

CLAIMS:

1. A method performed by a network node (210) for sending to a wireless device (250) a first synchronization signal and an associated information message, for synchronization of the wireless device (250) with the network node (210), the network node (210) and the wireless device (250) operating in a wireless communications network (200), the method comprising:

sending (801) the first synchronization signal in N OFDM symbols within a subframe, at least once in a time and frequency position in every one of the N OFDM symbols, wherein N is equal or larger than 2, and,

for each sending of the first synchronization signal, *sending* (802) an associated information message at a pre-defined time and frequency position in an OFDM symbol, which pre-defined time and frequency position is relative to the time and frequency position of the first synchronization signal, and which associated information message is associated with the first synchronization signal; wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS; wherein the associated information message is different in each OFDM symbol wherein the associated information message is sent, wherein the associated information message comprises an index, and wherein a subframe timing is obtainable by the wireless device (250) by detecting the index; wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the subframe timing is obtainable by the wireless device (250) by detecting the sequence index comprised in the associated SSS.

- ~~2. The method of claim 1, wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS.~~

- ~~3.2.~~ The method of any of claim ~~1s~~ 1-2, wherein the associated information message comprises an associated

Physical Broadcast CHannel, PBCH, wherein the associated PBCH further comprises associated system information.

4.3. _____ The method of claim 1 or claim 2~~any of claims 1-3~~, wherein the first synchronization signal is sent in a beam state, and wherein the associated information message is sent using the same beam state as the first synchronization signal associated with the associated information message.

~~5. The method of any of claims 1-4, wherein the associated information message is different in each OFDM symbol wherein the associated information message is sent, wherein the associated information message comprises an index, and wherein a subframe timing is obtainable by the wireless device (250) by detecting the index.~~

~~6. The method of any of claims 1-4, wherein the associated information message is the same in each OFDM symbol wherein the associated information message is sent within a subframe, and wherein the associated information message is different in each subframe wherein the associated information message is sent within a transmitted frame, wherein the associated information message comprises an index, and wherein a frame timing is obtainable by the wireless device (250) by detecting the index.~~

~~7. The method of claims 2 and 5, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the subframe timing is obtainable by the wireless device (250) by detecting the sequence index comprised in the associated SSS.~~

~~8. The method of any of claims 2 and 6, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the frame timing is obtainable by the wireless device (250) by detecting the sequence index comprised in the associated SSS.~~

9.4. _____ A method performed by a wireless device (250) for detecting a first synchronization signal and an associated information message sent by a network node (210) for synchronization of the wireless device (250) with the network node (210), the network node (210) and the

wireless device (250) operating in a wireless communications network (200), the method comprising:

detecting (901) the first synchronization signal, wherein the first synchronization signal has been sent by the network node (210) in N OFDM symbols within a subframe, at least once in a time and frequency position in every one of the N OFDM symbols, wherein N is equal or larger than 2, and,

detecting (903) the associated information message at a pre-defined time and frequency position, which pre-defined time and frequency position is relative to the time and frequency position of the detected first synchronization signal, which associated information message is associated with the first synchronization signal; and

obtaining (904) subframe timing and/or frame timing by detecting an index comprised in the associated information message; wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS; wherein the associated information message is different in each OFDM symbol wherein the associated information message is sent by the network node (210), wherein the associated information message comprises an index, and wherein a subframe timing is obtained by the wireless device (250) by detecting the index.

~~10. The method of claim 9, wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS.~~

~~11.5.~~ _____ The method of claim ~~4~~10, wherein detecting the associated information message comprises matching a sequence of the detected associated information message to one of a set of possible information message sequences.

~~12.6.~~ _____ The method of ~~claim 4 or claim 5~~any of any of claims 9-11, wherein the associated information message comprises an associated Physical Broadcast CHannel, PBCH, wherein the associated PBCH further comprises associated system information.

13. ~~The method of any of claims 9-12, wherein the associated information message is different in each OFDM symbol wherein the associated information message is sent by the network node (210), wherein the associated information message comprises an index, and wherein a subframe timing is obtained by the wireless device (250) by detecting the index.~~

14. ~~The method of any of claims 9-12, wherein the associated information message is the same in each OFDM symbol wherein the associated information message is sent by the network node (210) within a subframe, and wherein the associated information message is different in each subframe wherein the associated information message is sent by the network node (210) within a transmitted frame, wherein the associated information message comprises an index, and wherein a frame timing is obtained by the wireless device (250) by detecting the index.~~

15.7. _____ The method of claim ~~4s~~ 11 and 13, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the subframe timing is obtained by the wireless device (250) by detecting the sequence index comprised in the associated SSS.

16. ~~The method of any of claims 11 and 14, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the frame timing is obtained by the wireless device (250) by detecting the sequence index comprised in the associated SSS.~~

17.8. _____ The method of claims 12 and ~~13~~ 14 and ~~7~~ 15, wherein the associated information message comprises the associated system information, and wherein the frame timing is obtained by the wireless device (250) by detecting the index comprised in the associated system information.

18.9. _____ A network node (210) configured to send to a wireless device (250) a first synchronization signal and an associated information message, for synchronization of the wireless device (250) with the network node (210), the network node (210) and the wireless device (250)

being configured to operate in a wireless communications network (200), the network node (210) being configured to:

send the first synchronization signal in N OFDM symbols within a subframe, at least once in a time and frequency position in every one of the N OFDM symbols, wherein N is equal or larger than 2, and,

for each sending of the first synchronization signal, send an associated information message at a pre-defined time and frequency position in an OFDM symbol, which pre-defined time and frequency position is relative to the time and frequency position of the first synchronization signal, and which associated information message is associated with the first synchronization signal; wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS; wherein the associated information message is different in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210), wherein the associated information message comprises an index, and wherein a subframe timing is obtainable by the wireless device (250) by detecting the index.

~~19. The network node (210) of claim 18, wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS.~~

~~20.10.~~_____ The network node (210) of any of claim ~~9-18-19~~, wherein the associated information message comprises an associated Physical Broadcast CHannel, PBCH, wherein the associated PBCH further comprises associated system information.

~~21.11.~~_____ The network node (210) of any of claims ~~9-10-18-20~~, wherein the network node (210) is further configured to send the first synchronization signal in a beam state, and to send the associated information message using the same beam state as the first synchronization signal associated with the associated information message.

22. The network node (210) of any of claims 18-21, wherein the associated information message is different in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210), wherein the associated information message comprises an index, and wherein a subframe timing is obtainable by the wireless device (250) by detecting the index.

23. The network node (210) of any of claims 18-21, wherein the associated information message is the same in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210) within a subframe, and wherein the associated information message is different in each subframe wherein the associated information message is configured to be sent by the network node (210) within a transmitted frame, wherein the associated information message comprises an index, and wherein a frame timing is obtainable by the wireless device (250) by detecting the index.

24.12. _____ The network node (210) of claim 9s 19 and 22, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the subframe timing is obtainable by the wireless device (250) by detecting the sequence index comprised in the associated SSS.

25. The network node (210) of any of claims 19 and 23, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the frame timing is obtainable by the wireless device (250) by detecting the sequence index comprised in the associated SSS.

26.13. _____ A wireless device (250) configured to detect a first synchronization signal and an associated information message configured to be sent by a network node (210), for synchronization of the wireless device (250) with the network node (210), the network node (210) and the wireless device (250) being configured to operate in a wireless communications network (200), the wireless device (250) being configured to:

detect the first synchronization signal, wherein the first synchronization signal is configured to have been sent by the network node (210) in N OFDM symbols within a subframe, at least once in a time and frequency position in every one of the N OFDM symbols, wherein N is equal or larger than 2, and,

detect the associated information message at a pre-defined time and frequency position, which pre-defined time and frequency position is relative to the time and frequency position of the detected first synchronization signal, and which associated information message is associated with the first synchronization signal; and

obtain subframe timing and/or frame timing by detecting an index comprised in the associated information message; wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS; wherein the associated information message is different in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210), wherein the associated information message comprises an index, and wherein the wireless device (250) is further configured to obtain a subframe timing by detecting the index.

~~27. The wireless device (250) of claim 26, wherein the first synchronization signal is a Primary Synchronization Signal, PSS, and wherein the associated information message comprises an associated second synchronization signal, wherein the second synchronization signal is a Secondary Synchronization Signal, SSS.~~

~~28.14.~~ _____ The wireless device (250) of claim ~~13~~27, wherein to detect the associated information message comprises to match a sequence of the detected associated information message to one of a set of possible information message sequences.

~~29.15.~~ _____ The wireless device (250) of any of claims ~~13-14~~26-28, wherein the associated information message comprises an associated Physical Broadcast CHannel, PBCH, wherein the associated PBCH further comprises associated system information.

~~30. The wireless device (250) of any of claims 26-29, wherein the associated information message is different in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210), wherein the associated information message comprises an index, and wherein the wireless~~

~~device (250) is further configured to obtain a subframe timing by detecting the index.~~

5 ~~31. The wireless device (250) of any of claims 26-29, wherein the associated information message is the same in each OFDM symbol wherein the associated information message is configured to be sent by the network node (210) within a subframe, and wherein the associated information message is different in each subframe wherein the associated information message is configured to be sent by the network node (210) within a transmitted frame, wherein the associated~~
 10 ~~information message comprises an index, and wherein the wireless device (250) is further configured to obtain a frame timing by detecting the index.~~

~~32.16.~~ _____ The wireless device (250) of
 15 ~~claim 13s 27 and 30, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the wireless device (250) is further configured to obtain the subframe timing by detecting the sequence index comprised in the associated SSS.~~

20 ~~33. The wireless device (250) of any of claims 27 and 31, wherein the associated information message comprises the associated SSS, wherein the index is a sequence index, and wherein the wireless device (250) is further configured to obtain the frame timing by detecting the sequence index comprised in the associated SSS.~~

25 ~~34. The wireless device (250) of claims 29 and 31 and 33, wherein the associated information message comprises the associated system information, and wherein the wireless device (250) is further configured to obtain the frame timing by detecting the index comprised in the associated system information.~~

30 ~~35. Computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 1 to 8.~~

35 ~~36. A computer readable storage medium, having stored thereon a computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 1 to 8.~~

~~37. Computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 9 to 17.~~

~~38. A computer-readable storage medium, having stored thereon a computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 9 to 17.~~