Mammography, the primary screening and diagnostic tool for the detection and diagnosis of breast cancer, in many ways represents the extremes on the timeline in the shift of radiology toward full digital imaging. Mammography was the first modality to be digitally converted and to apply
computer-associated artificial intelligence to diagnosis. However, it was also the last major modality to have a commercially marketed digital system. Furthermore, in many departments mammography is the last division converted to digital format.

The delay in the development and deployment of full field digital mammography (FFDM) primarily relates to the exacting spatial resolution required in order to detect and correctly analyze microcalcifications. Many malignant microcalcifications may be as small as 0.3 mm in size, 1 order of magnitude smaller than most radiographically identified abnormalities. Controversy still exists regarding the optimum, cost-effective acquired pixel size for the appropriate visualization and analysis of microcalcifications. For example, a 50 or 100 μm pixel pitch might enable the identification of small clusters of microcalcifications. However, a 25 μm pixel pitch may enable a more rigorous analysis of the morphology of the individual microcalcifications, thus improving specificity by allowing better discrimination between benign and malignant microcalcifications. However, with each halving of acquired pixel pitch, there is a quadrupling of the number of pixels, which substantially increases the cost of storage and time required for processing and network transmission of the data.

A second major challenge faced by digital mammography is the need for superb contrast over a wide dynamic range. The breast contains benign, dense fibroglandular tissue and lucent fatty tissue as well as masses and/or microcalcifications that may be of benign or malignant origin. Uniformly dense mammograms and even mammograms with a combination of different densities can make discriminating subtle areas of malignancy most challenging. Improving visualization requires improved contrast resolution, which entails optimizing the bit depth of each pixel since contrast resolution is a function of the bit depth. Improved contrast resolution must also be optimized from a cost-benefit perspective similar to that for spatial resolution. The requirements for a wide dynamic range, with optimal spatial and contrast resolution, have been met through extensive research and confirmed with the approval process’s mandatory equivalency testing, allowing for the ultimate introduction of digital mammography into the marketplace. Because of these technological advances, new applications are being developed for FFDM. For example, tomosynthesis shows promise as a technique to improve visualization of breast cancer.

In addition to the acquisition of the digital mammogram, downstream requirements for processing (as well as computer-aided detection [CAD] and potentially computer-assisted classification [CAC]) had to be developed. The rigorous requirements related to the display for softcopy interpretation, which is the preferred manner for digital interpretation, and production of