Given a real, expansive dilation matrix we prove that any bandlimited function $\psi \in L^2(\mathbb{R}^n)$, for which the dilations of its Fourier transform form a partition of unity, generates a wavelet frame for certain translation lattices. Moreover, there exists a dual wavelet frame generated by a finite linear combination of dilations of $\psi$ with explicitly given coefficients. The result allows a simple construction procedure for pairs of dual wavelet frames whose generators have compact support in the Fourier domain and desired time localization. The construction relies on a technical condition on $\psi$, and we exhibit a general class of function satisfying this condition.