CLAIMS

What is claimed is:

1. A multi-band shared-aperture antenna, comprising a plurality of coupled array elements, a frequency combining unit, a low-frequency feed unit, and a high-frequency feed unit, wherein

each coupled array element is disposed on a reflection panel;

the frequency combining unit is connected to the plurality of coupled array elements; the frequency combining unit comprises at least two frequency combining layer; each frequency combining layer comprises at least one frequency combiner; each frequency combiner comprises an antenna port, at least one high-frequency port, and at least one low-frequency port; a plurality of high-frequency ports form at least one high-frequency port group, and a plurality of low-frequency ports form at least one low-frequency port group; and for each layer, a quantity of high-frequency port groups is not greater than a quantity of frequency combiners, a quantity of low-frequency port groups is less than the quantity of frequency combiners, and the quantity of high-frequency port groups is not less than the quantity of low-frequency port groups;

wherein a plurality of upper-layer low-frequency ports are connected to lower-layer antenna ports, an antenna port of a first-layer frequency combiner is connected to the coupled array element, a plurality of high-frequency ports of the first-layer frequency combiner are connected to the high-frequency feed unit, a plurality of low-frequency ports of a last-layer frequency combiner are connected to the low-frequency feed unit, and a high-frequency port of the last-layer frequency combiner is connected to the high-frequency feed unit;

the low-frequency feed unit is configured to feed a low-frequency signal; and

the high-frequency feed unit is configured to feed at least one type of frequency signal higher than the low-frequency signal.

2. The multi-band shared-aperture antenna according to claim 1, wherein the coupled array elements form reconstructed elements of different frequency bands based on different port groups, coupled array elements corresponding to the low-frequency ports in the low-frequency port group jointly form a low-frequency reconstructed element, and coupled array elements corresponding to the high-frequency ports in the high-frequency port group jointly form a high-frequency reconstructed element.

3. The multi-band shared-aperture antenna according to claim 1 or 2, wherein a distance d between centers of every two adjacent coupled array elements satisfies:

$n_1*d \leq 0.5\lambda_1$, wherein

n_1 is a quantity of high-frequency ports in the high-frequency port group, λ_1 is a wavelength corresponding to a high-frequency signal input by the high-frequency feed unit, and n_1 is a positive integer.

4. The multi-band shared-aperture antenna according to claim 3, wherein if a maximum scanning angle of the multi-band shared-aperture antenna is θ_{max}, the distance d between the centers of every two adjacent coupled array elements satisfies:

$$n_1 * d \leq \frac{\lambda_1}{1+\sin\theta_{max}}.$$

5. The multi-band shared-aperture antenna according to any one of claims 1 to 4, wherein a quantity n_2 of low-frequency ports in the low-frequency port group satisfies:

$n_2 * d \leq 0.5\lambda_2$, wherein

λ_2 is a wavelength corresponding to a low-frequency signal input by the low-frequency feed unit, n_2 is a positive integer, and d is the distance between the centers of every two adjacent coupled array elements.

6. The multi-band shared-aperture antenna according to claim 5, wherein if the maximum scanning angle of the multi-band shared-aperture antenna is θ_{max}, the quantity n_2 of low-frequency ports in the low-frequency port group satisfies:

$$n_2 * d \leq \frac{\lambda_2}{1+\sin\theta_{max}}.$$

7. The multi-band shared-aperture antenna according to any one of claims 1 to 6, wherein phase shift units further exist on the low-frequency feed unit and the high-frequency feed unit; and

each phase shift unit is configured to adjust phase lags/leads of electromagnetic waves radiated by the low-frequency feed unit and the high-frequency feed unit to specified phases corresponding to the coupled array element, and the phase shift unit is any one or more of the following structures: a digital phase shifter, an analog phase shifter, and a hybrid phase shifter.

8. The multi-band shared-aperture antenna according to any one of claims 1 to 7, wherein the coupled array element comprises at least one dipole array element, a polarization direction of the dipole array element is parallel to that of the coupled array element, and coupling capacitors exist on two sides of a tail end of the dipole array element.

9. The multi-band shared-aperture antenna according to claim 8, wherein when the coupled array element comprises two dipole array elements, the dipole array elements are disposed orthogonally.

10. The multi-band shared-aperture antenna according to any one of claims 1 to 9, wherein the

frequency combiner comprises any one or more of the following structures: a frequency divider, a duplexer, and a filter.

11. A communication device, comprising the multi-band shared-aperture antenna according to any one of claims 1 to 10.