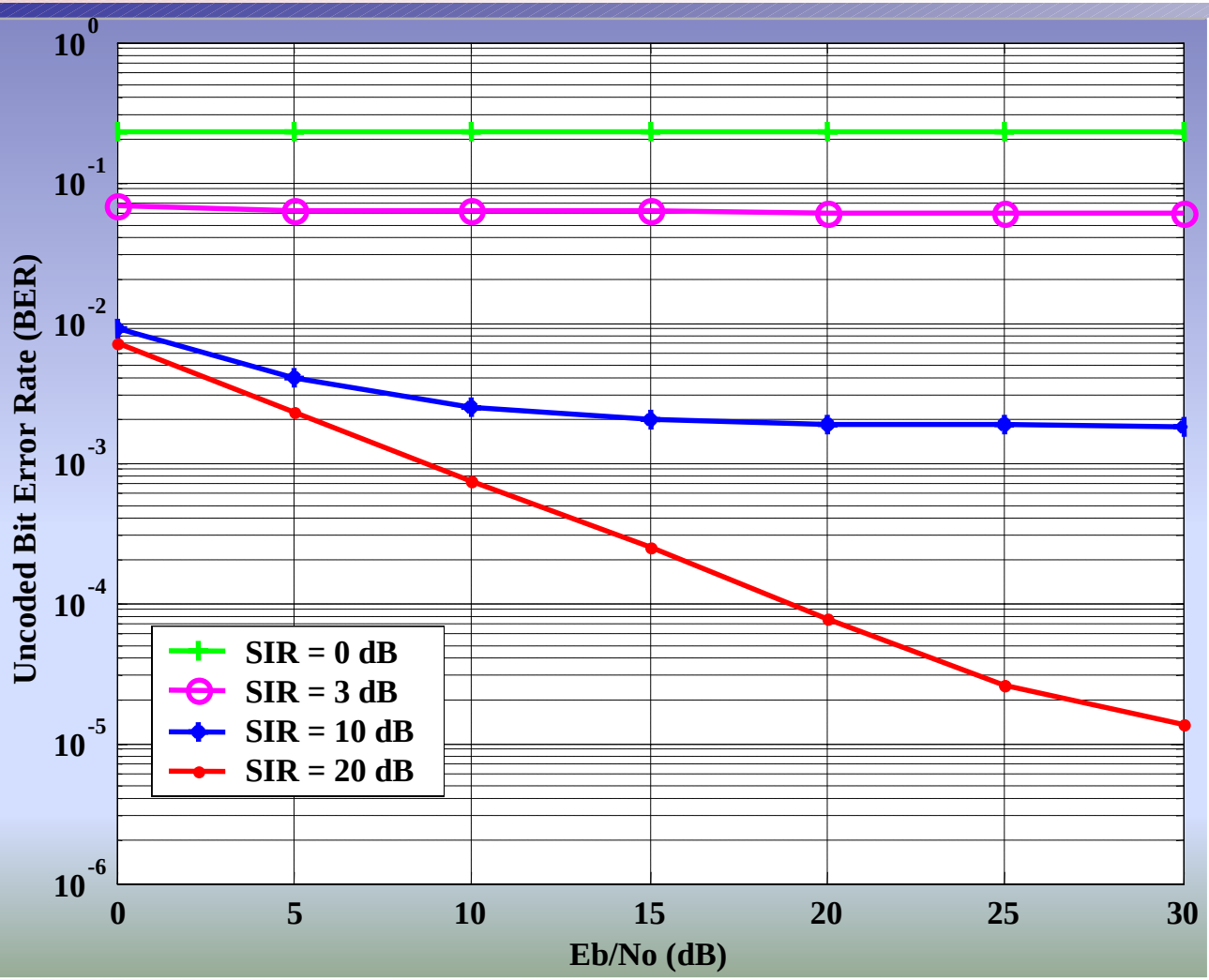
BER performance (ETSI-B channel)

10dB SNR improvement compared to single omni-directional system



BER performance with multipath interference (ETSI-B channel)

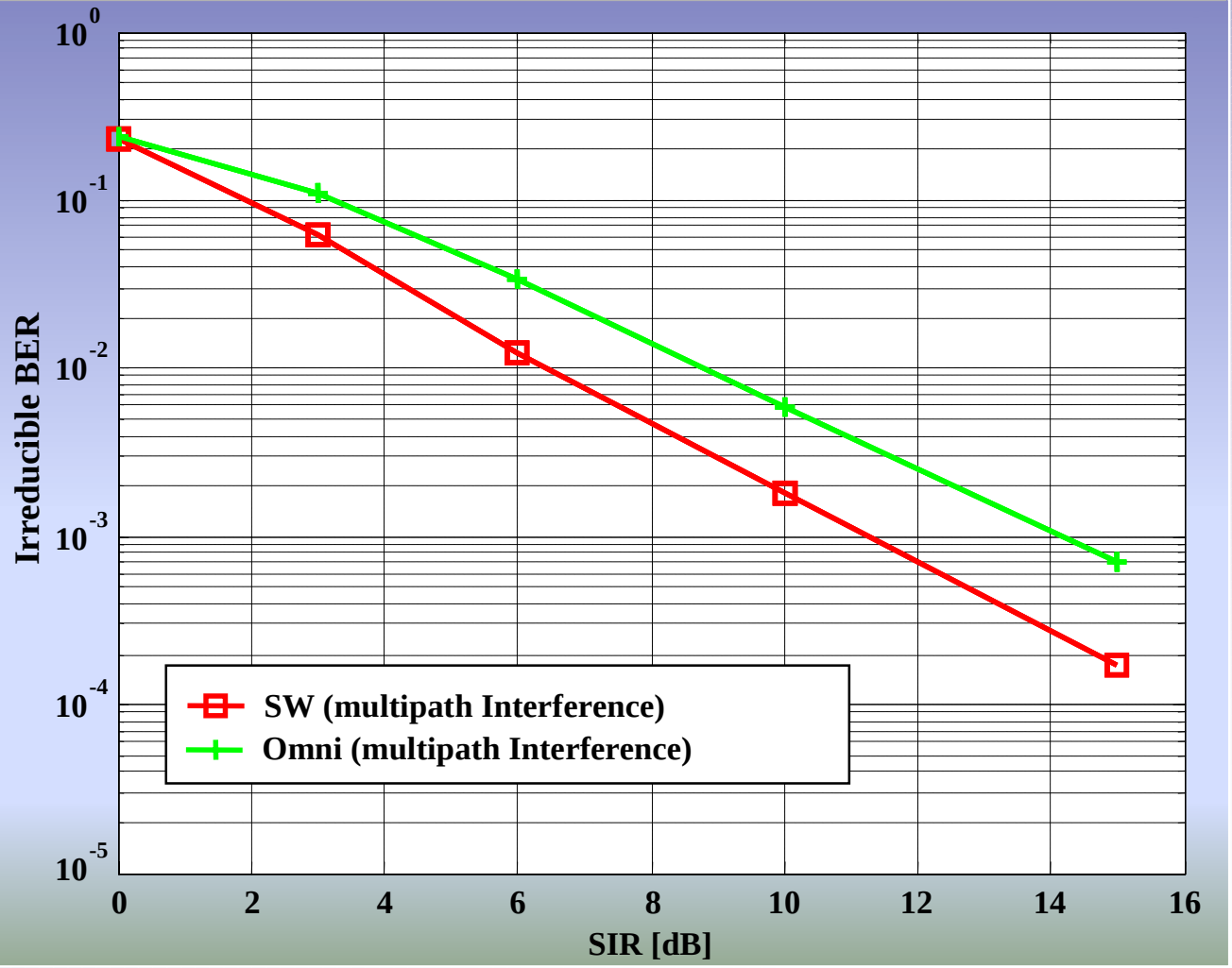
Interference will deteriorate the BER performance even using switched sector array



SIR robustness over omni-directional system

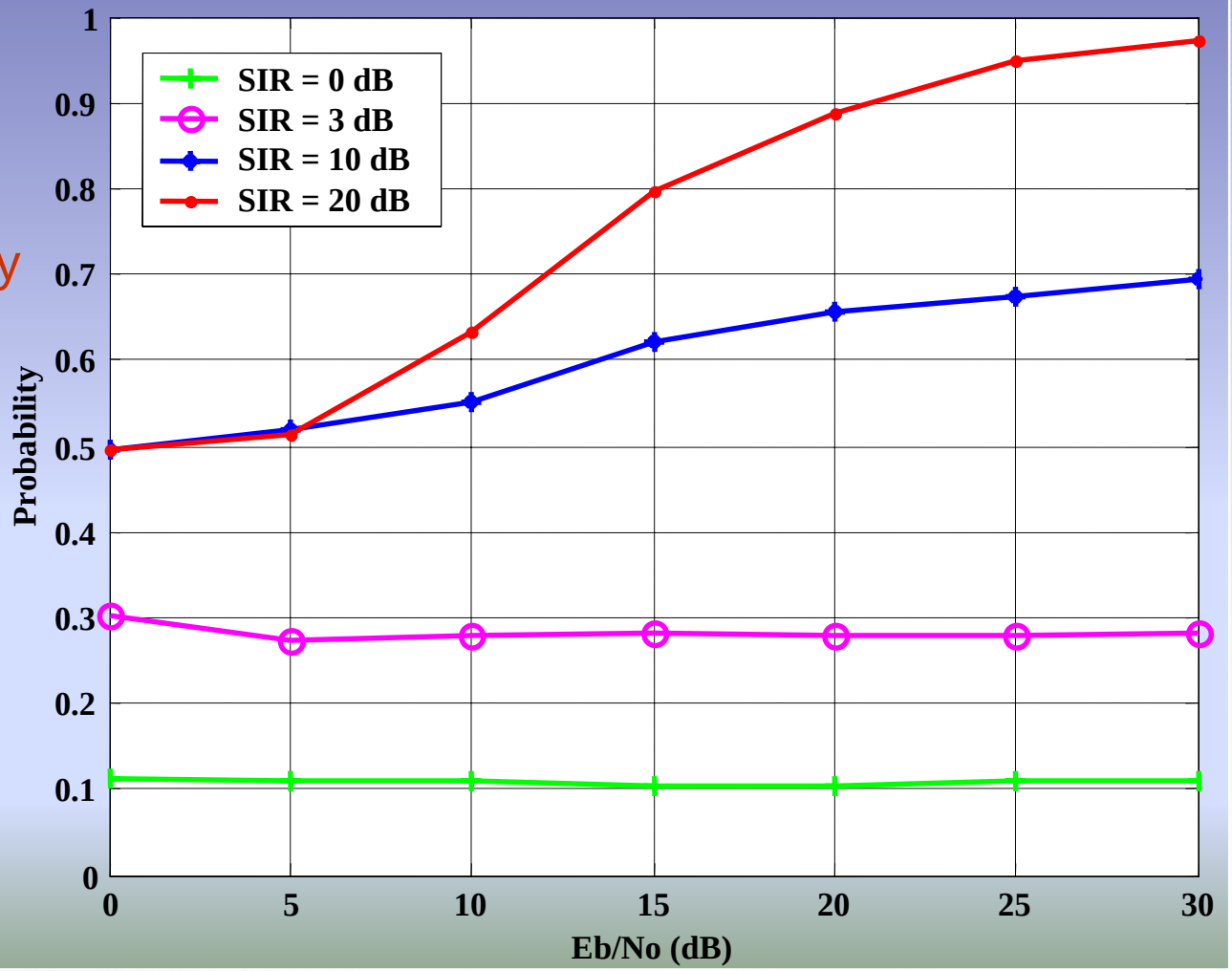
Switched sector array based on RSSI (SW) can improve SIR robustness by 2-3dB compared to single omni-directional system

Irreducible BER:
is the value of BER floor at Eb/No = ∞



Switching success probability in ETSI-B channel with interference

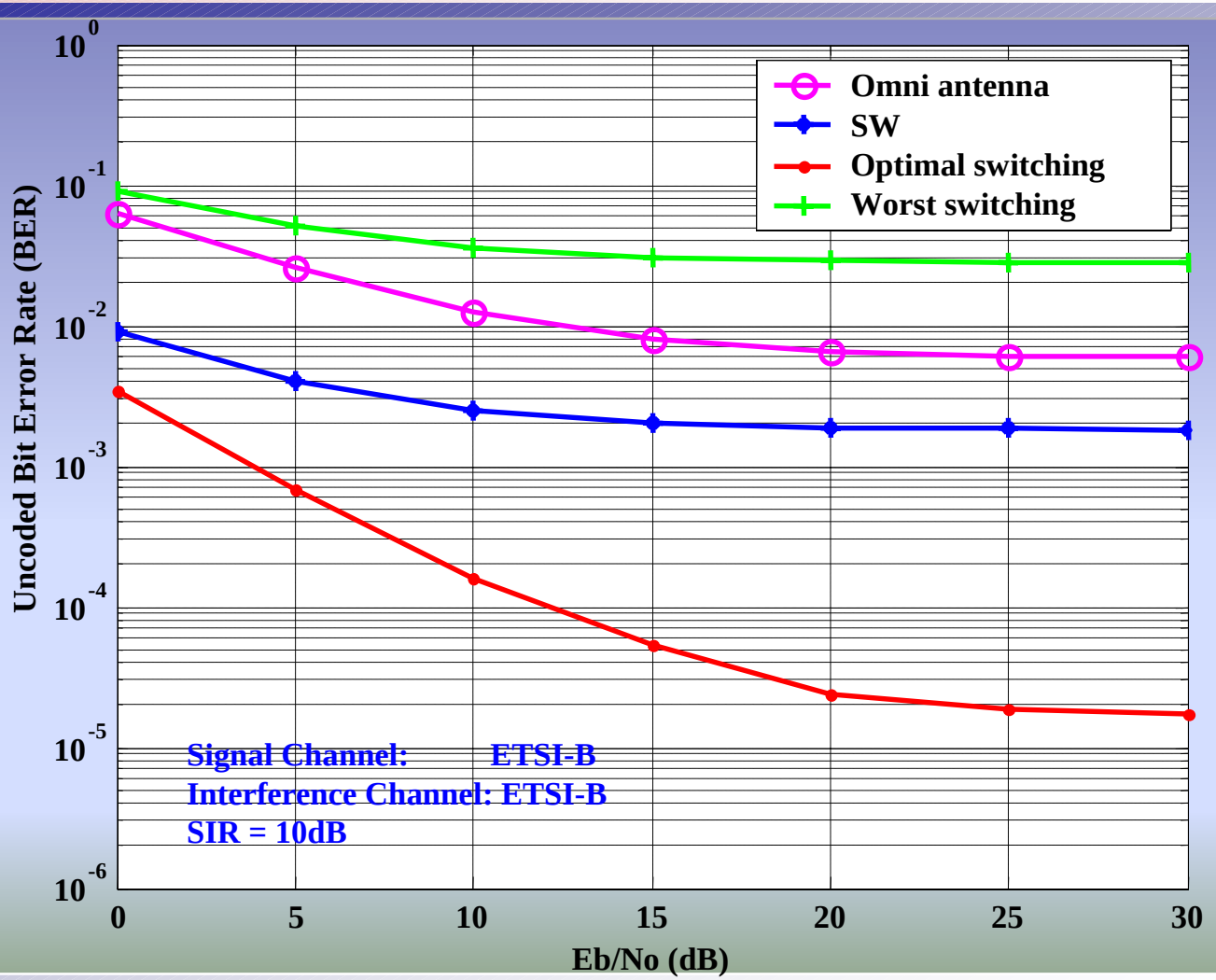
Successful switching probability depends on SIR and SNR



Switching method comparison

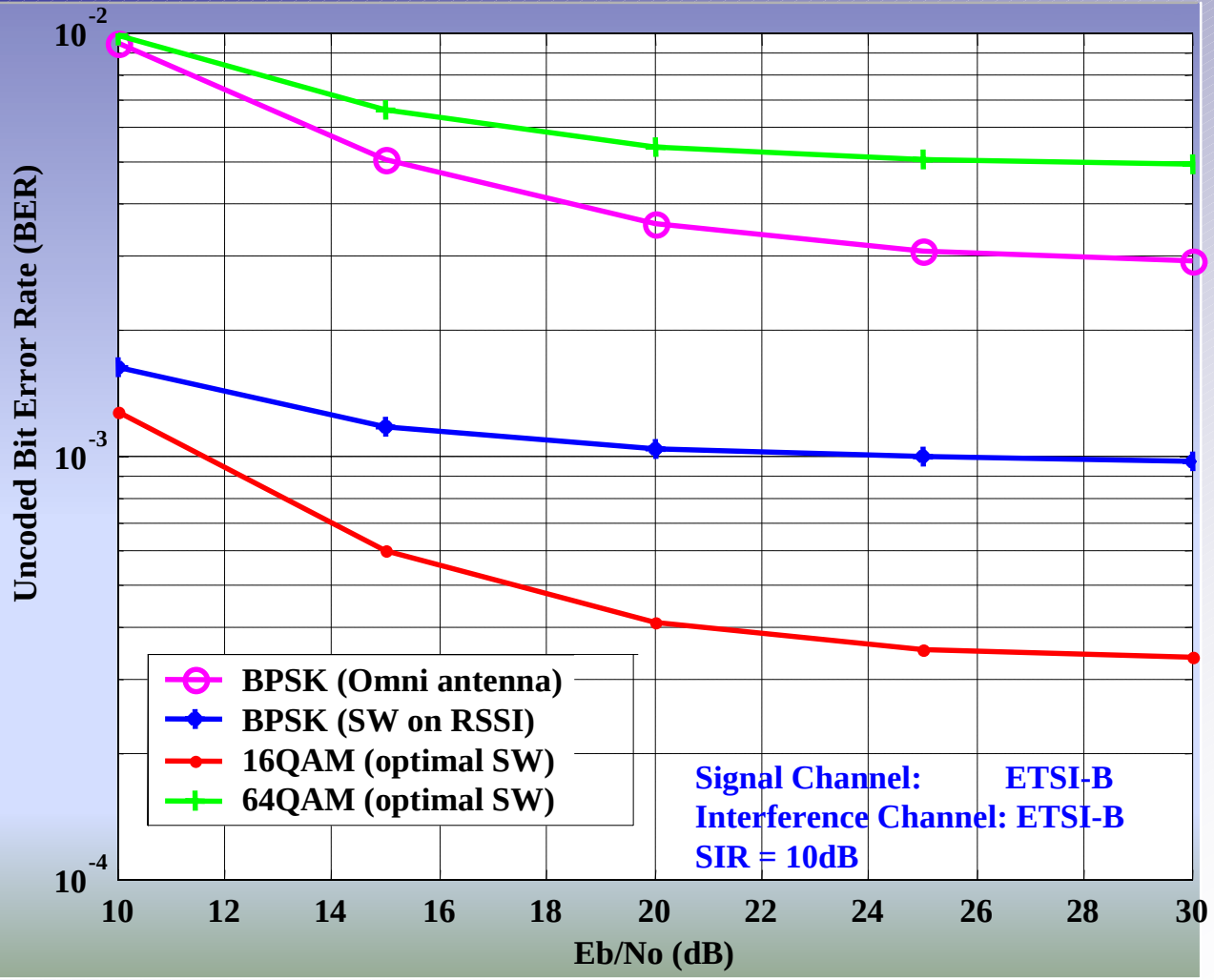
Optimal Switching:
selects the sector that provides the best BER

Worst Switching:
selects the sector that provides the worst BER



Capacity improvement

Approximately five-fold data rate improvement can be expected using optimum switching Compared to single omni-directional system



Approach to optimum switching

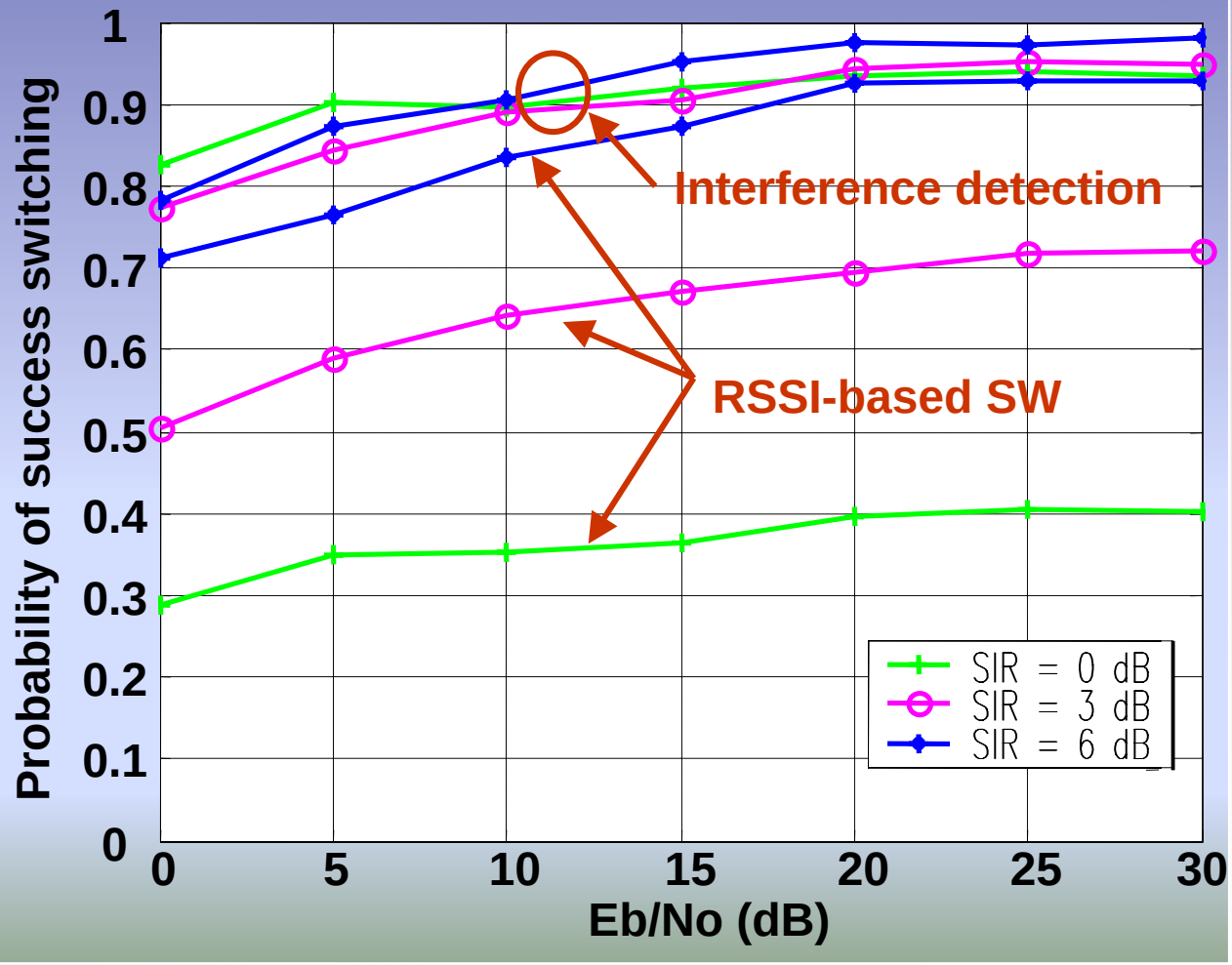
- Successful switching probability based on RSSI measurement is strongly dependent on SIR rather than SNR

- Interference detection is useful for switching criteria in the presence of strong interference

Switching success probability using interference detection-based switching

S: 2path channel
I: 2path channel

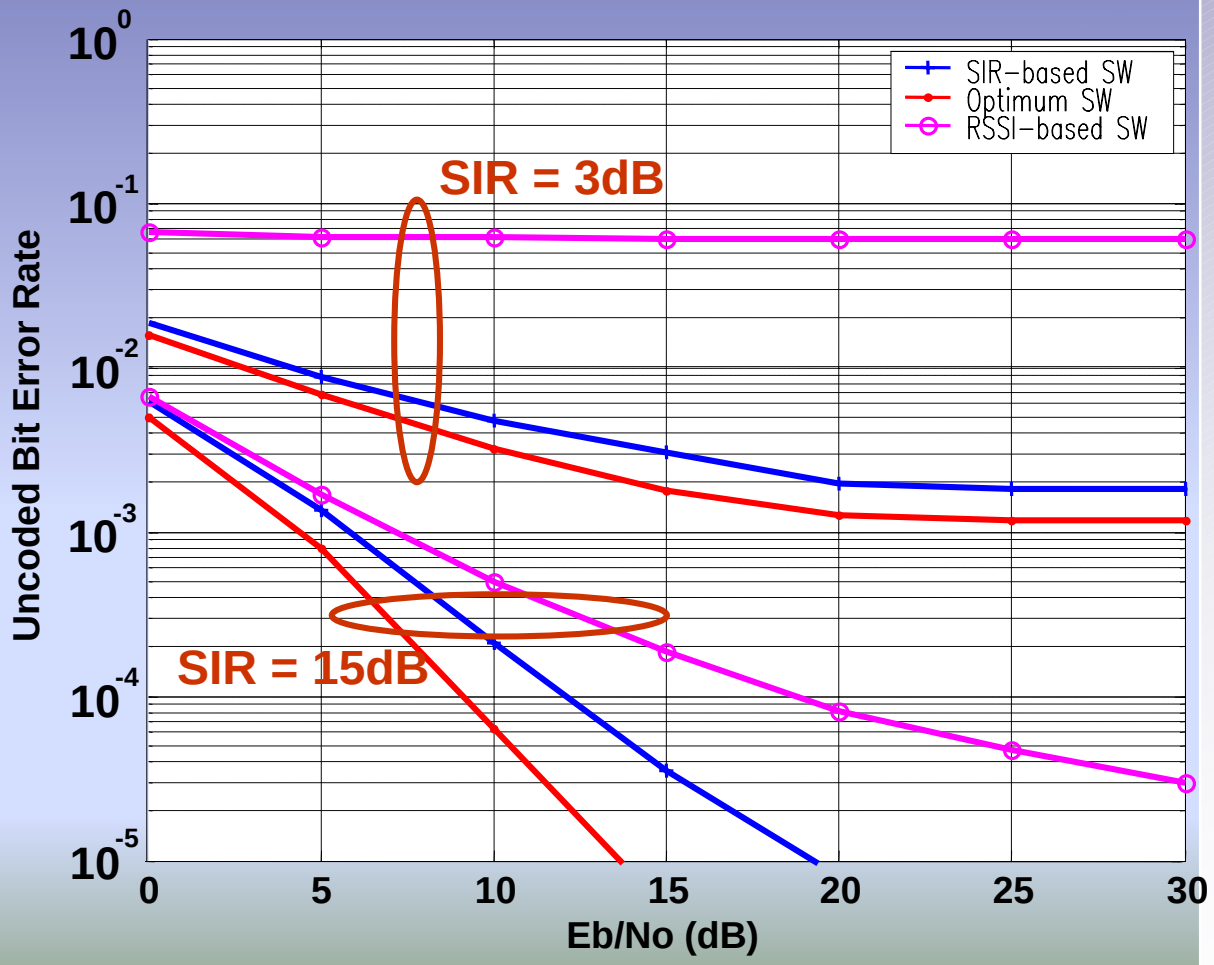
Successful switching probability is improved at low SIR



BER performance comparison

S: 2path channel
I: 2path channel

Switching method based on interference detection can approach the optimum sector switching

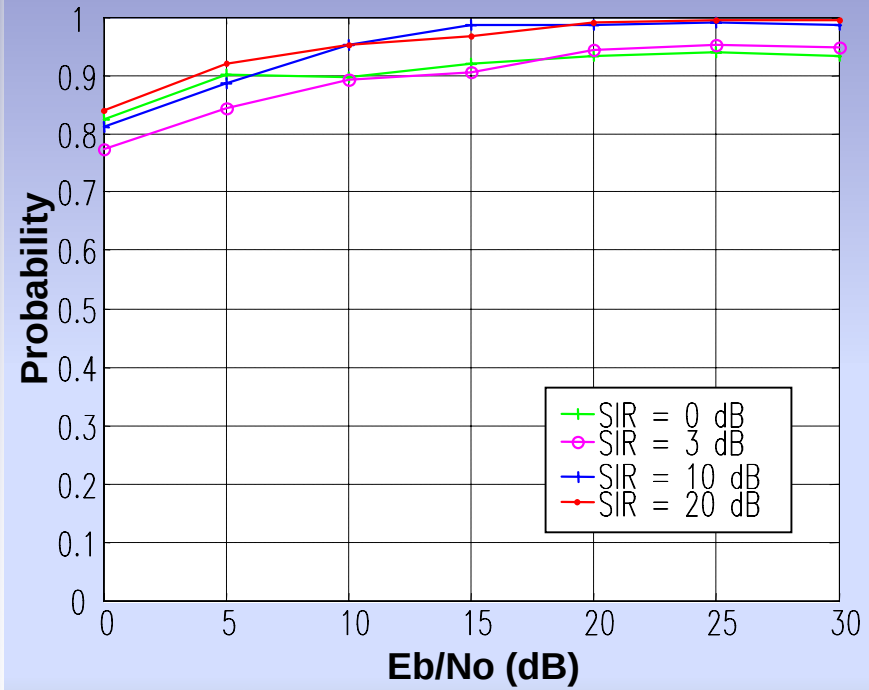


Conclusions

- Performance of switched sector array for OFDM system in the environment with multipath interference was shown:
  - 10dB SNR improvement over an omni-directional system
  - Two-fold SIR improvement over an omni-directional system
  - Successful RSSI-based switching depends on the prevailing SIR.
  - Five-fold increase in data rate using the optimum sector selection
  - Switching method based on interference detection can approach the optimum sector switching at low SIR conditions

Switching success probability using interference detection-based switching

- Successful switching probability is improved at low SINR
- Correct switching depends on multipath



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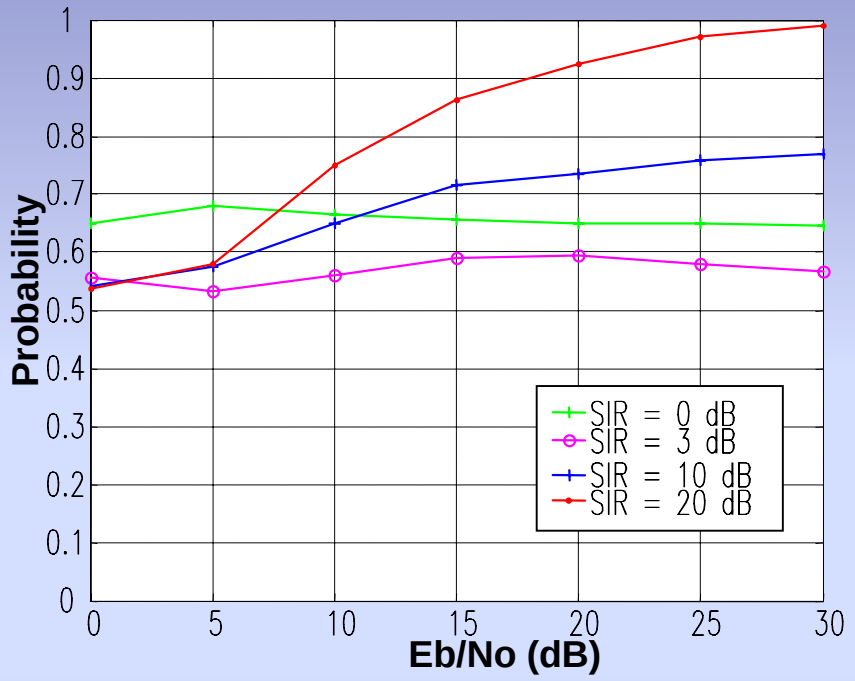

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