# Detail derivation of Matric-1

$$F_E(x) = \frac{x^{q\mu} e^{-(\alpha/2)}}{2^{\mu+1}\Gamma(\mu+1)} \sum_{k=0}^{\infty} \frac{k!\, m_k}{(\mu+1)_k} L_k^{\mu}\left(\frac{2(\mu+1)x^{\alpha}}{\mu}\right)$$

$\Rightarrow$ CDF Channel gain $\lambda_b = |h_b|^2$.

$$\therefore F_{\lambda_b}(x) = \int_0^{\sqrt{x}} f_{\lambda_b}(w)\,dw.$$

$$= \frac{\sqrt{x}^{\,q\mu} e^{-\left(\frac{\gamma^{q}}{2}\right)}}{2^{\mu+1}\Gamma(\mu+1)} \sum_{k=0}^{\infty} \frac{k!\, m_k}{(\mu+1)_k} L_k^{\mu}\left(\frac{2(\mu+1)\sqrt{x}^{\,\alpha}}{\mu}\right)$$

$$\Rightarrow P_R(O_1) = P_r(CS_1 < R)$$

$$= 1 - P_r\left[\min(\gamma_{SR}, \gamma_{SD}) > \Phi_1\right]$$

$$= F_{\lambda_{SR}}(\Phi_1) + F_{\lambda_{SD}}(\Phi_1) - F_{\lambda_{SR}}(\Phi_1) F_{\lambda_{SD}}(\Phi_1)$$

$$\gamma_{SR}^{S1} = \frac{\alpha_1 p \lambda_{SR}}{\alpha_1 p \lambda_{SR} + d^{T}_{SR}}$$

arranging the terms

$$\therefore \Phi_1 = \frac{\gamma_{SR}\, d^{T}_{SR}}{\alpha_1 B - \gamma_{SR}\alpha_2 B}$$

$$= \omega.$$

$$\therefore a_1 = v.$$

$$\therefore a_1 = \frac{n_1 d^{T}_{SR}}{p(a_1 - n_1 a_2)}.$$

## Detail of performance Metric II

$\rightarrow \quad O_2 = E_1 \cup E_2 \cup E_3$

$$\rightarrow P_r(O_2) = \begin{cases} P_r(\lambda_{SR} < \Phi_1) + P_r(\lambda_{SR} > \Phi_1, \lambda_{SR} < \Phi_2) + P_r\left(\lambda_{SR} > \Phi_2, \lambda_{RD} < \frac{n_2}{P}\right), & \text{if } \Phi_1 < \Phi_2 \\ P_r(\lambda_{SR} < \Phi_1) + P_r\left(\lambda_{SR} > \Phi_1, \lambda_{RD} < \frac{n_2}{P}\right), & \text{else} \end{cases}$$

$\Rightarrow \quad n_2 = 2^{2R_2} - 1$

$\therefore \quad \Phi_2 = \dfrac{n_2}{\alpha_2 P}$

$\Phi_{max} = \max(\Phi_1, \Phi_2)$

$\Rightarrow$ So, finally,

$$P_r(O_2) = \frac{\Phi_{max}^{0.5\alpha\mu} \, e^{-\left(\frac{\Phi_{max}^{0.5\alpha}}{2}\right)}}{2^{\mu+1}\,\Gamma(\mu+1)} \sum_{k_1=0}^{\infty} \frac{k_1! \, m^{k_1}}{(\mu+1)_{k_1}} L_{k_1}^{\mu} \left(\frac{\ldots}{\mu}\right)$$

Substitute value in $\Phi_2 = \dfrac{n_2}{\alpha_2 P}$ in equation we get whole term for $P_r(O_2)$.

A Detailed Derivation of Metric - III

$$C_{s_1} = 0.5 \min\{\log_2(1+\gamma_{SD}), \log_2(1+\gamma_{SR_1})\}$$

$$= 0.5 \log_2\left(1 + \frac{\gamma P_{a_1}}{\gamma P_{a_2} + 1}\right)$$

$$= 0.5 \log_2(1+\gamma_P) - 0.5 \log_2(1+\gamma P_{a_2}$$

$$\Rightarrow C_{s_2} = 0.5 \log_2 (1 + \min\{\lambda_{SD} P a_2, \lambda_{RD} P\})?$$

$$C_{s_1} = \frac{0.5}{\ln(2)}\left[\underbrace{\int_0^\infty \ln(1+\beta x) f_x(x)\,dx}_{w_1} - \underbrace{\int_0^\infty \ln(1+a_2 P_2) f_x(x)}_{w_2}\right.$$