

CLAIMS

WHAT IS CLAIMED IS:

1. — A method for wireless communication, comprising:

receiving, by a first integrated access and backhaul (IAB) node and from an upstream node in a wireless network, an indication of an uplink transmission timing advance for the IAB node to apply to uplink communications for transmitting the uplink communications to the upstream node, wherein the upstream node is one of an IAB donor or an upstream IAB node; receiving, by the IAB node and from the upstream node, a media access control (MAC) control element (CE) including an indication of a downlink transmission timing advance for the IAB node to apply for transmitting downlink communications to a downstream node; and

transmitting the downlink communications from the first node to the downstream node based on the MAC CE.

2. — ~~The method of claim 1~~, wherein the indication of the downlink transmission timing advance includes a value that is relative to ~~an uplink transmission timing advance, and the uplink transmission timing advance, and wherein the downstream node is one of a user equipment (UE) or a downstream IAB node; and transmitting the downlink communications from the IAB node to the downstream node based on the indication of the downlink transmission timing advance.~~

2. The method of claim 1, further comprising computing the downlink transmission timing advance based at least in part on the value and the uplink transmission timing advance.

3. — ~~The method of claim 21, further comprising receiving, by the first node, an indication of the uplink transmission timing advance for transmitting uplink communications to an upstream node.~~

4. — ~~The method of claim 3, further comprising:~~

: determining, based at least in part on the uplink transmission timing advance, a timing for transmission of the uplink communications to the upstream node; and transmitting the uplink communications from the IAB node to the upstream node based on the timing.

transmitting the uplink communications from the first node to the upstream node based on the timing.

5. — ~~4. The method of claim 31, wherein the indication of the downlink transmission timing advance is and the uplink transmission timing advance are received from the upstream node in the wireless network~~MAC CE.

6.—~~5.~~ The method of claim ~~5~~1 wherein the indication of the downlink transmission timing advance is received from an upstream access network function of the upstream node.

7.—~~6.~~ The method of claim ~~3~~1, wherein receiving the indication of the uplink transmission timing advance comprises receiving a separate MAC CE indicating the uplink transmission timing advance.

8.—~~The method of claim 3, wherein receiving the indication of the uplink transmission timing advance comprises receiving the MAC CE including both the indication of the downlink transmission timing advance and the indication of the uplink transmission timing advance.~~

9.—~~The method of claim 8.~~ The method of claim ~~4~~4, wherein a first number of bits and a second number of bits in the MAC CE are respectively used for the indication of the downlink transmission timing advance and the indication of the uplink transmission timing advance, and wherein the first number is different from the second number.

10.—~~8.~~ The method of claim ~~3~~1, further comprising:

 _determining a granularity of a timing advance (TA) command corresponding to the uplink transmission timing advance based at least in part on a subcarrier spacing associated with uplink transmissions; and

 _determining a timing for transmission of uplink data based at least in part on applying the uplink transmission timing advance to the granularity.

11.—~~9.~~ The method of claim ~~1~~1, further comprising:

 _determining a granularity of a timing advance (TA) command corresponding to the downlink transmission timing advance based at least in part on a subcarrier spacing associated with downlink transmissions; and

 _determining a timing for transmission of data based at least in part on applying the downlink transmission timing advance to the granularity.

12.—~~10.~~ The method of claim ~~1~~1, further comprising scheduling, based at least in part on the downlink transmission timing advance, transmission of the downlink communications to the downstream node.

13.—~~11.~~ The method of claim ~~1~~1, further comprising transmitting the indication of the downlink transmission timing advance to the downstream node.

14.—~~12.~~ The method of claim ~~1~~1, wherein receiving the MAC CE comprises receiving the MAC CE in at least one of a random access channel response message or a subsequent physical downlink shared channel (PDSCH).

15.—~~13.~~ The method of claim ~~1~~1, wherein receiving the indication of the downlink transmission timing advance is based at least in part on a raster used by the ~~first~~IAB node to transmit a random access preamble to an upstream node.

~~16.~~—14. The method of claim 1, wherein transmitting the downlink communications is based at least in part on determining a minimum timing gap from receiving the indication of the downlink transmission timing advance, wherein determining the minimum timing gap is based on at least one of a time for downlink shared data channel processing, a time for uplink shared data channel processing, a time required for timing advance, a time required to generate downlink shared data channel data, or a MAC processing latency.

~~17.~~—15. An apparatus for wireless communication, comprising:

~~_~~ a transceiver;

~~_~~ a memory configured to store instructions; and

~~_~~ one or more processors communicatively coupled with the transceiver and the memory,

wherein the one or more processors are configured to:

~~receive~~ receive, from an upstream node in a wireless network, an indication of an uplink transmission timing advance for the apparatus to apply to uplink communications for transmitting the uplink communications to the upstream node, wherein the upstream node is one of an integrated access and backhaul (IAB) donor or an upstream IAB node; receive, from the upstream node, a media access control (MAC) control element (CE) including an indication of a downlink transmission timing advance for the apparatus to apply for transmitting downlink communications to a downstream node; and

~~transmit the downlink communications to the downstream node based on the MAC CE.~~

~~18.~~—~~The apparatus of claim 17, wherein the indication of the downlink transmission timing advance includes a value that is relative to an~~the uplink transmission timing advance, and wherein the downstream node is one of a user equipment (UE) or a downstream IAB node; and transmit the downlink communications to the downstream node based on the indication of the downlink transmission timing advance.

16. The apparatus of claim 15, wherein the one or more processors are further configured to compute the downlink transmission timing advance based at least in part on the value and the uplink transmission timing advance.

~~19.~~—17. The apparatus of claim ~~18~~15, wherein the one or more processors are further configured to ~~receive an indication of the uplink transmission timing advance for transmitting uplink communications to an upstream node in a wireless network.~~

~~20.~~—~~The apparatus of claim 19, wherein the one or more processors are further configured to:~~

: determine, based at least in part on the uplink transmission timing advance, a timing for transmission of the uplink communications to the upstream node; and transmit the uplink communications to the upstream node based on the timing.

~~transmit the uplink communications to the upstream node based on the timing.~~

21.—~~18.~~ The apparatus of claim ~~19~~15, wherein the indication of the downlink transmission timing advance ~~is and the uplink transmission timing advance are~~ received from the upstream node in the ~~wireless network~~MAC CE.

22.—~~19.~~ The apparatus of claim ~~21~~15, wherein the indication of the downlink transmission timing advance is received from an upstream access network function of the upstream node.

23.—~~20.~~ The apparatus of claim ~~19~~15, wherein the one or more processors are configured to receive a separate MAC CE indicating the uplink transmission timing advance.

24.—~~The apparatus of claim 19, wherein the one or more processors are configured to receive the MAC CE including both the indication of the downlink transmission timing advance and the indication of the uplink transmission timing advance.~~

25.—~~The apparatus of claim 24~~21. The apparatus of claim 15, wherein a first number of bits and a second number of bits in the MAC CE are respectively used for the indication of the downlink transmission timing advance and the indication of the uplink transmission timing advance, and wherein the first number is different from the second number.

26.—~~22.~~ The apparatus of claim ~~19~~15, wherein the one or more processors are further configured to:

determine a granularity of a timing advance (TA) command corresponding to the uplink transmission timing advance based at least in part on a subcarrier spacing associated with uplink transmissions; and

determine a timing for transmission of uplink data based at least in part on applying the uplink transmission timing advance to the granularity.

27.—~~23.~~ The apparatus of claim ~~17~~15, wherein the one or more processors are further configured to:

determine a granularity of a timing advance (TA) command corresponding to the downlink transmission timing advance based at least in part on a subcarrier spacing associated with downlink transmissions; and

determine a timing for transmission of data based at least in part on applying the downlink transmission timing advance to the granularity.

~~28.~~—24. The apparatus of claim ~~17~~15, wherein the one or more processors are further configured to schedule, based at least in part on the downlink transmission timing advance, transmission of the downlink communications to the downstream node.

~~29.~~—25. The apparatus of claim ~~17~~15, wherein the one or more processors are further configured to transmit the indication of the downlink transmission timing advance to the downstream node.

~~30.~~—26. The apparatus of claim ~~17~~15, wherein the one or more processors are configured to receive the MAC CE in at least one of a random access channel response message or a subsequent physical downlink shared channel (PDSCH).

~~31.~~—27. The apparatus of claim ~~17~~15, wherein the one or more processors are configured to receive the indication of the downlink transmission timing advance based at least in part on a raster used by the apparatus to transmit a random access preamble to an upstream node.

~~32.~~—28. The apparatus of claim ~~17~~15, wherein the one or more processors are configured to transmit the downlink communications based at least in part on determining a minimum timing gap from receiving the indication of the downlink transmission timing advance, wherein the one or more processors are configured to determine the minimum timing gap based on at least one of a time for downlink shared data channel processing, a time for uplink shared data channel processing, a time required for timing advance, a time required to generate downlink shared data channel data, or a MAC processing latency.

~~33.~~—29. An apparatus for wireless communication, comprising:

means for receiving, from an upstream node in a wireless network, an indication of an uplink transmission timing advance for the apparatus to apply to uplink communications for transmitting the uplink communications to the upstream node, wherein the upstream node is one of an integrated access and backhaul (IAB) donor or an upstream IAB node; means for receiving, from the upstream node, a media access control (MAC) control element (CE) including an indication of a downlink transmission timing advance for the apparatus to apply for transmitting downlink communications to a downstream node; and

means for transmitting the downlink communications to the downstream node based on the MAC CE.

~~34.~~—The apparatus of claim 33, wherein the indication of the downlink transmission timing advance includes a value that is relative to ~~an~~the uplink transmission timing advance, and wherein the downstream node is one of a user equipment (UE) or a downstream IAB node; and means for transmitting the downlink communications to the downstream node based on the indication of the downlink transmission timing advance.

30. The apparatus of claim 29, further comprising means for computing the downlink transmission timing advance based at least in part on the value and the uplink transmission timing advance.

~~35.—31. The apparatus of claim 3429, further comprising means for receiving an indication of the uplink transmission timing advance for transmitting uplink communications to an upstream node.~~

~~36.—The apparatus of claim 35, further comprising:~~

~~; means for determining, based at least in part on the uplink transmission timing advance, a timing for transmission of the uplink communications to the upstream node; and means for transmitting the uplink communications to the upstream node based on the timing.~~

~~means for transmitting32. The apparatus of claim 29, wherein the indication of the downlink transmission timing advance and the uplink communications to transmission timing advance are received from the upstream node based on in the timingMAC CE.~~

~~33. The apparatus of claim 29, wherein the indication of the downlink transmission timing advance is received from an upstream access network function of the upstream node.~~

~~34. The apparatus of claim 29, wherein the means for receiving the indication of the uplink transmission timing advance receives the indication of the uplink transmission timing advance a separate MAC CE.~~

~~37.—35. A non-transitory computer-readable medium, comprising code executable by one or more processors for wireless communications, the code comprising code for:~~

~~receiving, by a first node in a wireless network receiving, by an integrated access and backhaul (IAB) node and from an upstream node in a wireless network, an indication of an uplink transmission timing advance for the IAB node to apply to uplink communications for transmitting the uplink communications to the upstream node, wherein the upstream node is one of an IAB donor or an upstream IAB node; receiving, by the IAB node and from the upstream node, a media access control (MAC) control element (CE) including an indication of a downlink transmission timing advance for transmitting downlink communications to a downstream node; and the IAB node to apply for transmitting downlink communications to a downstream node, wherein the indication of the downlink transmission timing advance includes a value that is relative to the uplink transmission timing advance, and wherein the downstream node is one of a user equipment (UE) or a downstream IAB node; and transmitting the downlink communications from the IAB node to the downstream node based on the indication of the downlink transmission timing advance.~~

~~transmitting the downlink communications from the first node to the downstream node based on the MAC CE.~~

~~38.—36. The non-transitory computer-readable medium of claim 37, wherein the indication of the downlink transmission timing advance includes a value that is relative to an uplink transmission timing advance, and35, further comprising code for computing the downlink transmission timing advance based at least in part on the value and the uplink transmission timing advance.~~

~~39.~~—~~37.~~ The non-transitory computer-readable medium of claim ~~38~~35, further comprising code for receiving, by the first node, an indication of the uplink transmission timing advance for transmitting uplink communications to an upstream node.

~~40.~~—The non-transitory computer-readable medium of claim ~~39~~, further comprising code for:
: determining, based at least in part on the uplink transmission timing advance, a timing for transmission of the uplink communications to the upstream node; and transmitting the uplink communications from the IAB node to the upstream node based on the timing.

~~transmitting~~38. The non-transitory computer-readable medium of claim 35, wherein the indication of the downlink transmission timing advance and the uplink communication transmission timing advance are received from the first upstream node to in the MAC CE.

39. The non-transitory computer-readable medium of claim 35, wherein the indication of the downlink transmission timing advance is received from an upstream access network function of the upstream node based on the timing.

40. The non-transitory computer-readable medium of claim 35, wherein the code for receiving the indication of the uplink transmission timing advance receives the indication of the uplink transmission timing advance a separate MAC CE.

~~41.~~—A method for wireless communication, comprising:

transmitting, by a first node to a downstream integrated access and backhaul (IAB) node, an indication of an uplink transmission timing advance for the downstream IAB node to apply for transmitting uplink communications to the first node, wherein the first node is one of an IAB donor or an upstream IAB node; and

transmitting, by the first node to the downstream IAB node, an indication of a downlink transmission timing advance for the downstream IAB node to apply for transmitting downlink communications from the downstream IAB node.

~~42.~~—The method of claim ~~41~~, wherein the indication of the downlink transmission timing advance includes a value that is relative to the uplink transmission timing advance.

~~43.~~—42. The method of claim 41, further comprising receiving, from the downstream IAB node, one or more uplink transmissions based on the uplink transmission timing advance.

~~44.~~—43. The method of claim 41, wherein transmitting the indication of the downlink transmission timing advance is based at least in part on a raster over which a random access channel request is received from the downstream IAB node.

44. The method of claim 41, wherein the indication of the downlink transmission timing advance and the uplink transmission timing advance are is transmitted in a same media access control (MAC) control element (CE).

45.—_An apparatus for wireless communication, comprising:

_a transceiver;

_a memory configured to store instructions; and

_one or more processors communicatively coupled with the transceiver and the memory,

wherein the one or more processors are configured to:

_transmit, to a downstream integrated access and backhaul (IAB) node, an indication of an uplink transmission timing advance for the downstream IAB node to apply for transmitting uplink communications to the apparatus; and

_transmit, to the downstream IAB node, an indication of a downlink transmission timing advance for the downstream IAB node to apply for transmitting downlink communications from the downstream IAB node.

~~46.—The apparatus of claim 45, wherein the indication of the downlink transmission timing advance includes a value that is relative to the uplink transmission timing advance.~~

47.—~~46.~~ The apparatus of claim 45, wherein the one or more processors are further configured to receive, from the downstream IAB node, one or more uplink transmissions based on the uplink transmission timing advance.

48.—~~47.~~ The apparatus of claim 45, wherein the one or more processors are configured to transmit the indication of the downlink transmission timing advance based at least in part on a raster over which a random access channel request is received from the downstream IAB node.

48. The apparatus of claim 45, wherein the indication of the downlink transmission timing advance and the uplink transmission timing advance are is transmitted in a same media access control (MAC) control element (CE).

49.—_An apparatus for wireless communication, comprising:

_means for transmitting, to a downstream integrated access and backhaul (IAB) node, an indication of an uplink transmission timing advance for the downstream IAB node to apply for transmitting uplink communications to the apparatus; and

_means for transmitting, to the downstream IAB node, an indication of a downlink transmission timing advance for the downstream IAB node to apply for transmitting downlink communications from the downstream IAB node.

~~50.—The apparatus of claim 49, wherein the indication of the downlink transmission timing advance includes a value that is relative to the uplink transmission timing advance.~~

~~51.—50.~~ The apparatus of claim 49, further comprising means for receiving, from the downstream IAB node, one or more uplink transmissions based on the uplink transmission timing advance.

~~52.—51.~~ The apparatus of claim 49, wherein the means for transmitting the indication of the downlink transmission timing advance transmits based at least in part on a raster over which a random access channel request is received from the downstream IAB node.

52. The apparatus of claim 49, wherein the indication of the downlink transmission timing advance and the uplink transmission timing advance are is transmitted in a same media access control (MAC) control element (CE).

~~53.—A non-transitory computer-readable medium, comprising code executable by one or more processors for wireless communications, the code comprising code for:~~

~~transmitting, by a first node to a downstream integrated access and backhaul (IAB) node, an indication of an uplink transmission timing advance for the downstream IAB node to apply for transmitting uplink communications to the first node; and~~

~~, wherein the first node is one of an IAB donor or an upstream IAB node; and~~
~~transmitting, by the first node to the downstream IAB node, an indication of a downlink transmission timing advance for the downstream IAB node to apply for transmitting downlink communications from the downstream IAB node.~~

~~54.—The non-transitory computer-readable medium of claim 53, wherein the indication of the downlink transmission timing advance includes a value that is relative to the uplink transmission timing advance.~~

~~55.—54.~~ The non-transitory computer-readable medium of claim 53, further comprising code for receiving, from the downstream IAB node, one or more uplink transmissions based on the uplink transmission timing advance.

~~56.—55.~~ The non-transitory computer-readable medium of claim 53, wherein the code for transmitting the indication of the downlink transmission timing advance transmits based at least in part on a raster over which a random access channel request is received from the downstream IAB node.

56. The non-transitory computer-readable medium of claim 53, wherein the indication of the downlink transmission timing advance and the uplink transmission timing advance are is transmitted in a same media access control (MAC) control element (CE).