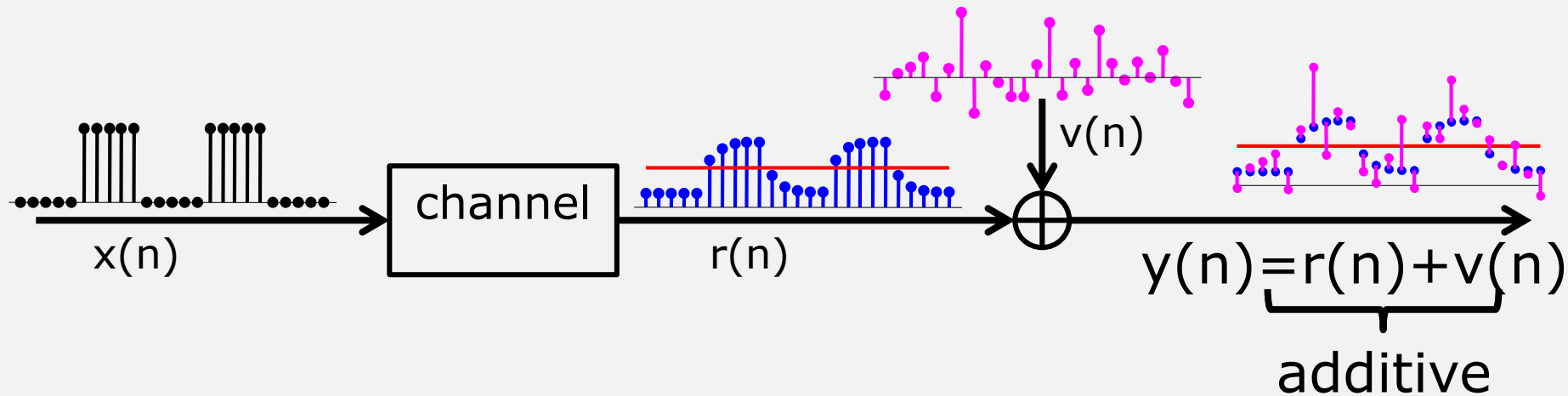


Additive Noise and Its Effect

Additive Noise



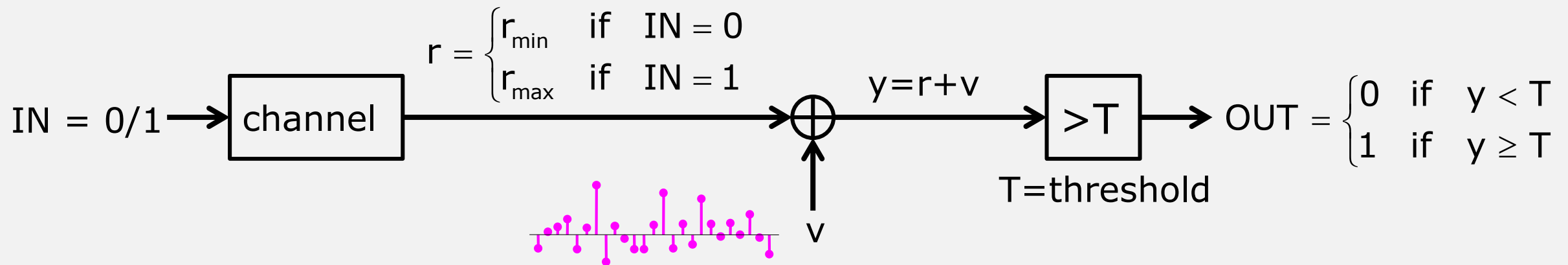
- **Definitions:**
 - $x(n)$: channel input
 - $r(n)$: channel output without noise
 - $v(n)$: noise
 - $y(n)$: received signal
- Additive noise moves the received signal away from the channel output without noise.
- If the noise is large enough and in the right direction, the output sample will be on the wrong side of the threshold!

Simplifying Assumptions for BER Analysis

- **Perfect synchronization**
 - We know exactly where to sample the output to decode each bit.
- **Single sample decoding**
 - We decode each bit by comparing one output sample with a threshold
- **No ISI**
 - The channel response depends only on the current bit, and not on past bits.
- **Additive “White” Gaussian Noise (AWGN)**
 - White: the noise varies fast enough that its value at different samples are unrelated to each other.
 - Gaussian: to be defined next time

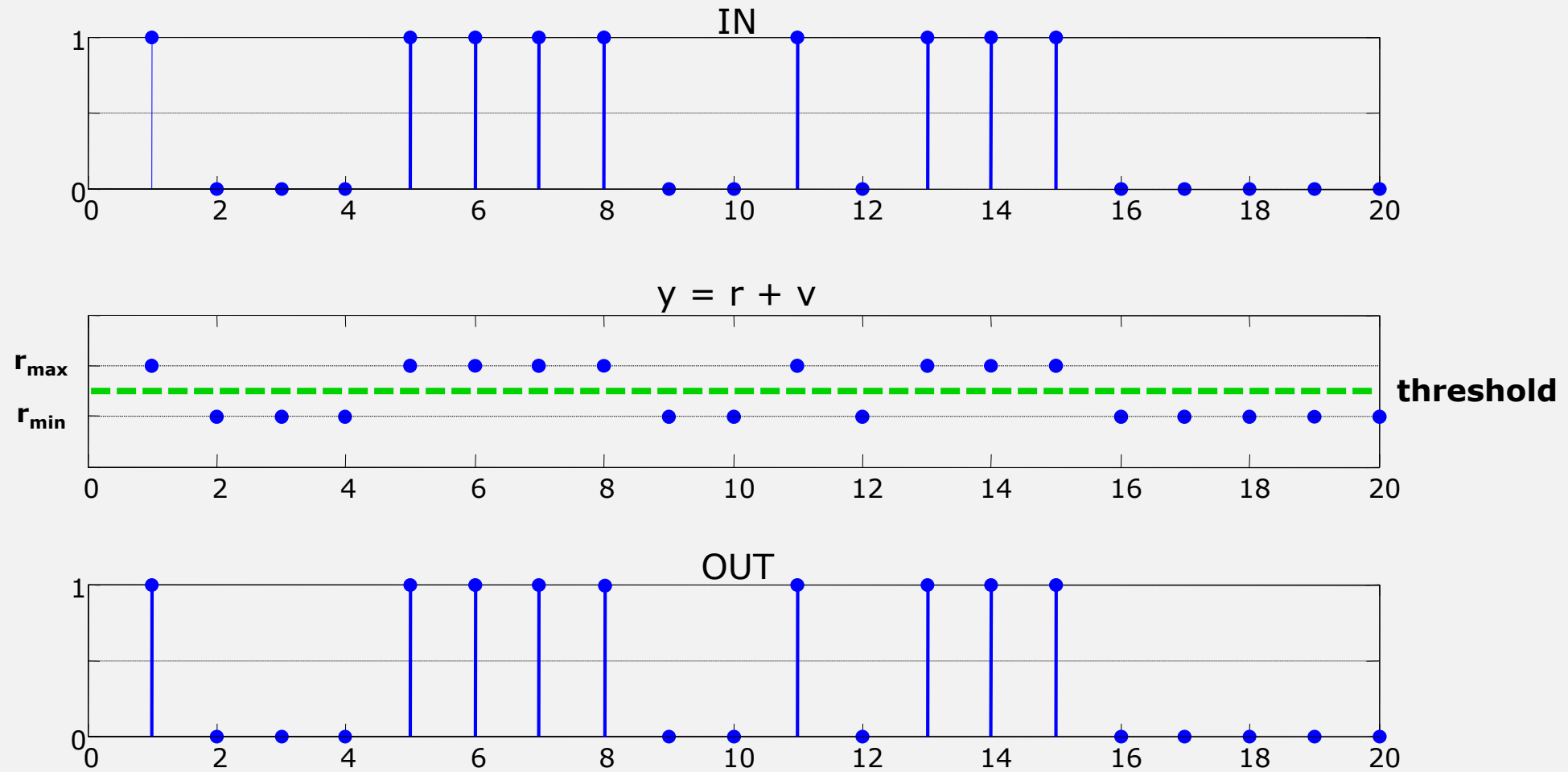
Simplified Model

- Under these assumptions, we only need to consider one sample per bit and can analyze each bit in isolation (independently) of the other bits.



- How can we predict the bit error rate for this model?

No Noise = No Bit Errors



Noise Leads to Bit Errors

