

CLUSTER SIZE DIMENSIONING

• IL NETWORK: $P_{cov} = P_{zob} \{ B_{I} R_2 < B_{I} R_2^* \} = P_{zob} \{ \bar{C}_I > \bar{C}_I|_{min} \}$
 $\approx P_{zob} \{ \bar{C}_I > \bar{C}_I|_{min} \} \geq P_{cov}^*$

- NODE POSITION = FIXED $\rightarrow d_u = R; d_I = D = R\sqrt{3}K$

- SHADOWING: LOG-NORMAL, INDEPENDENT

• $\bar{C} = C_m \cdot m_u^2 \rightarrow \bar{C} [dB_m] = \underbrace{C_m [dB_m]}_{10 \log_{10}(KR^{-\beta})} + S_u \quad S_u \in \mathcal{N}(0, \sigma_u^2)$

• $\bar{I} = \sum_1^{N_{INT}} \bar{I}_j = \sum_1^{N_{INT}} I_{mj} \cdot m_j^2 \rightarrow \bar{I} [dB_m] = I_m [dB_m] + S_I$

$I_m [dB_m] = ?$

$S_I \in ?$

Starting points:

- $I_{mj} = K d_I^{-\beta}$

- $S_j = 10 \log_{10} m_j^2 \in \mathcal{N}(0, \sigma_j^2)$

$$\begin{aligned}
 \cdot \quad I_{m_j} &= K D^{-\beta} \forall_j \\
 \rightarrow \bar{I} &= \sum_1^{N_{INT}} \bar{I}_j = \sum_1^{N_{INT}} I_{m_j} m_j^2 = K D^{-\beta} \underbrace{\sum_1^{N_{INT}} m_j^2}_{m_I^2} \\
 \rightarrow \bar{I} [\text{dB}_m] &= \underbrace{I_m [\text{dB}_m]}_{10 \log_{10} (K D^{-\beta} N_{INT})} + S_I
 \end{aligned}$$

$$\cdot \quad S_I = 10 \log_{10} m_I^2$$

Assumption = m_I^2 is log-normal

$$\rightarrow S_I \in \mathcal{N}(\bar{S}_I; \sigma_I^2)$$

$$\text{Assumption: } \bar{S}_I = 0 \quad / \quad \sigma_I^2 = \sigma_J^2$$

$$\text{Assumption: } \sigma_I^2 = \sigma_U^2 = \sigma^2$$

$$P_{cov} \approx P_{2b} \left\{ \bar{C}/\bar{I} > \bar{C}/\bar{I}|_{min} \right\}$$

$$= P_{2b} \left\{ \bar{C} [dBm] - \bar{I} [dBm] > \bar{C}/\bar{I}|_{min} [dB] \right\}$$

$$= P_{2b} \left\{ C_m [dBm] + s_u - I_m [dBm] - s_I > \bar{C}/\bar{I}|_{min} [dB] \right\}$$

$$= P_{2b} \left\{ \underbrace{s_u - s_I}_{s \in N(0, 2\sigma^2)} > \bar{C}/\bar{I}|_{min} [dB] - C_m/I_m [dB] \right\}$$

$$= \frac{1}{2} \operatorname{erfc} \left\{ \frac{\bar{C}/\bar{I}|_{min} [dB] - C_m/I_m [dB]}{\sqrt{2} \sqrt{2\sigma^2}} \right\}$$

$$= \frac{1}{2} \operatorname{erfc} \left\{ \frac{\bar{C}/\bar{I}|_{min} [dB] - 10 \log_{10} KR^{-\beta} / KD^{-\beta} N_{int}}{2\sigma} \right\}$$

$$= \frac{1}{2} \operatorname{erfc} \left\{ \frac{\bar{C}/\bar{I}|_{min} [dB] + 10 \log_{10} N_{int} - 10\beta \log_{10} \sqrt{3JK}}{2\sigma} \right\} \geq P_{cov}^*$$

