The radio capacity of a cellular system is defined as

$$m = \frac{B_t}{B_c N} \text{ radio channels/cell} \tag{9.19}$$

where m is the radio capacity metric, B_t is the total allocated spectrum for the system, B_c is the channel bandwidth, and N is the number of cells in a complete frequency reuse cluster. As shown in Chapter 3, N is related to the co-channel reuse factor Q by

$$Q = \sqrt{3N} \tag{9.20}$$

From Equations (9.18), (9.19), and (9.20), the radio capacity is given as

$$m = \frac{B_t}{B_c \frac{Q^2}{3}} = \frac{B_t}{B_c \left(\frac{6}{3^{n/2}} \left(\frac{C}{I} \right)_{min} \right)^{2/n}} \tag{9.21}$$

As shown by Lee [Lee89a], when $n = 4$, the radio capacity is given by

$$m = \frac{B_t}{B_c \sqrt{\frac{2}{3} \left(\frac{C}{I} \right)_{min}}} \text{ radio channels/cell} \tag{9.22}$$

In order to provide the same voice quality, $(C/I)_{min}$ may be lower in a digital systems when compared to an analog system. Typically, the minimum required C/I is about 12 dB for narrowband digital systems and 18 dB for narrowband analog FM systems, although exact values are determined by subjective listening tests in real-world propagation conditions. Each digital wireless standard has a different $(C/I)_{min}$, and in order to compare different systems, an equivalent C/I must be used. Lower $(C/I)_{min}$ values imply more capacity. If B_t and m are kept constant in Equation (9.22), then it is clear that B_c and $(C/I)_{min}$ are related by

$$\left(\frac{C}{I} \right)_{eq} = \left(\frac{C}{I} \right)_{min} \left(\frac{B_c}{B_c'} \right)^2 \tag{9.23}$$

where B_c is the bandwidth of a particular system, $(C/I)_{min}$ is the tolerable value for the same system, B_c' is the channel bandwidth for a different system, and $(C/I)_{eq}$ is the minimum C/I value for the different system when compared to the $(C/I)_{min}$ for a particular system. Notice that for a constant number of users per radio channel, the same voice quality will be maintained in a different system if $(C/I)_{min}$ increases by a factor of four when the bandwidth is halved. Equation (9.22) indicates that maximum radio capacity occurs when $(C/I)_{min}$ and B_c are minimized, yet Equation (9.23) shows that $(C/I)_{min}$ and B_c are inversely related.