Chapter 2

CELLULAR RF REQUIREMENTS AND INTEGRATION TRENDS

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1. Handset Technology Drivers

The cellular handset has gone through a rapid evolution. From being an executive’s attache-sized cell-phone toy to end up in everybody’s pocket, or from 3 kg $\Rightarrow \lesssim 100$ g, $\$ 3000 \Rightarrow \lesssim \$ 100$, and from useless $\Rightarrow$ weeks of standby time.

In this chapter we will outline some of the challenges and trends in the handsets technology business.

Needless to say, it is the ever increasing integration capabilities predicted by Moore’s law that has facilitated the rapid adoption of cellular phones. With annular sales exceeding 500 million units the volumes are high enough to exploit the most advanced integrated circuit technologies, and, in fact, the handset business has driven the development of low-power and RF technologies. With such a large market, many players are interested and competition is fierce. In the beginning phones were competing with size as well as talk and standby time, but today these parameters are mostly “good enough” and it is with the versatility of the handset, for example as personal information managers, music players, games, or cameras that manufacturers compete. In addition to the growing user-application suite, the cellular evolution with more frequency bands and cellular standards is constantly challenging the designers, as all of this has to be added without raising the manufacturing cost. Of course handsets supporting
new standards must also achieve similar use time and size as the more mature 2G handsets.
How has this evolution been made possible and how can we continue to deliver increased functionality at lower cost and size?

1.1 Handset Complexity

In figure 2.1 the PCB of one of the very first pocket sized GSM handsets is shown, the Ericsson GH192 from 1992. This phone has a single band (900 MHz) digital radio modem\(^1\) and occupies two printed-circuit boards (PCB). Some seven years later, the Ericsson T28, see figure 2.2, supported two bands (900 and 1800 MHz) on a single PCB with the RF part only some 25% in size of that of the GH192. The next step, see figure 2.3, which was launched circa a year after the T28, now has added a third frequency (1900 MHz), enabling roaming between, for example, Europe and the USA, with an even smaller RF board area. To summarize the changes when moving from the GH192 to the T39 we see no reduction in the number of application specific integrated circuits (ASIC) but a reduction from 2 → 1 in standard integrated circuits (IC), 12 → 5 in modules, 350 → 90 in RF board components, while, the number of RF bands increased from 1 → 3, clearly indicating that much functionality has been moved from