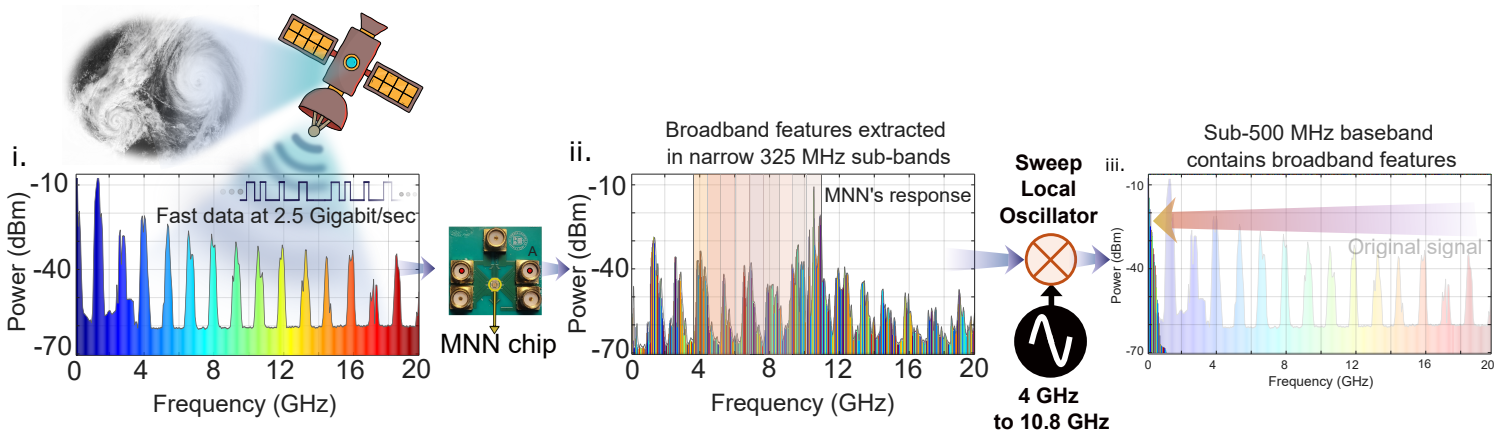
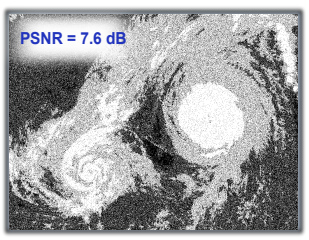
a.

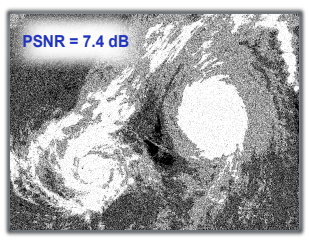


b.

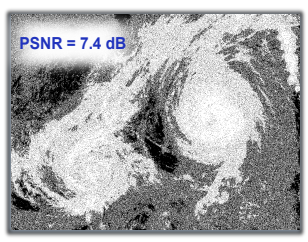
i. Local oscillator at 4 GHz



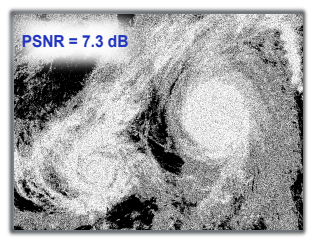
ii. Local oscillator at 4.4 GHz



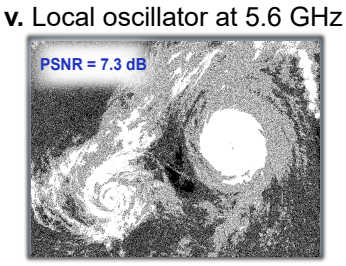
iii. Local oscillator at 4.8 GHz



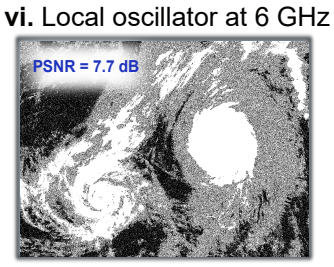
iv. Local oscillator at 5.2 GHz



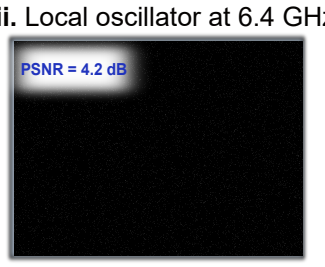
v. Local oscillator at 5.6 GHz



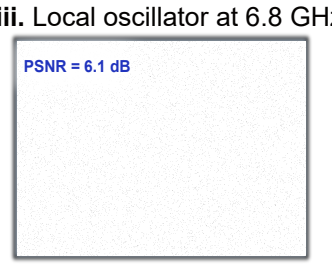
vi. Local oscillator at 6 GHz



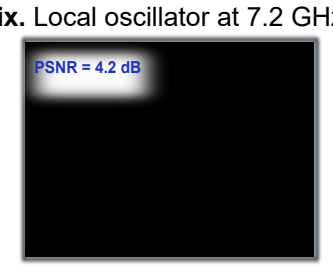
vii. Local oscillator at 6.4 GHz



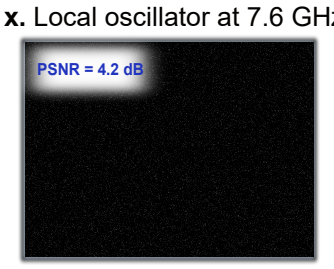
viii. Local oscillator at 6.8 GHz



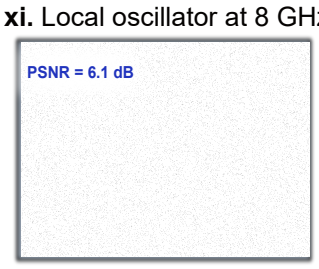
ix. Local oscillator at 7.2 GHz



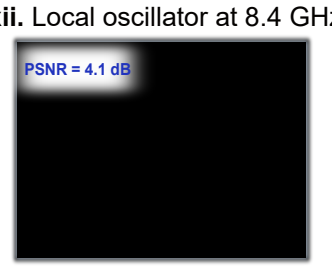
x. Local oscillator at 7.6 GHz



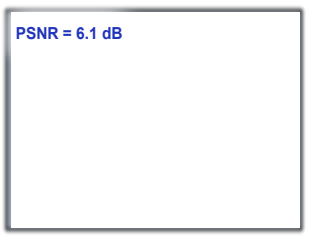
xi. Local oscillator at 8 GHz



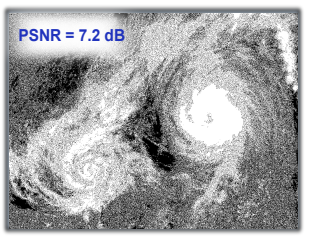
xii. Local oscillator at 8.4 GHz



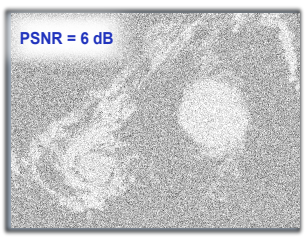
xiii. Local oscillator at 8.8 GHz



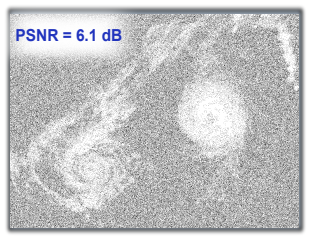
xiv. Local oscillator at 9.2 GHz



xv. Local oscillator at 9.6 GHz

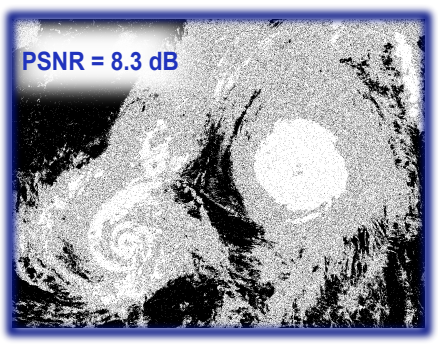


xvi. Local oscillator at 10 GHz



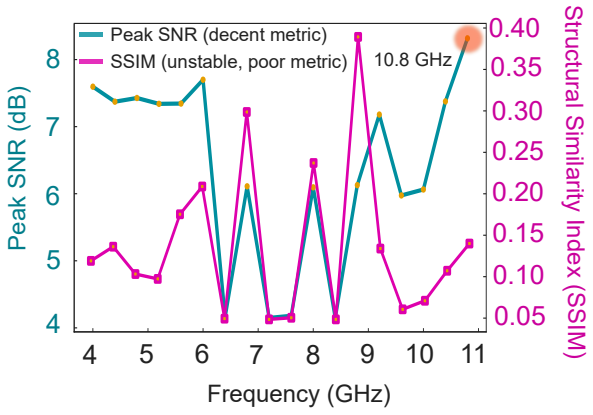
c.

i. Local oscillator at 10.8 GHz

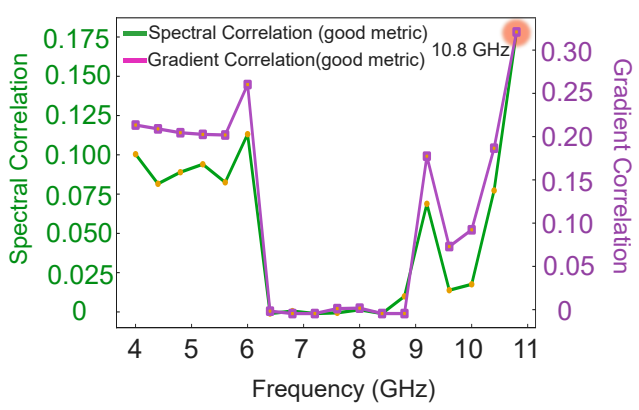


(Best image quality for a single pass)

ii. Peak SNR and SSIM vs Frequency



iii. Spectral & Gradient Correlation vs Frequency



Extended Data Figure 4. LO-dependent reconstruction quality using the proposed p-bit generation scheme in Figures 5 and 6. **a,** Fast 8-bit pixel data at 2.5 Gb/s is directly injected into the MNN waveguides, generating a broadband frequency-comb response. A narrow 325 MHz baseband sub-band is selected using a tunable local oscillator (LO). We seek to determine how much information each output sub-band retains from the original broadband input, since the MNN redistributes signal content across its wide instantaneous comb-like spectrum. **b,** Representative single-shot reconstructions obtained using p-bits for different LO values. Each image is annotated with its peak signal-to-noise ratio (PSNR). Certain LO frequencies exhibit strong Static-Ratio diversity in the p-bit output, producing effective dithering and clearer structural features, while others show weak spectral diversity and yield washed-out images. **c,** Image quality across LO settings is quantified using four metrics. **c.i,** PSNR indicates pixel-wise fidelity and is maximized near LO = 10.8 GHz, corresponding to the perceptually best reconstruction in this sweep. **c.ii,** Due to the Gaussian noise-like texture present in the reconstructed images, SSIM, being driven primarily by local contrast, underestimates their perceptual similarity to ground truth. **c.iii,** In contrast, spectral correlation (similarity in Fourier magnitude) and gradient-magnitude correlation (similarity in edges and contours) more faithfully track the perceptual quality of the MNN-enabled dithering-based reconstruction, correctly identifying the LO ≈ 10.8 GHz band as optimal.