

SUMMARY

One non-limiting and exemplary embodiment facilitates providing multi-band Uplink Orthogonal Frequency Division Multiple Access (OFDMA) based Random Access (UORA).

In one general aspect, the techniques disclosed here feature a station (STA) apparatus comprising: a receiver which, in operation, receives a Trigger frame allocating Random Access Resource Units (RA-RUs) over multiple bands, the Trigger frame including a first User Info field that comprises a first Band Indication subfield for specifying a first band among the multiple bands, a first RU Allocation subfield for indicating a first RA-RU of one or more contiguous RA-RUs in the first band specified by the first Band Indication subfield, and a first Number of RA-RU subfield for indicating a number of the contiguous RA-RUs minus one in the first band specified by the first Band Indication subfield; and a controller which, in operation: sets a first Orthogonal Frequency Division Multiple Access (OFDMA) random access backoff (OBO) counter to 0 if an initial value of the first OBO counter is not larger than a number of first eligible RA-RUs in the first band, which is a first subset of contiguous RA-RUs specified by the Trigger frame; and randomly selects one of the first eligible RA-RUs in the first band.

In another general aspect, the techniques described here feature a communication method for uplink Orthogonal Frequency Division Multiple Access (OFDMA) based random access, the method comprising: initializing a first Orthogonal Frequency Division Multiple Access (OFDMA) random access backoff (OBO) counter according to a first OFDMA Contention Window (OCW); receiving a Trigger frame having Random Access Resource Units (RA-RUs) over multiple bands, the Trigger frame including a first User Info field that comprises a first Band Indication subfield for specifying a first band among the multiple bands, a first RU Allocation subfield for indicating a first RA-RU of one or more contiguous RA-RUs in the first band specified by the first Band Indication subfield, and a first Number of RA-RU subfield for indicating a number of the contiguous RA-RUs minus one in the first band specified by the first Band Indication subfield; setting the first OBO counter to 0 if an initial value of the first OBO counter is not larger than a number of first eligible RA-RUs in the first band, which is a first subset of contiguous RA-RUs specified by the Trigger frame; and randomly selecting one of the first eligible RA-RUs in each of the multiple bands.

It should be noted that general or specific embodiments may be implemented as a system, a method, an integrated circuit, a computer program, a storage medium, or any selective combination thereof.

Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually

CLAIMS

1. A station (STA) apparatus comprising:
 - a receiver which, in operation, receives a Trigger frame allocating Random Access Resource Units (RA-RUs) over multiple bands,
 - the Trigger frame including a first User Info field that comprises a first Band Indication subfield for specifying a first band among the multiple bands, a first RU Allocation subfield for indicating a first RA-RU of one or more contiguous RA-RUs in the first band specified by the first Band Indication subfield, and a first Number of RA-RU subfield for indicating a number of the contiguous RA-RUs minus one in the first band specified by the first Band Indication subfield; and
 - a controller which, in operation:
 - sets a first Orthogonal Frequency Division Multiple Access (OFDMA) random access backoff (OBO) counter to 0 if an initial value of the first OBO counter is not larger than a number of first eligible RA-RUs in the first band, which is a first subset of contiguous RA-RUs specified by the Trigger frame; and
 - randomly selects one of the first eligible RA-RUs in the first band.
2. The STA apparatus of claim 1, wherein an RA-RU is determined to be eligible if the STA apparatus supports all transmit parameters indicated in a Common Info field of the Trigger frame and in the first User Info field of the Trigger frame corresponding to the RA-RU; and if the STA apparatus is not associated with a Basic Service Set (BSS) it intends to transmit to and a predetermined subfield of the first User Info field of the Trigger frame corresponding to the RA-RU is a first predetermined number.
3. The STA apparatus of claim 1, wherein an RA-RU is determined to be eligible if the STA apparatus supports all transmit parameters indicated in a Common Info field of the Trigger frame and in the first User Info field of the Trigger frame corresponding to the RA-RU; and if the STA apparatus is an associated communication apparatus and a Transmitter Address (TA) field of the Trigger frame is set to a BSS identifier (ID) of an associated BSS and a predetermined subfield of the first User Info field of the Trigger frame corresponding to the RA-RU is a second predetermined number.

4. The STA apparatus of claim 1, wherein the first OBO counter corresponds to the multiple bands.

5. The STA apparatus of claim 1, wherein
the Trigger frame includes a second Band Indication subfield for specifying a second band among the multiple bands, a second RU Allocation subfield for indicating a second RA-RU of one or more contiguous RA-RUs in the second band, and a second Number of RA-RU subfield for indicating a number of the contiguous RA-RUs minus one in the second band, and wherein a second subset of the contiguous RA-RUs specified by the Trigger frame constitutes second eligible RA-RUs in the second band, from which one eligible RA-RU is randomly selected, and

the STA further comprises:

a transmitter which, in operation, transmits a first Trigger Based Physical layer Protocol Data Unit (TB PPDU) in the selected first eligible RA-RU in the first band and transmits a second TB PPDU in the selected second eligible RA-RU in the second band if both the selected first eligible RA-RU in the first band and the selected second eligible RA-RU in the second band are considered to be idle, wherein the first and second TB PDUs carry a same Medium Access Control Protocol Data Unit (MPDU) or Aggregate MPDU.

6. The STA apparatus of claim 1, wherein a range of a first OFDMA Contention Window (OCW), which corresponds to the first OBO counter, is specific to the type of STA apparatus.

7. The STA apparatus of claim 6, wherein the first OBO counter corresponds to the first band.

8. The STA apparatus of claim 6, wherein a second Band Indication subfield further specifies a second band among the multiple bands, and

the controller, when in operation:

sets a second OBO counter to 0 if an initial value of the second OBO counter is not larger than a number of eligible RA-RUs in the second band; and

randomly selects one of the eligible RA-RUs in the second band for Trigger Based Physical layer Protocol Data Unit (TB PPDU) transmission;

wherein the second OBO counter is initialized according to a second OCW.

9. The STA apparatus of claim 8, wherein the range of the first OCW is specific to the first band and a range of the second OCW is specific to the second band.

10. The STA apparatus of claim 9, further comprising:
a transmitter which, in operation, transmits a first TB PPDU in the selected eligible RA-RU in the first band and a second TB PPDU in the selected eligible RA-RU in the second band if both the selected eligible RA-RUs are considered to be idle, wherein the first and second TB PPDU carry a same Medium Access Control Protocol Data Unit (MPDU), or a same Aggregated MPDU (A-MPDU), or different MPDUs, or different A-MPDUs.

11. The STA apparatus of claim 1, wherein the first User Info field includes a subfield that is set to a first predetermined value to indicate the RA-RU(s) allocated by the first User Info field are reserved for associated STA apparatuses operating in one of the multiple bands.

12. The STA apparatus of claim 11, wherein the subfield is set to a second predetermined value to indicate the RA-RU(s) allocated by the first User Info field are reserved for STA apparatuses which are operating in one of the multiple bands and are not associated with a BSS they intend to transmit to.

13. A communication method for uplink Orthogonal Frequency Division Multiple Access (OFDMA) based random access, the method comprising:
initializing a first Orthogonal Frequency Division Multiple Access (OFDMA) random access backoff (OBO) counter according to a first OFDMA Contention Window (OCW);
receiving a Trigger frame having Random Access Resource Units (RA-RUs) over multiple bands, the Trigger frame including a first User Info field that comprises a first Band Indication subfield for specifying a first band among the multiple bands, a first RU Allocation subfield for indicating a first RA-RU of one or more contiguous RA-RUs in the first band specified by the first Band Indication subfield, and a first Number of RA-RU subfield for indicating a number of the contiguous RA-RUs minus one in the first band specified by the first Band Indication subfield;

setting the first OBO counter to 0 if an initial value of the first OBO counter is not larger than a number of first eligible RA-RUs in the first band, which is a first subset of contiguous RA-RUs specified by the Trigger frame; and

randomly selecting one of the first eligible RA-RUs in each of the multiple bands.

14. The method of claim 13, further comprising:

randomly selecting one of eligible RA-RUs in a second band further specified by a second Band Indication subfield; and

transmitting a first Trigger Based Physical layer Protocol Data Unit (TB PPDU) carrying a Medium Access Control Protocol Data Unit (MPDU) or Aggregate MPDU in the selected eligible RA-RU in the first band and a second TB PPDU carrying the same MPDU or Aggregate MPDU in the selected eligible RA-RU in the second band if both the selected eligible RA-RUs are considered to be idle.

15. The method of claim 13, wherein a second Band Indication subfield further specifies a second band among the multiple bands, and the method further comprising:

initializing a second OBO counter according to a second OCW;

setting the second OBO counter to 0 if an initial value of the second OBO is not larger than a number of eligible RA-RUs in the second band, which is a second subset of the contiguous RA-RUs in the Trigger frame; and

randomly selecting one of the eligible RA-RUs in the second band for Trigger Based Physical layer Protocol Data Unit (TB PPDU) transmission.