Asymptotic spectra of large (grid) graphs with a uniform local structure

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We are concerned with sequences of graphs having a grid geometry, with a uniform local structure in a bounded domain $\Omega \subset \mathbb{R}^d$, $d \geq 1$. We assume Ω to be Lebesgue measurable with regular boundary and contained, for convenience, in the cube $[0,1]^d$. When $\Omega = [0,1]$, such graphs include the standard Toeplitz graphs and, for $\Omega = [0,1]^d$, the considered class includes d-level Toeplitz graphs. In the general case, the underlying sequence of adjacency matrices has a canonical eigenvalue distribution, in the Weyl sense, and we show that we can associate to it a symbol f. The knowledge of the symbol and of its basic analytical features provide many informations on the eigenvalue structure, of localization, spectral gap, clustering, and distribution type. Few generalizations are also considered in connection with the notion of generalized locally Toeplitz sequences and applications are discussed, stemming e.g. from the approximation of differential operators via numerical schemes.