General Remark on Transistor Sizing

The (main) purpose of a MOST is to make gain, hence, large g_m and small g_{ds}.

$I_{DS} \approx K\frac{W}{L}V_{dsat}^2$, hence, $V_{dsat} \approx \sqrt{\frac{I_{DS}}{W}}\frac{1}{\sqrt{K}}\sqrt{L}$

- choose “reasonable” current density I_{DS}/W
- adjust V_{dsat} with $L \rightarrow V_{dsat}$ and V_{ds} sets g_{ds}
- adjust g_m with I_{DS}/W
- Current density I_{DS}/W design procedure

(with V_{dsat} fixed, also $\omega_T = \mu V_{dsat}/L^2$ is fixed , and $I_{DS}/g_m = V_{dsat}/2$ fixed)

BTW: $\frac{2}{V_{dsat}} = \frac{g_m}{I_{DS}}$

Similar for subthreshold, but $I_{DS} = I_{D0}\frac{W}{L}e^{V_{GS}/(nV_t)}\left(1 - e^{-V_{DS}/V_t}\right)$, hence, choose $V_{DS} > 4V_t \approx 100mV$ and $g_m \approx I_{DS}/(nV_t)$ (choose $V_{DS} > 100mV$ to set g_{ds}, and adjust g_m with I_{DS})