$$R = \frac{1}{2} wlog(1 + \frac{P_s g_{sd}}{\sigma^2} + \frac{P_s g_{sr} P_r g_{rd}}{\sigma^2(\sigma^2 + P_s g_{sr} + P_r g_{rd})}) \tag{1}$$

Assume there are two relays and let $a_1 = \frac{g_{sr_1}}{\sigma^2}$ and $b_1 = \frac{P_r g_{r_1 d}}{\sigma^2}$ similarily a_2, b_2 for relay 2. At a particular source power P_s, relay 1 is chosen over relay 2 if $\frac{a_1 b_1}{1+P_s a_1 + b_1} > \frac{a_2 b_2}{1+P_s a_2 + b_2}$

Consider the function $f(p) = \frac{pab}{1+pa+b}$

$$f'(p) = \frac{(1+b)ab}{(1+pa+b)^2} \tag{2}$$

$f'(p)$ is positive and decreasing with p.

The power at which both the relays give same rate can be obtained by equating $f_1(p)$ and $f_2(p)$.

$$P_0 = (1+b_1)(1+b_2)\frac{\frac{a_1 b_1}{1+b_1} - \frac{a_2 b_2}{1+b_2}}{a_1 a_2 (b_2 - b_1)} \tag{3}$$

For P_0 to be positive, both numerator and denominator should have same sign i.e., if $\frac{a_1 b_1}{1+b_1} > \frac{a_2 b_2}{1+b_2}$ then $b_2 > b_1$. To explain this intuitively, let us assume b_1, b_2 to be much larger than 1 which reduces the first inequialitely ti $a_1 > a_2$. What this means is, if at a source power less than P_0