

CLAIMS

1. A method (700) of transmitting device-generated synchronization signals from a wireless device (16) configured for operation in a wireless communication network (10), said method (700) comprising:

generating (702) the device-generated synchronization signals using at least a subset of the same sequences used by base stations (20) in the network (10) for generating network synchronization signals; and

transmitting (704) the device-generated synchronization signals according to a relative positioning or mapping that characteristically differs from a relative positioning or mapping used for transmitting the network synchronization signals ~~and thereby enabling a receiver to determine that the synchronization signals are device-generated synchronization signals, rather than the network synchronization signals~~ originating from any of the base stations (20) in the wireless communication network (10).

2. The method (700) of claim 1, wherein transmitting the device-generated synchronization signals includes transmitting primary and secondary device-generated synchronization signals according to an ordering that characteristically differs from an ordering used by the network (10) for the transmission of the primary and secondary network synchronization signals.

3. The method (700) of claim 2, wherein transmitting the primary and secondary device-generated synchronization signals comprises transmitting the primary device-generated synchronization signal, followed by transmission of the secondary device-generated synchronization signal, whereas, with respect to the transmission of the primary and secondary network synchronization signals from any given base station (20), transmission of the primary network synchronization signal follows transmission of the secondary network synchronization signal.

4. The method (700) of claim 1, wherein transmitting the device-generated synchronization signals include transmitting primary and secondary device-generated synchronization signals according to a spacing or distance that characteristically differs from a spacing or distance used by the network (10) for the transmission of primary and secondary network synchronization signals.

5. The method (700) of claim 1, wherein the network synchronization signals comprise primary and secondary network synchronization signals, with transmission of the secondary network synchronization signal characteristically mapped to a downlink carrier, and wherein transmitting the device-generated synchronization signals comprises transmitting primary and secondary device-generated synchronization signals, including mapping transmissions of the secondary device-generated synchronization signal to an uplink carrier.

6. The method (700) of any of claims 1-5, further comprising including or omitting one or more control fields in a Device-to-Device, D2D, broadcast control channel transmitted by the wireless device (16) in association with transmission of the device-generated synchronization signals, wherein the control field omissions or inclusions characteristically distinguish the D2D broadcast control channel from network broadcast control channel transmissions by any of the base stations (20) in association with their respective transmissions of the network synchronization signals.

7. The method (700) of any of claims 1–6, wherein the device-generated synchronization signals are transmitted in accordance with a relative positioning that characteristically differs from the relative positioning used for transmitting the network synchronization signals.

8. The method (700) of claim 7, wherein the device-generated synchronization signals are transmitted in accordance with additionally a relative mapping that characteristically differs from the relative mapping used for transmitting the network synchronization signals.

9. The method (700) of any of claims 1–8, wherein transmitting the device-generated synchronization signals includes transmitting secondary device-generated synchronization signals in accordance with a relative positioning or mapping that characteristically differs from the relative positioning or mapping used for transmitting the secondary network synchronization signals.

107. A wireless device (16) configured for operation in a wireless communication network (10) and comprising:

a communication interface (40) configured for transmitting signals to base stations (20) of the network (10) and for transmitting signals to other wireless devices (16);
and

a processing circuit (46) that is operatively associated with the communication interface (40) and configured to:

generate ~~the~~ device-generated synchronization signals using at least a subset of the same sequences used by the base stations (20) in the network (10) for generating network synchronization signals; and

transmit the device-generated synchronization signals according to a relative positioning or mapping that characteristically differs from a relative positioning or mapping used for transmitting the network synchronization signals ~~and thereby enabling a receiver to determine that the synchronization signals are device-generated synchronization signals, rather than the network synchronization signals~~ originating from any of the base stations (20) in the wireless communication network (10).

118. The wireless device (16) of claim 107, wherein the processing circuit (46) is configured to transmit the device-generated synchronization signals by transmitting primary and secondary device-generated synchronization signals according to an ordering that characteristically differs from an ordering used by the network for the transmission of primary and secondary network synchronization signals.

129. The wireless device (16) of claim 118, wherein the processing circuit (46) is configured to transmit the primary and secondary device-generated synchronization signals by transmitting the primary device-generated synchronization signal, followed by transmission of the secondary device-generated synchronization signal, whereas, with respect to the transmission of the primary and secondary network synchronization signals from any given base station (20), transmission of the primary network synchronization signal follows transmission of the secondary network synchronization signal.

1340. The wireless device (16) of claim 107, wherein the processing circuit (46) is configured to transmit the device-generated synchronization signals by transmitting primary and secondary device-generated synchronization signals according to a spacing or distance that characteristically differs from a spacing or distance used by the network (10) for the transmission of primary and secondary network synchronization signals.

1444. The wireless device (16) of claim 107, wherein the network synchronization signals comprise primary and secondary network synchronization signals, with transmission of the

secondary network synchronization signal characteristically mapped to a downlink carrier, and wherein the processing circuit (46) is configured to transmit the device-generated synchronization signals by transmitting primary and secondary device-generated synchronization signals, including mapping transmissions of the secondary device-generated synchronization signal to an uplink carrier.

1512. The wireless device (16) of any of claims 10–147–11, wherein the processing circuit (46) is further configured to include or omit one or more control fields in a Device-to-Device, D2D, broadcast control channel transmitted by the wireless device (16) in association with transmission of the device-generated synchronization signals, wherein the control field omissions or inclusions characteristically distinguish the D2D broadcast control channel from network broadcast control channel transmissions by any base stations (20) in association with their respective transmissions of the network synchronization signals.

16. The wireless device (16) of any of claims 10–15, wherein the processing circuit (46) is configured to transmit the device-generated synchronization signals in accordance with a relative positioning that characteristically differs from the relative positioning used for transmitting the network synchronization signals.

17. The wireless device (16) of claim 16, wherein the processing circuit (46) is configured to transmit the device-generated synchronization signals in accordance with a relative mapping that characteristically differs from the relative mapping used for transmitting the network synchronization signals.

18. The wireless device (16) of any of claims 10–17, wherein the processing circuit (46) is configured to transmit secondary device-generated synchronization signals in accordance with a relative positioning or mapping that characteristically differs from the relative positioning or mapping used for transmitting the secondary network synchronization signals.

13. ~~A method (600) in a wireless device (16) configured for operation in a wireless communication network (10), the method (600) comprising:~~
~~detecting (602) synchronization signals received at the wireless device (16);~~
~~deciding (604) from a relative positioning or mapping of the synchronization signals as to whether the synchronization signals are network synchronization signals~~

originating from a base station (20) in the network (10), or are device-generated synchronization signals originating from another wireless device (16); and processing the synchronization signals according to first processing procedures (606) when the synchronization signals are decided to be network synchronization signals, and according to second processing procedures (608) when the synchronization signals are decided to be device-generated synchronization signals.

14. — The method (600) of claim 13, wherein the second processing procedures (608) include attempting to decode a Physical Device-to-Device, D2D, Synchronization Channel, PD2DSCH, that is transmitted when the synchronization signals are device-generated synchronization signals, and processing one or more parameters obtained from decoding the PD2DSCH.

15. — The method (600) of claim 13 or 14, wherein the first processing procedures (606) include first rules for synchronizing one or more timings of the wireless device (16) with respect to network synchronization signals, and wherein the second processing procedures (608) include second rules for synchronizing one or more timings of the wireless device (16) with respect to device-generated synchronization signals.

16. — The method (600) of any of claims 13–15, wherein the synchronization signals include primary and secondary synchronization signals and wherein the step of deciding (604) includes deciding that the synchronization signals are device-generated synchronization signals rather than network synchronization signals, when a distance between the primary and secondary synchronization signals, as one aspect of said relative positioning, differs from a defined distance known to be used by base stations (20) operating in the Time Division Duplex, TDD, mode, or when an ordering of the primary and secondary synchronization signals, as another aspect of said relative positioning, differs from a defined ordering known to be used by base stations (20) operating in the Frequency Division Duplex, FDD, mode.

17. — The method (600) of any of claims 13–16, wherein the synchronization signals include primary and secondary synchronization signals and wherein the step of deciding (604) includes at least one of:

deciding that the synchronization signals do not originate from a base station (20) operating in Time Division Duplex, TDD, mode, when a distance between the primary and secondary synchronization signals, as one aspect of said relative

positioning, differs from a defined distance known to be used by base stations (20) operating in the TDD mode; or
deciding that the synchronization signals do not originate from a base station (20) operating in Frequency Division Duplex, FDD, mode, when an ordering of the primary and secondary synchronization signals, as another aspect of said relative positioning, differs from a defined ordering known to be used by base stations (20) operating in the FDD mode.

18. — A wireless device (16) configured for operation in a wireless communication network (10) and comprising:

a communication interface (40) configured for receiving signals from base stations (20) in the network (10) and from other wireless devices (16); and
a processing circuit (46) that is operatively associated with the communication interface (40) and configured to:
detect synchronization signals received at the wireless device (16);
decide from a relative positioning or mapping of the synchronization signals as to whether the synchronization signals are network synchronization signals originating from any of the base stations (20), or are device-generated synchronization signals originating from another wireless device (16); and
process the primary and secondary synchronization signals according to first processing procedures when the synchronization signals are decided to be network synchronization signals, and according to second processing procedures when the synchronization signals are decided to be device-generated synchronization signals.

19. — The wireless device (16) of claim 18, wherein, according to the second processing procedures, the processing circuit (46) is configured to attempt to decode a Physical Device-to-Device, D2D, Synchronization Channel, PD2DSCH, that is transmitted when the synchronization signals are device-generated synchronization signals, and to process one or more parameters obtained from decoding the PD2DSCH.

20. — The wireless device (16) of claim 18 or 19, wherein, according to the first processing procedures, the processing circuit (46) is configured to follow first rules for synchronizing one or more timings of the wireless device (16) with respect to network synchronization signals, and, according to the second processing procedures, to follow second rules for synchronizing one or

~~more timings of the wireless device (16) with respect to device-generated synchronization signals.~~

~~21. The wireless device (16) of any of claims 18-20, wherein the synchronization signals include primary and secondary synchronization signals and wherein the processing circuit (46) is configured to decide that the synchronization signals are device-generated synchronization signals rather than network synchronization signals when a distance between the primary and secondary synchronization signals, as one aspect of said relative positioning, differs from a defined distance known to be used by base stations (20) operating in the Time Division Duplex, TDD, mode, or when an ordering of the primary and secondary synchronization signals, as another aspect of said relative positioning, differs from a defined ordering known to be used by base stations (20) operating in the Frequency Division Duplex, FDD, mode.~~

~~22. The wireless device (16) of any of claims 18-21, wherein the synchronization signals include primary and secondary synchronization signals and wherein the processing circuit (46) is configured to:~~

~~decide that the synchronization signals do not originate from a base station (20) operating in Time Division Duplex, TDD, mode, when a distance between the primary and secondary synchronization signals, as one aspect of said relative positioning, differs from a defined distance known to be used by base stations (20) operating in the TDD mode; or~~

~~decide that the synchronization signals do not originate from a base station (20) operating in Frequency Division Duplex, FDD, mode, when an ordering of the primary and secondary synchronization signals, as another aspect of said relative positioning, differs from a defined ordering known to be used by base stations (20) operating in the FDD mode.~~