Interference Cancellation Receiver

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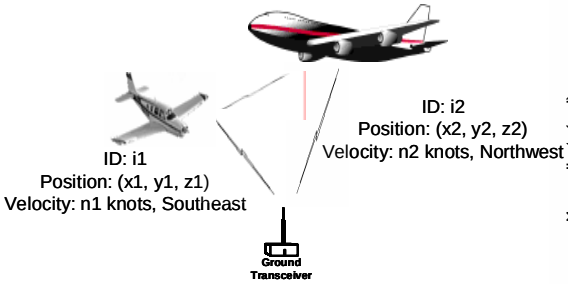
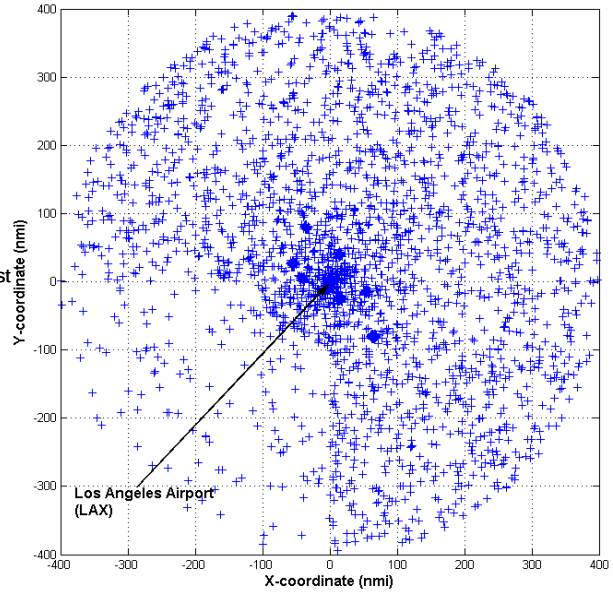
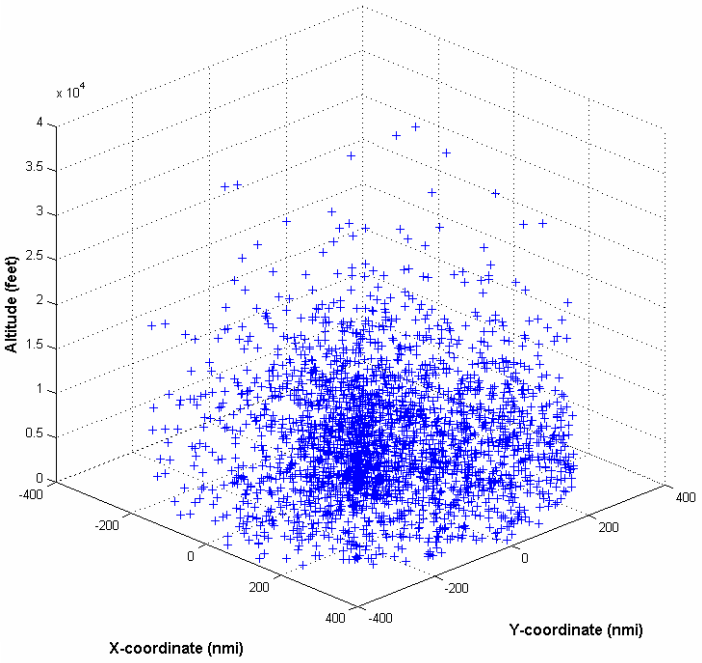
Background

- **Co-channel interference is caused by complex interactions of thousands of RF signals in a high-density traffic aeronautical mobile environment**







Heavy Traffic Environment
(Approx. 3,000 Aircraft)

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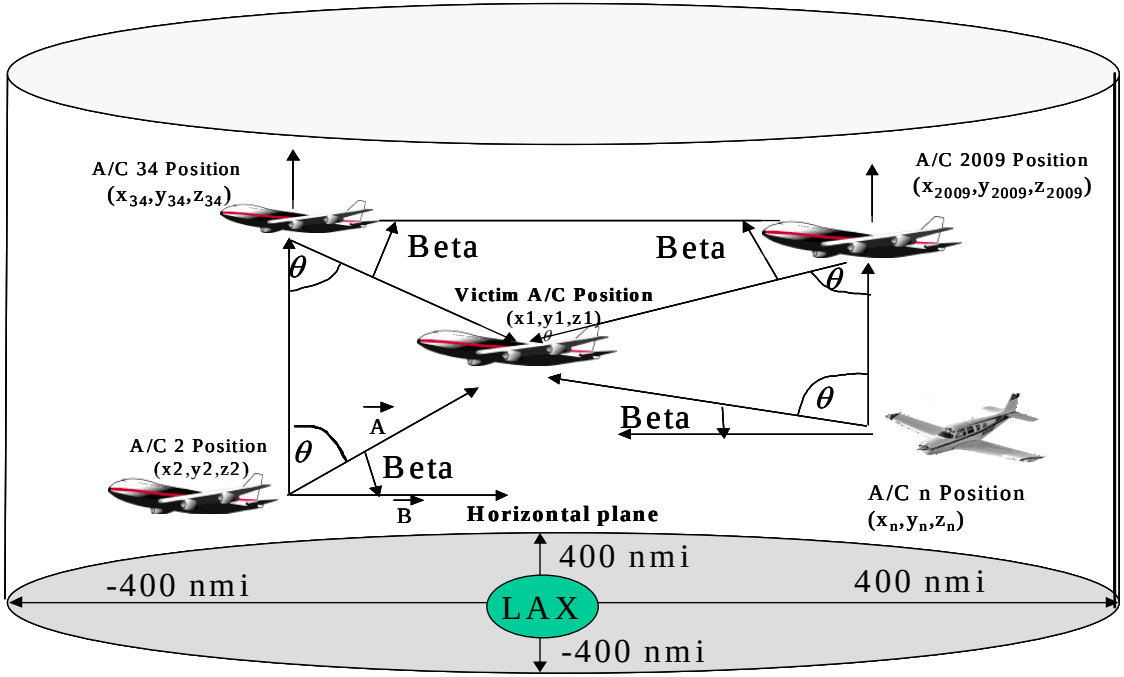
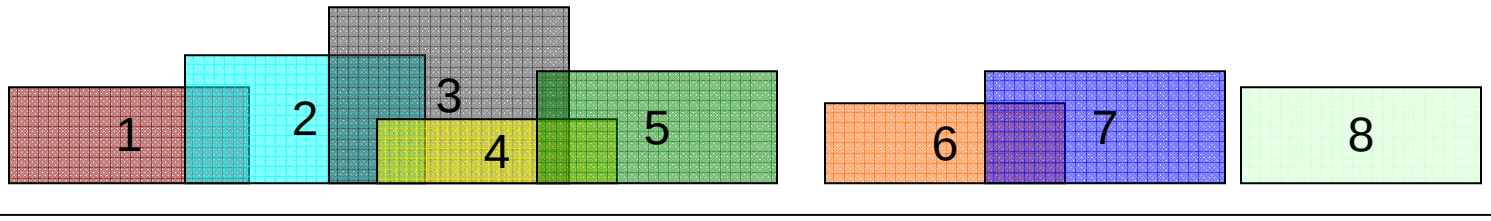
Co-Channel Interference Problem



Victim Aircraft Subject to
Co-Channel Interference



Overlapping co-channel signals arriving at victim receiver

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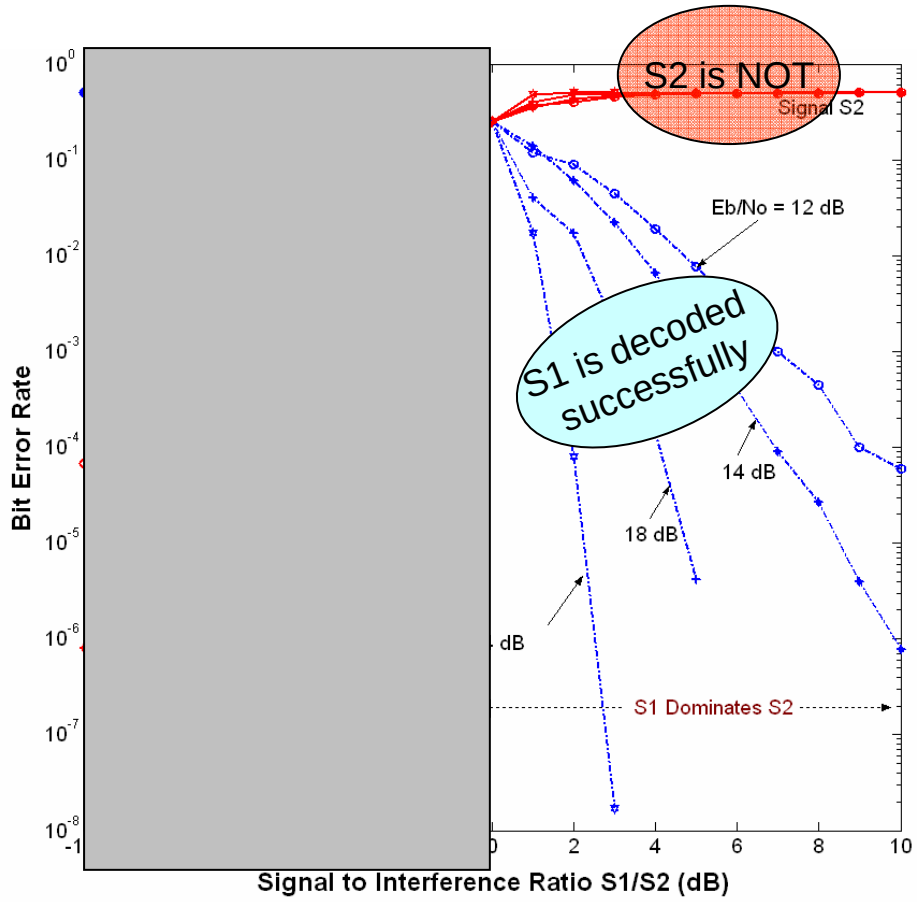
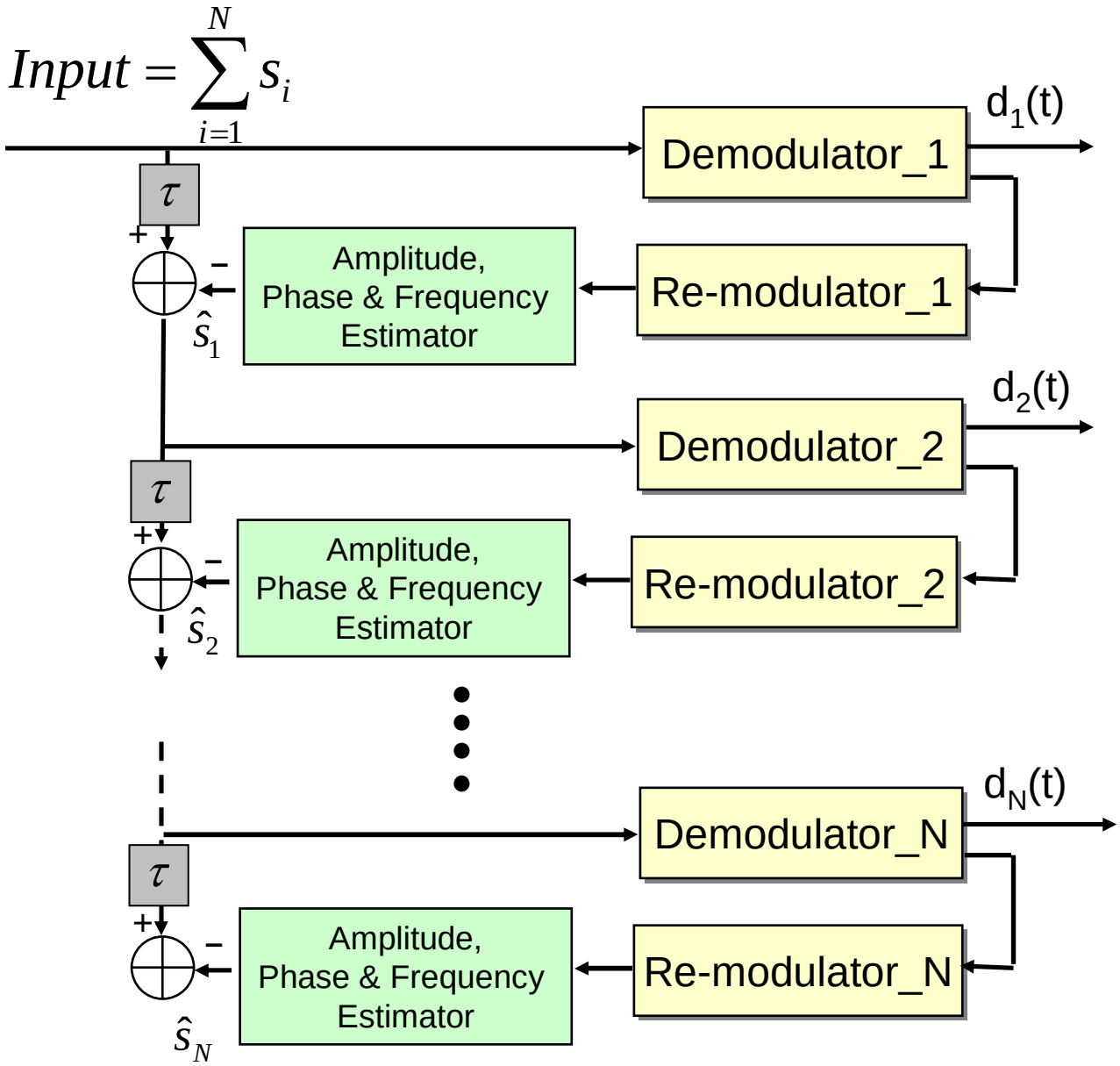
Co-Channel Interference Effects

- Co-channel interference limits system capacity, throughput and reduces the effective use of the scarce spectrum resources.

- Conventional receiver can successfully decode only one co-channel signal at a time on a single channel



An Approach to Solving the Co-Channel Interference Problem: Interference Cancellation Receiver



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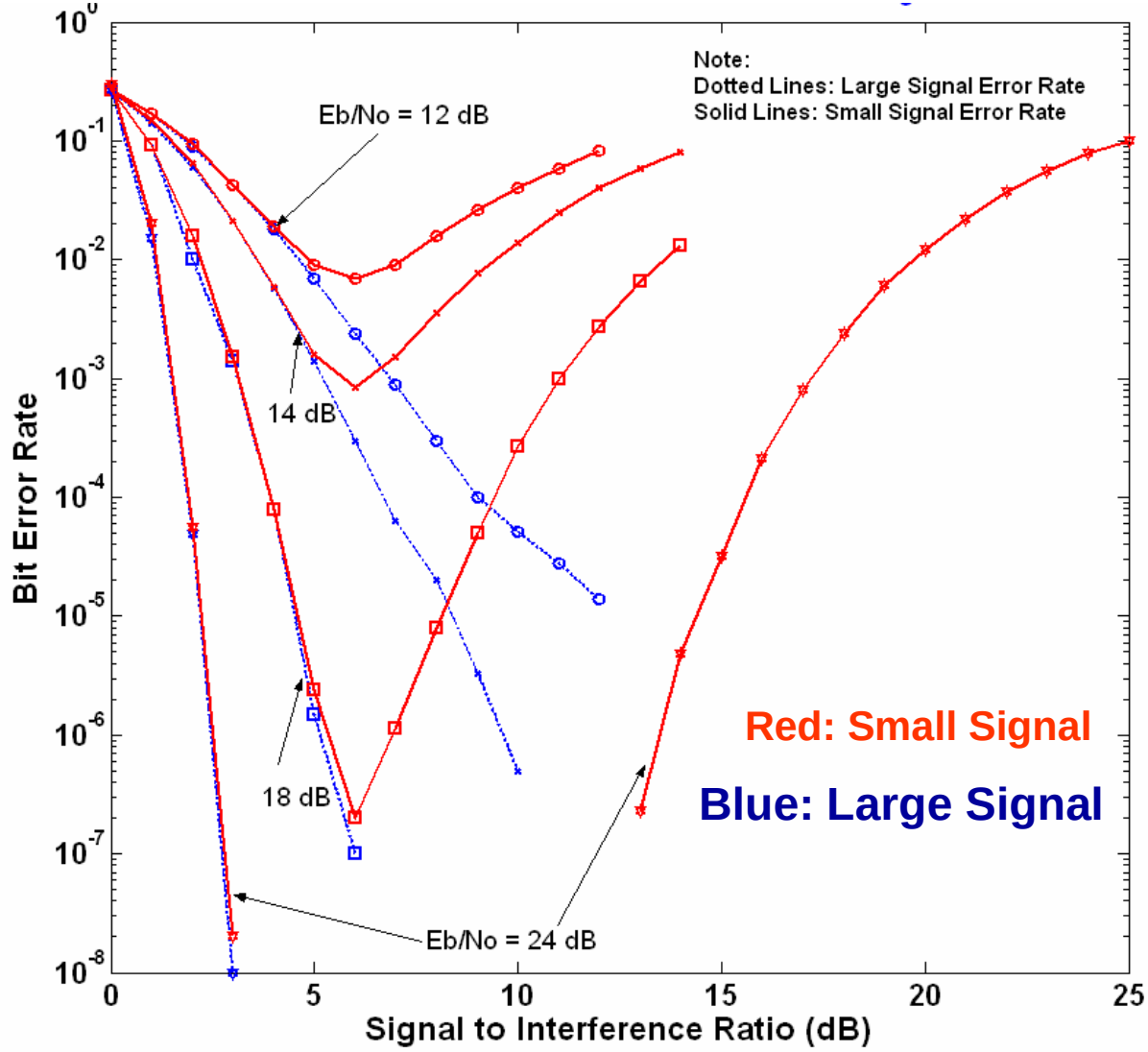
Performance Results

Case 1. Interference Cancellation Receiver Capable of Decoding Two Overlapping Co-Channel Signals



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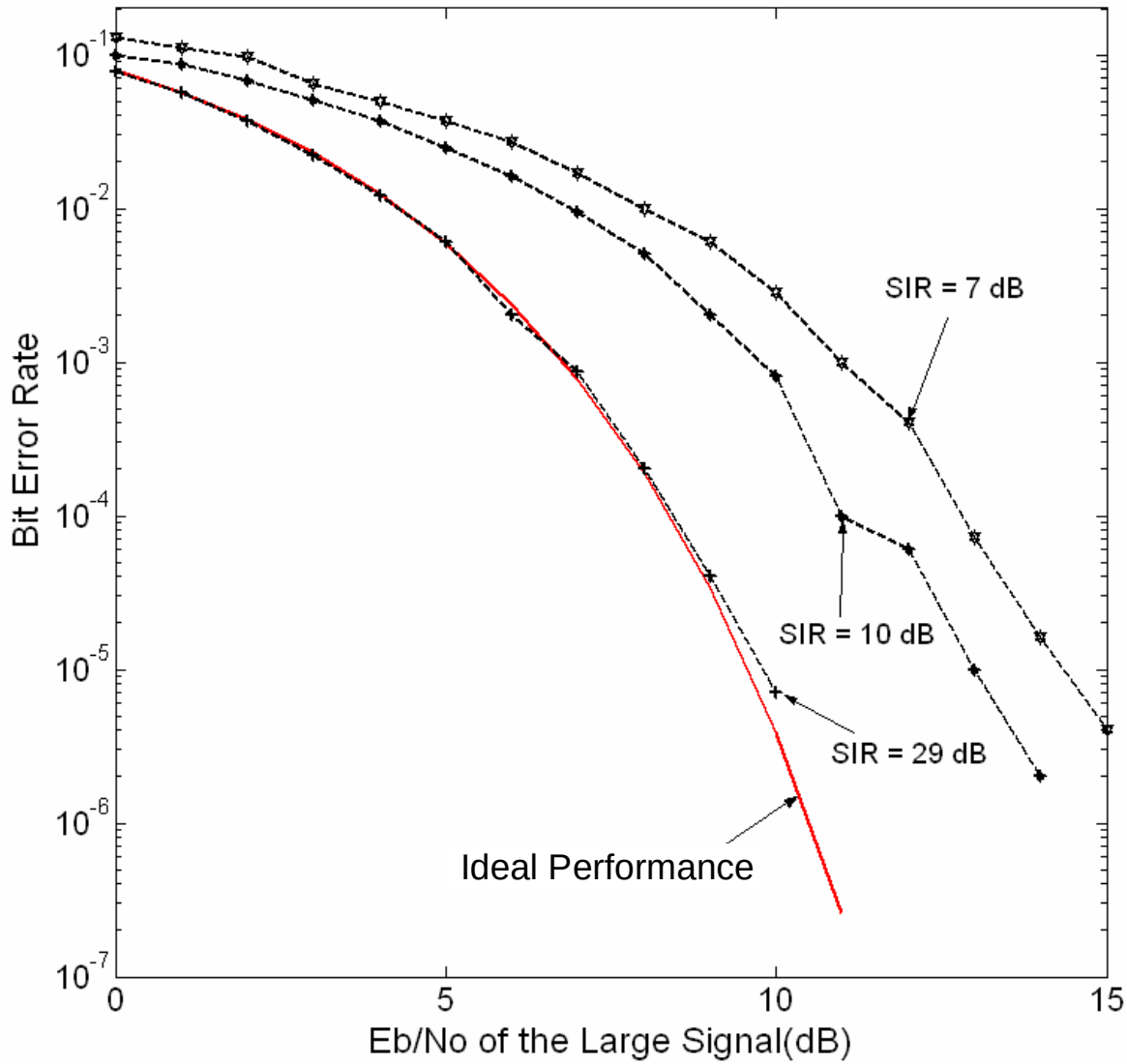
Performance Results (Case 1): Performance of the Large Signal



Observation: An SIR about **29 dB** is needed to achieve ideal performance for the large signal. The large signal requires a significant amount of SIR because the interference from the Small Signal is always present.

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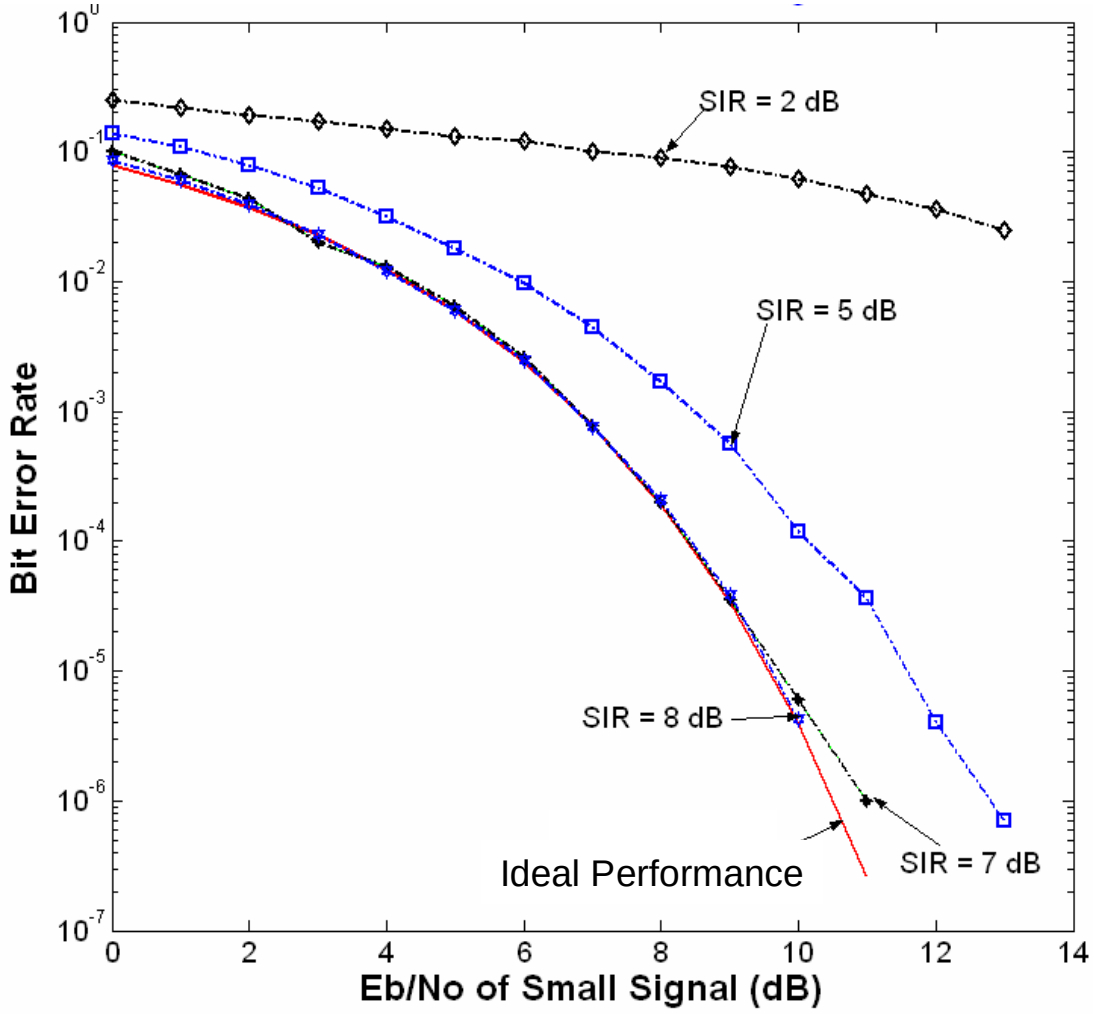
Performance Results (Case 1): Performance of the Small Signal



Observation: only about **7 dB** of SIR is needed to achieve ideal performance for the Small Signal. This is because the interference from the Large Signal is already removed.

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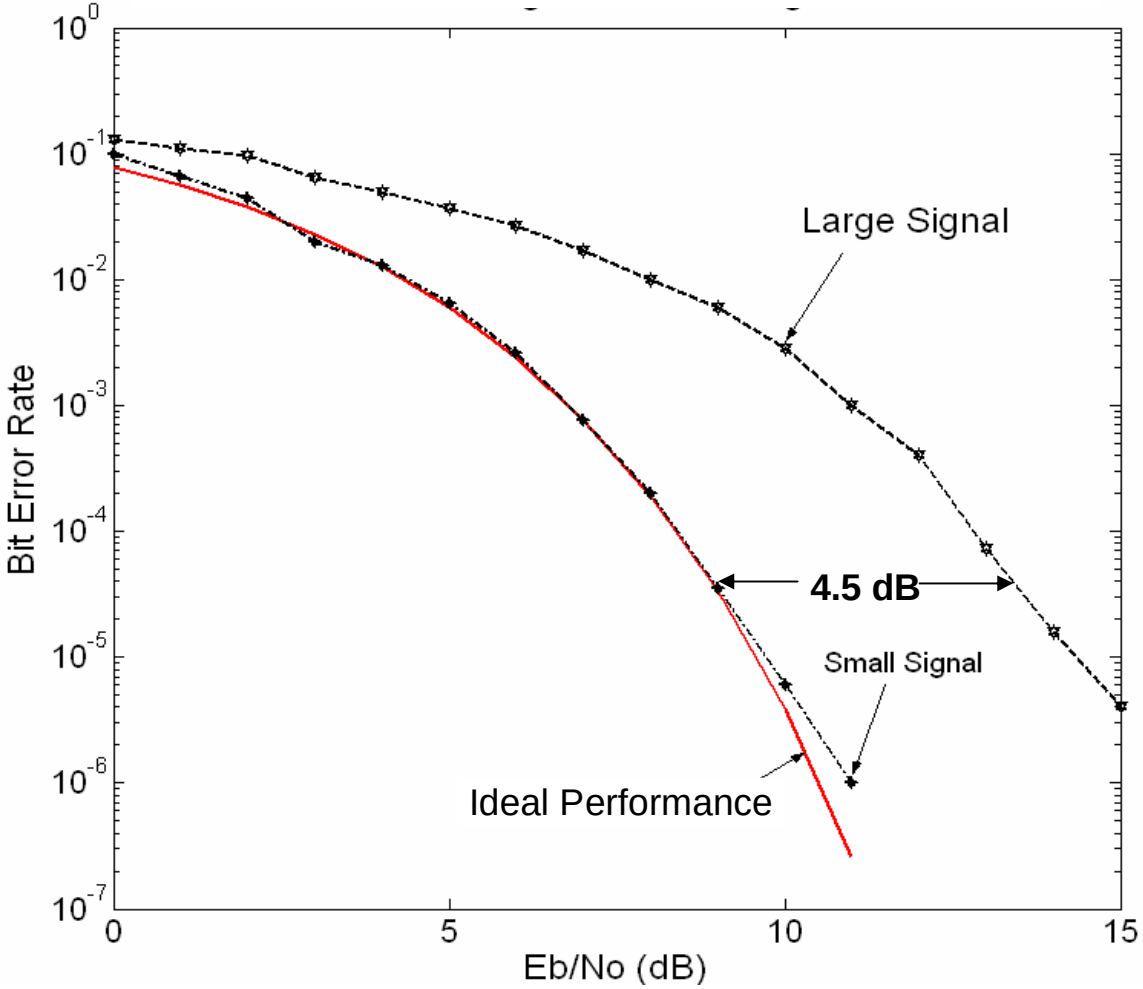
Performance Results (Case 1): Performance of the Large and Small Signal at SIR = 7 dB



Observation: When **SIR = 7 dB**, multi-signal decoding can be achieved with a penalty of about **4.5 dB** in performance. Higher SIR would lower the performance penalty.

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Performance Results

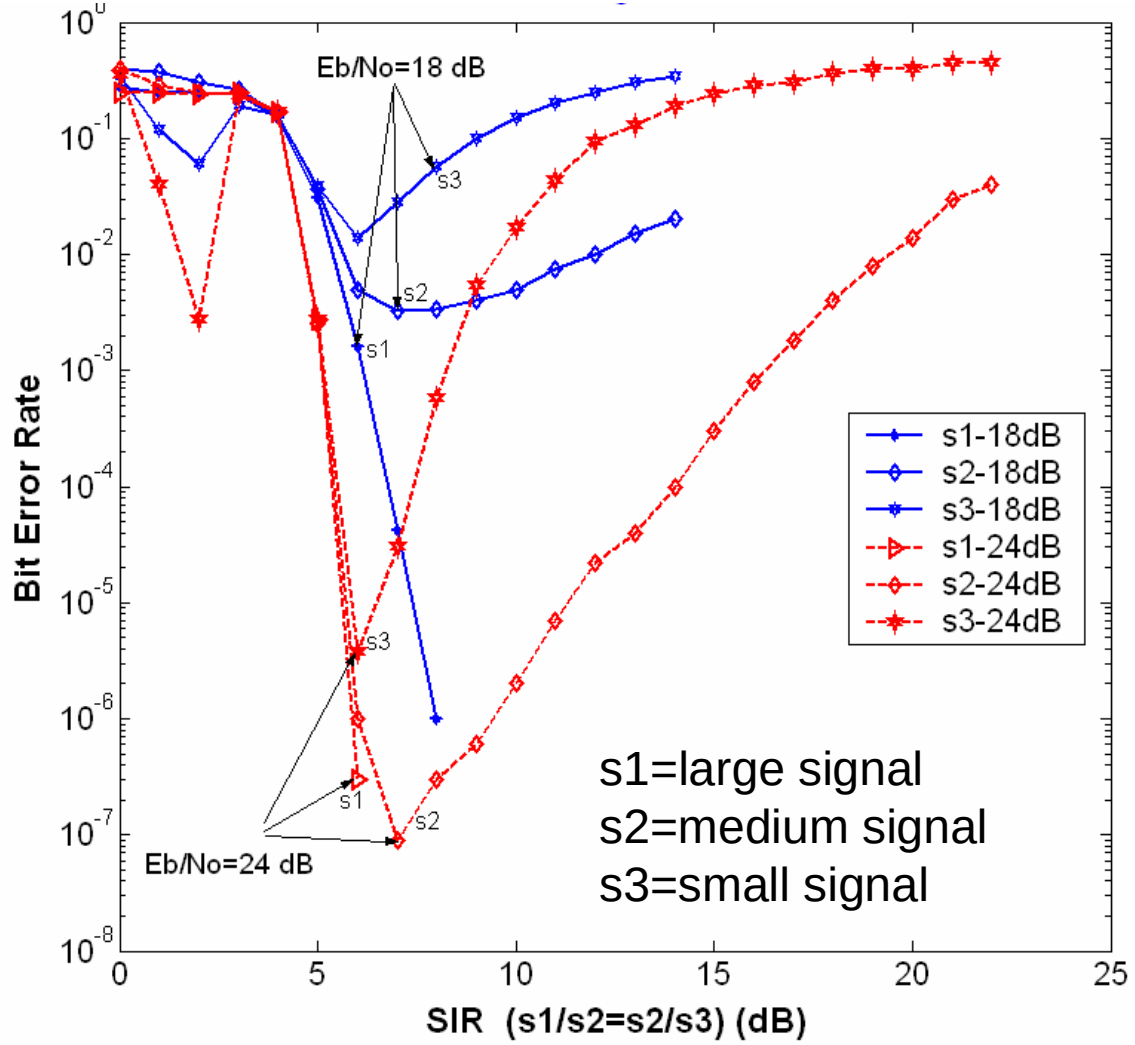
Case 2. Interference Cancellation Receiver Capable of Decoding Three Overlapped Co-Channel Signals

Observation:

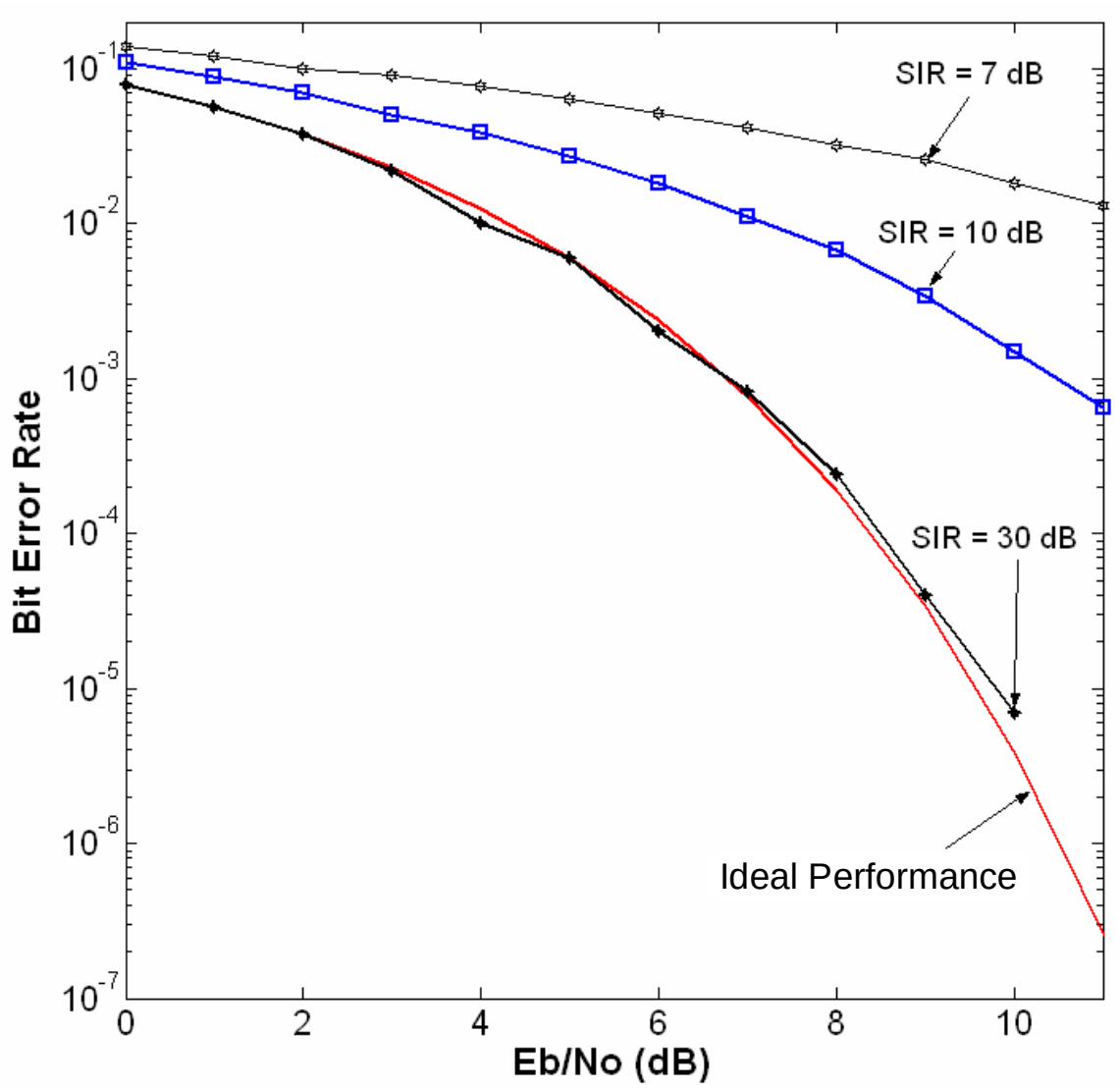
1. BER of the large signal continues to decrease for high SIR

2. BER of the medium signal optimizes around **SIR = 7 dB** and becomes worse beyond that

3. BER of the small signal optimizes around **SIR=6 dB** and becomes worse beyond that



Performance Results (Case 2): Performance of the Large Signal



Observation: The Large Signal is always interfered by the Medium and Small Signals, thus requiring high SIR to achieve ideal performance.

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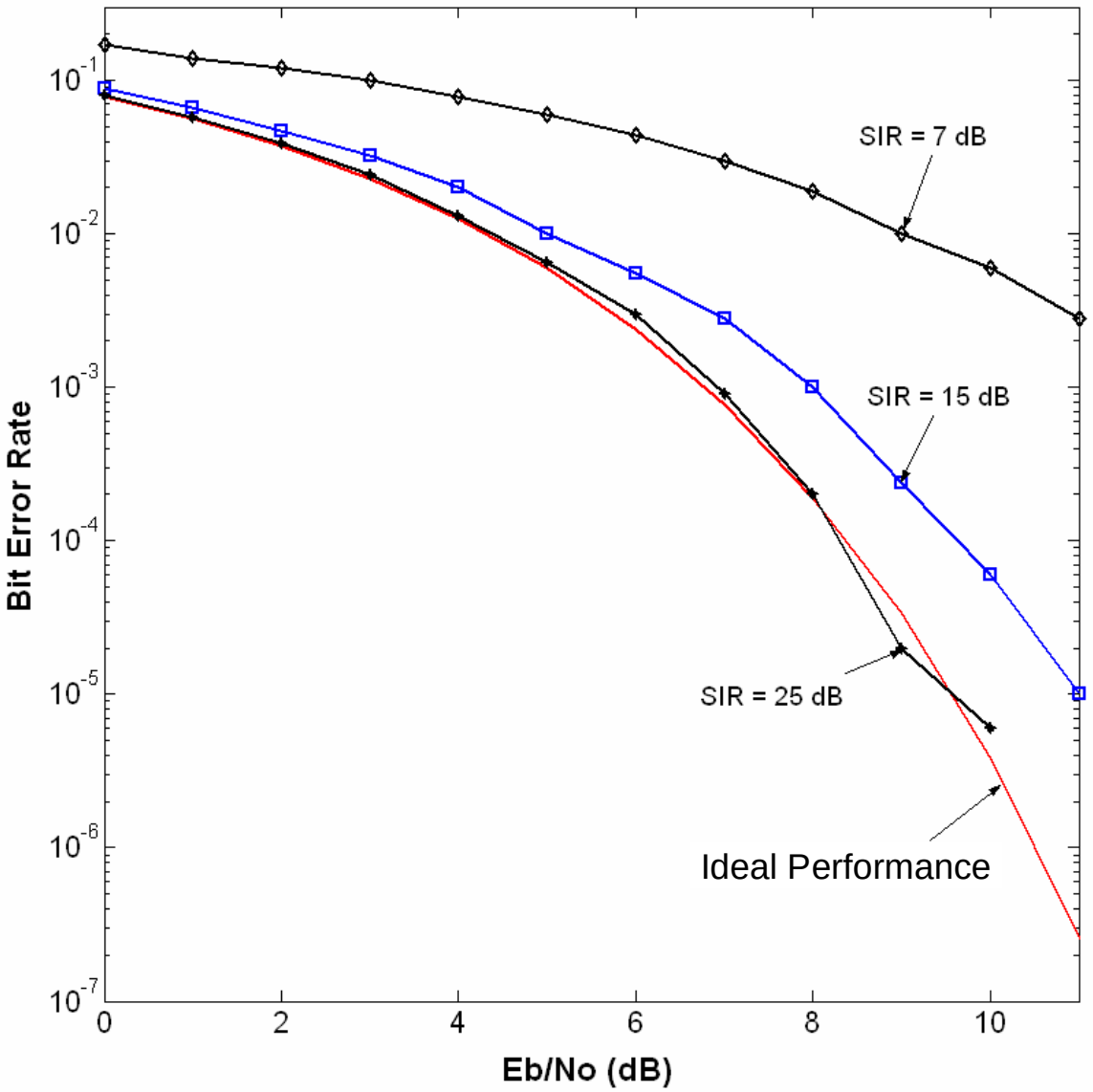
Performance Results (Case 2): Performance of the Medium Signal



Observation: Although an SIR of 25 dB is needed to achieve ideal performance, a decent performance can be obtained with SIR greater or equal to 15 dB.

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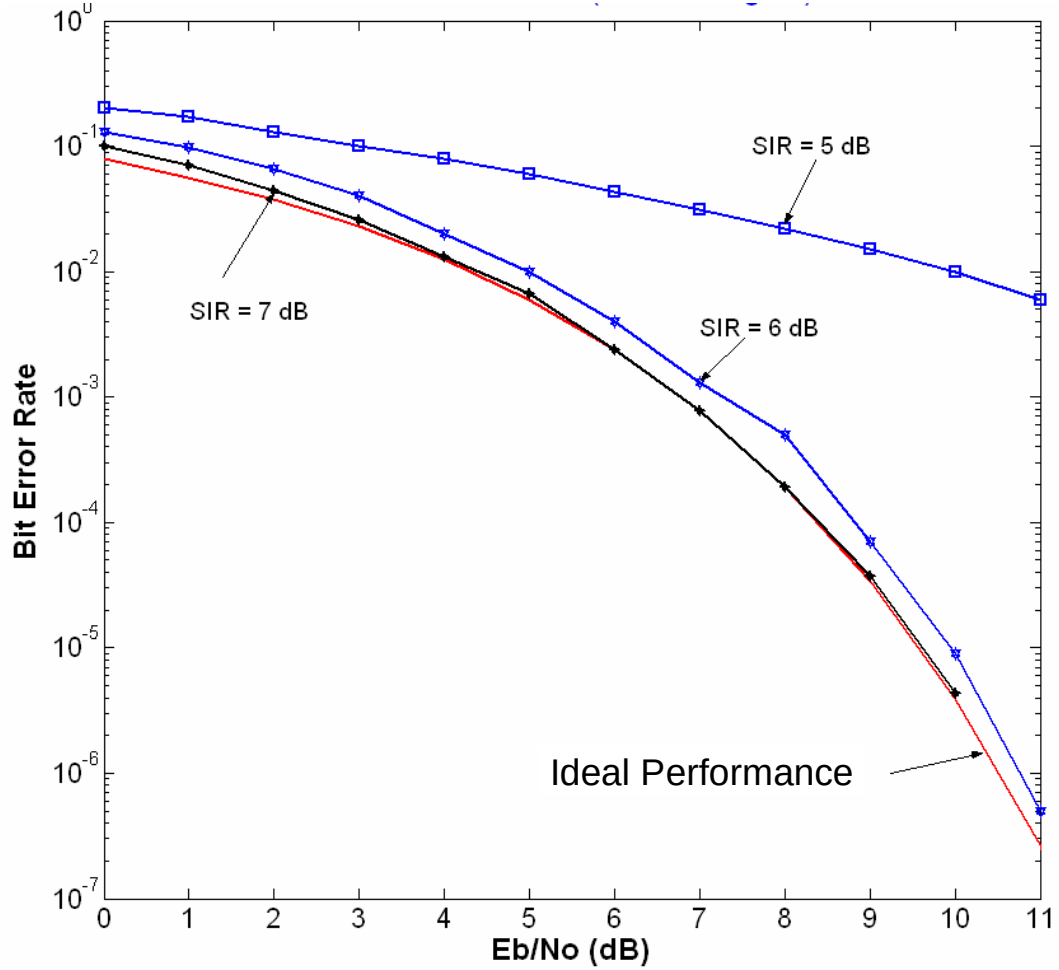
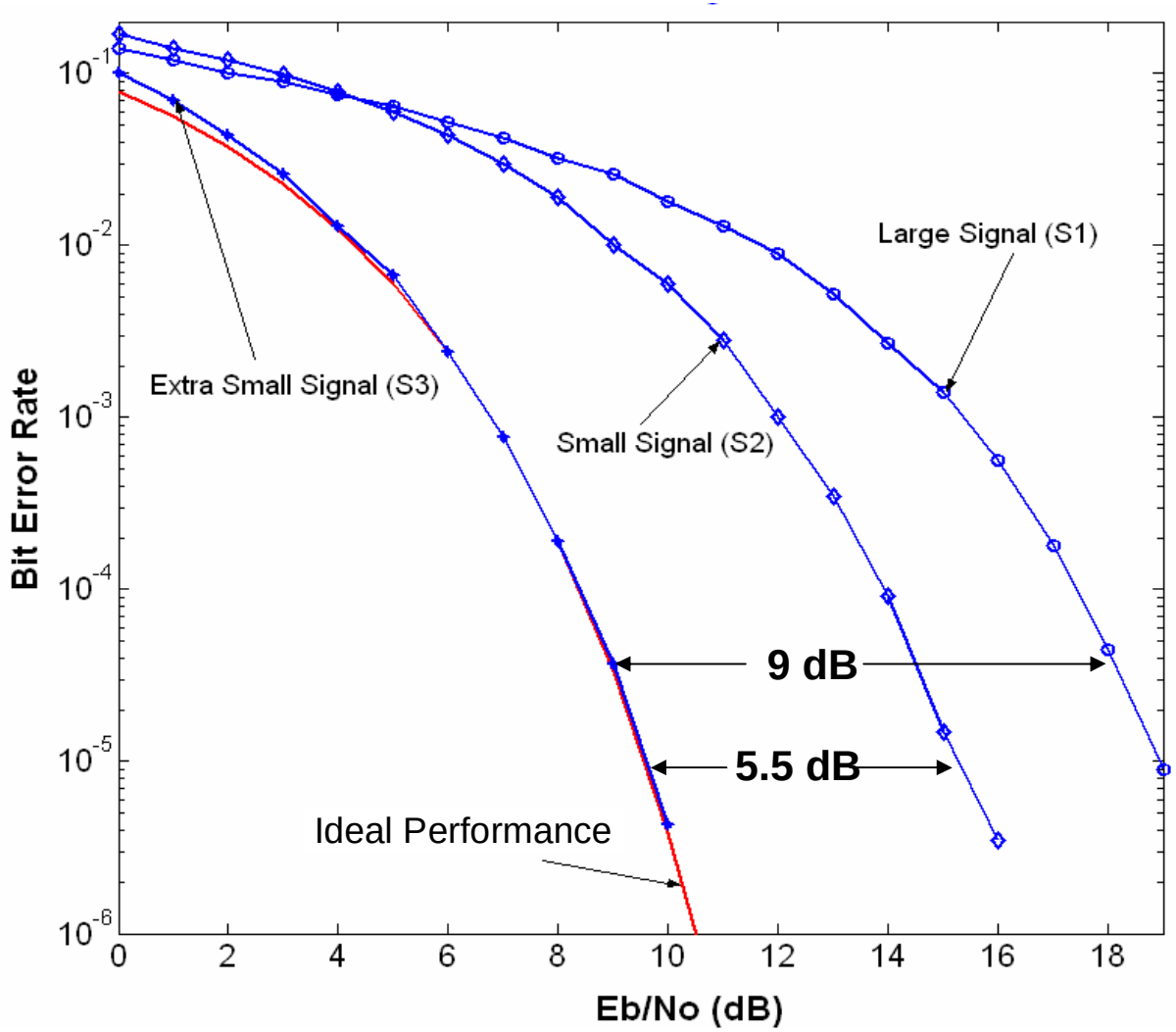
Performance Results (Case 2): Performance of the Small Signal



Observation: Similar to Case 1, an SIR of 7 dB is sufficient to achieve ideal performance for the Small Signal.

Performance Results (Case 2): Performance of All Three Signals at SIR = 7 dB



Observation: Only **7 dB** of SIR is needed for the small signal to achieve ideal performance, While the medium and the large signal perform **5.5 dB** and **9 dB** worse than the smallest signal, respectively.

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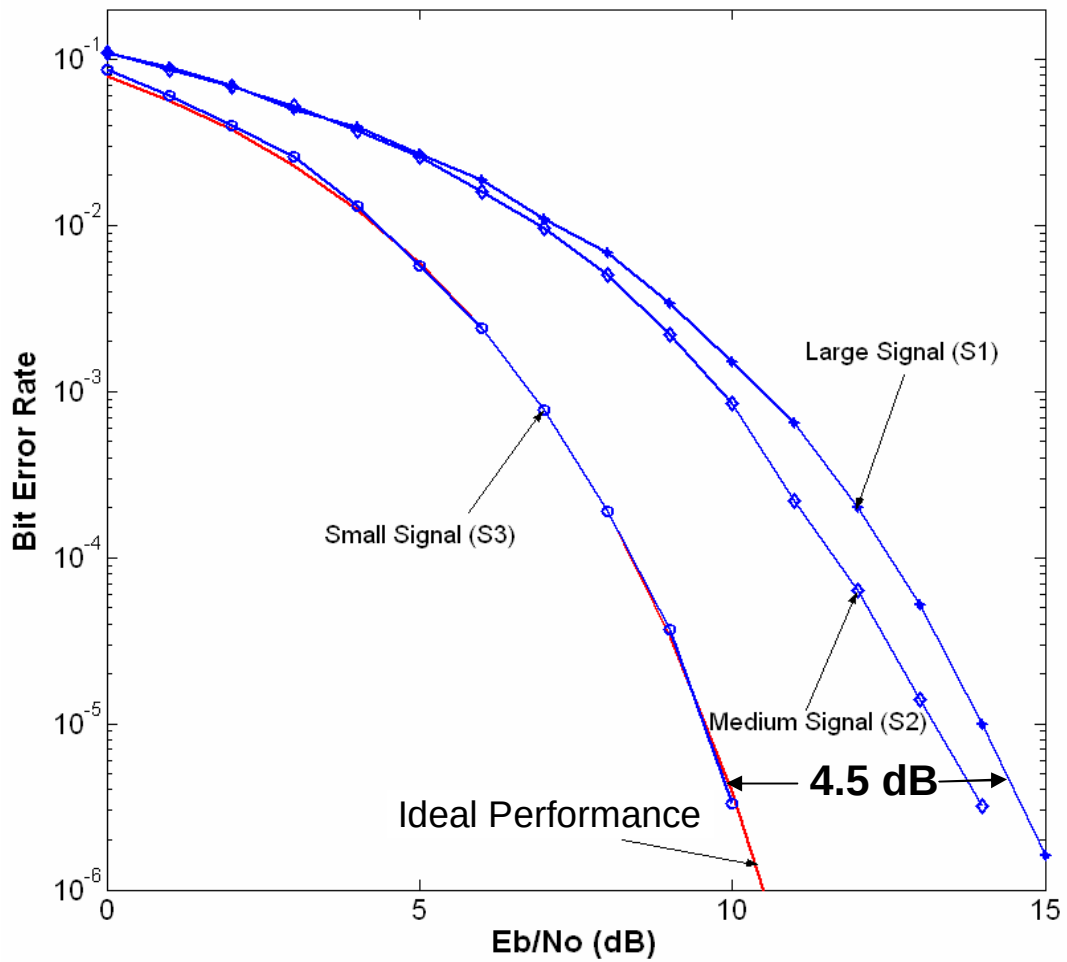
Performance Results (Case 2): Performance of All Three Signals at SIR = 10 dB



Observation: When SIR is **10 dB**, multi-signal decoding can be achieved with a small penalty in performance of about **4.5 dB**. SIRs higher than 10 dB would result in better the performance.

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Conclusion

- **Presented an effective interference cancellation technique that offers substantial improvement in performance**
  - **This technique can successfully recover very weak signals that are completely buried inside stronger ones**
  - **Simple concept: only involves addition and subtraction of signals as a means to remove co-channel interference**
- **Found that multi-signal decoding capability for co-channel signals is possible and most effective when**
  - **There is sufficient separation (>10 dB) among interfering signals**
  - **Given a small penalty in performance (4 - 4.5 dB above ideal performance)**
- **Future research**
  - **Sensitivity of this technique to incorrect estimates of phase, frequency and amplitude fluctuations**
  - **Extend this technique to other signaling formats such as CDMA or OFDM**

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