In PTL 1, there is a description of an exemplary antenna for this type of communication apparatus. The technology described in PTL 1 is disposed with a plurality of antenna elements and is configured to have what is called diversity.

Citation List

Patent Literature

[0003]

PTL 1: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2009-514292

Summary of Invention

Technical Problem

[0004]

Meanwhile, technologies that use a comparatively wide band as the band used for wireless transmission in a wireless transmission system are increasing, and wide band technologies are desired as antennas for use with comparatively high frequency bands such as from several MHz to several GHz.

[0005]

Also, even for antennas having diversity, antennas having a simple and compact configuration with better diversity characteristics are desired.

[0006]

Embodiments of t~~T~~he present invention ~~takes as an object to~~ provide an

antenna apparatus having wide band characteristics.

Also, embodiments of the present invention ~~takes as an object to~~ provide an antenna apparatus having favorable diversity characteristics.

Solution to Problem

[0007]

In one aspect, there is provided an antenna apparatus including:

a first antenna element;

a second antenna element; and

a branch circuit to which the first antenna element and the second antenna element are coupled via respectively separate transmission lines; wherein a delay process is conducted on one of the transmission lines by modifying the lengths of the transmission line coupling the first antenna element to the branch circuit and the transmission line coupling the second antenna element to the branch circuit, thereby adjusting the input impedance and/or phase of the first and second antenna elements such that wider band characteristics than the antenna characteristics of the first and second antenna elements individually are configured, when the distance between a site where the absolute value is maximized over a current distribution of the first antenna element and a site where the absolute value is maximized over a current distribution of the second antenna element is taken to be the antenna-to-antenna distance, and when the length of a delay line produced due to a difference in the lengths of the two transmission lines is taken to be the delay line

distance, the absolute value of the difference between the antenna-to-antenna distance and the delay line distance is made equal to an integer multiple, equal to or greater than 0, of the wavelength of a frequency at which transmitting or receiving is conducted in the antenna apparatus, and the sum of the antenna-to-antenna distance and the delay line distance is made equal to an integer multiple, equal to or greater than 1, of the wavelength of a near-center frequency at which transmitting or receiving is conducted in the antenna apparatus.

In another aspect, there is provided a communication apparatus including an antenna apparatus, wherein

the antenna apparatus includes

a first antenna element,

a second antenna element, and

a branch circuit to which the first antenna element and the second antenna element are coupled via respectively separate transmission lines, and wherein a delay process is conducted on one of the transmission lines by modifying the lengths of the transmission line coupling the first antenna element to the branch circuit and the transmission line coupling the second antenna element to the branch circuit, thereby adjusting the input impedance and/or phase of the first and second antenna elements such that wider band characteristics than the antenna characteristics of the first and second antenna elements individually are configured, when the distance between a site where the absolute value is maximized over a current distribution of the first antenna

element and a site where the absolute value of maximized over a current distribution of the second antenna element is taken to be the antenna-to-antenna distance, and when the length of a delay line produced due to a difference in the lengths of the two transmission lines is taken to be the delay line distance, the absolute value of the difference between the antenna-to-antenna distance and the delay line distance is made equal to an integer multiple, equal to or greater than 0, of the wavelength of a frequency at which transmitting or receiving is conducted in the antenna apparatus, and the sum of the antenna-to-antenna distance and the delay line distance is made equal to an integer multiple, equal to or greater than 1, of the wavelength of a near-center frequency at which transmitting or receiving is conducted in the antenna apparatus.

Embodiments of t~~T~~he present invention provide~~is~~ an antenna apparatus that includes a first antenna element, a second antenna element, and a branch circuit to which the first antenna element and the second antenna element are coupled via respectively separate transmission lines.

Additionally, a delay process is conducted on one of the transmission lines by modifying the lengths of the transmission line coupling the first antenna element to the branch circuit and the transmission line coupling the second antenna element to the branch circuit.

[0008]

By conducting this delay adjustment, the input impedance and/or phase of the first and second antenna elements are adjusted, and wider band characteristics than the antenna characteristics of the first and second antenna elements individually are configured.

Advantageous Effects of Invention

[0009]

According to embodiments of the present invention, an antenna