INITIAL CELL SEARCH PROCEDURE

FIELD

[0001] Various example embodiments relate generally to wireless networking and, more particularly, to access procedures in wireless networking.

BACKGROUND

[0002] Wireless networking provides significant advantages for user mobility. A users' ability to remain connected while on the move provides advantages not only for the user, but also provides greater efficiency and productivity for society as a whole. As user expectations for connection reliability, data speed, and device battery life, become more demanding, technology for wireless networking must also keep pace with such expectations. Accordingly, there is continuing interest in improving wireless networking technology.

SUMMARY

[0003] In a first aspect of the present disclosure, a user equipment apparatus comprises means for performing an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster, wherein the synchronization raster includes a cluster of three raster points positioned every 600 kHz.

[0004] In an example of the present disclosure, the synchronization raster points in each cluster may include frequency offsets from each other of 50 kHz, 150 kHz, and/or 250 kHz, apart from the 600 kHz.

[0005] In an example of the present disclosure, a range of synchronization raster points to be scanned may start at 120 kHz from an existing synchronization raster point to avoid overlapping with existing synchronization raster points valid for other existing channel bandwidth.

[0006] In an example of the present disclosure, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to scan through a first range of the plurality of SSB entries, where a first range of synchronization raster points is given by: (N * 1200 kHz) + (M* 50kHz), scan through a second

range of the plurality of SSB entries, where a second range of synchronization raster points is given by: 600 kHz + (N * 1200 kHz) + (M * 50 kHz), and scan through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by: 120 kHz + (N * 1200 kHz) + (M * 50 kHz), where values of N range from 1 to 2499, and values of M are 1, 3, and 5.

[0007] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to scan through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by: 600 kHz + (N * 1200 kHz) + (M * 50 kHz), and scan through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by: 120 kHz + (N * 1200 kHz) + (M * 50 kHz), where values of N range from 1 to 2499, and values of M are 1, 3, and 5.

[0008] In an example of the present disclosure, for synchronization raster points in the first range of the plurality of SSB entries, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to apply twenty physical resource block (PRB) unpunctured allocations for a physical broadcast channel (PBCH).

[0009] In an example of the present disclosure, for synchronization raster points in the second range or third range of the plurality of SSB entries, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to apply a plurality of PRB allocations for one or more puncturing patterns.

[0010] In an example of the present disclosure, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the instructions when executed by the at least one processor, may further cause the user equipment apparatus to search the synchronization raster points which are 600 kHz and 120 kHz higher than the synchronization raster points in the first range of synchronization raster points.

[0011] In an example of the present disclosure, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the instructions when executed by the at least one processor, may further cause the user equipment apparatus to: search the first range of synchronization raster points for the SSB, determine if the SSB is within the first range of synchronization raster points, and search the second range and third ranges of synchronization raster points based on the determination that the SSB is not located in the first range.

[0012] In an example of the present disclosure, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to search the first range of synchronization raster points and the second and third ranges of synchronization raster points together with an ascending order or a descending order in a frequency domain.

[0013] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the instructions, when executed by the at least one processor, may further cause the user equipment apparatus to scan through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by: 120 kHz + (N * 600 kHz) + (M * 50 kHz), where for the second range the values of N range from 2 to 4999, and the values of M are 1, 3, and 5.

[0014] In a second aspect of the present disclosure, a method in a user equipment apparatus comprises performing an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster, wherein the synchronization raster includes a cluster of three synchronization raster points positioned every 600 kHz.

[0015] In an example of the present disclosure, the synchronization raster points may include frequency offsets from each other of 50 kHz, 150 kHz, and/or 250 kHz, apart from the 600 kHz.

[0016] In an example of the present disclosure, a range of synchronization raster points to be scanned may start at 120 kHz from an existing synchronization raster point to avoid overlapping with existing synchronization raster points valid for other existing channel bandwidth.

[0017] In an example of the present disclosure, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the scanning may include scanning through a first range of the plurality of SSB entries, where a first range of synchronization raster points is given by (N * 1200 kHz) + (M* 50kHz), scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by 600 kHz + (N * 1200 kHz) + (M * 50 kHz); and scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by: 120 kHz + (N * 1200 kHz) + (M * 50 kHz), where the values of N range from 1 to 2499, and the values of M are 1, 3, and 5.

[0018] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the scanning may include scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by 600 kHz + (N * 1200 kHz) + (M * 50 kHz); and scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by: 120 kHz + (N * 1200 kHz) + (M * 50 kHz), where the values of N range from 1 to 2499, and the values of M are 1, 3, and 5.

[0019] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the scanning may include scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by: 120 kHz + (N * 600 kHz) + (M * 50 kHz), where for the second range the values of N range from 2 to 4999, and the values of M are 1, 3, and 5.

[0020] In a third aspect of the present disclosure, one or more non-transitory processor-readable media storing instructions which, when executed by one or more processors, cause a user equipment apparatus to perform an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster, and wherein the synchronization raster includes a cluster of three synchronization raster points positioned every 600 kHz.

[0021] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the scanning may further include: scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by 600 kHz + (N * 1200 kHz) + (M * 50 kHz); and scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by 120 kHz + (N * 1200 kHz) + (M * 50 kHz), wherein the values of N range from 1 to 2499, and the values of M are 1, 3, and 5.

[0022] In an example of the present disclosure, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the scanning may further include scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by 120 kHz + (N * 600 kHz) + (M * 50 kHz), where for the second range the values of N range from 2 to 4999, and the values of M are 1, 3, and 5.

[0023] According to some examples, there is provided the subject matter of the independent claims. Some further examples are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Some example embodiments will now be described with reference to the accompanying drawings.

[0025] FIG. 1 is a diagram of an example embodiment of wireless networking between a network and a user equipment (UE) apparatus, according to one illustrated aspect of the disclosure;

[0026] FIG. 2 illustrates an example embodiment of components of a user equipment apparatus or of a network, according to one illustrated aspect of the disclosure;

[0027] FIG. 3 illustrates a diagram of a Signal Synchronization Block (SSB), according to one illustrated aspect of the disclosure;

[0028] FIG. 4 illustrates an example embodiment of a flow diagram for a user equipment apparatus operation, according to one illustrated aspect of the disclosure;

[0029] FIG. 5 is a table illustrating an example embodiment of an offset between each of the synchronization raster points and the channel raster points used by the UE apparatus for a 5 MHz channel bandwidth, according to one illustrated aspect of the disclosure;

[0030] FIGS. 6A and 6B are a table illustrating an example embodiment of an offset between each of the synchronization raster points and the channel raster points used by the UE apparatus for a 3 MHz channel bandwidth, according to one illustrated aspect of the disclosure;

[0031] FIGS. 7A and 7B are a table illustrating an example embodiment of the offset between each of the synchronization raster points and the channel raster points used by the UE apparatus for a 3 MHz bandwidth, for a second range for a first example embodiment, according to one illustrated aspect of the disclosure;

[0032] FIGS. 8A and 8B are a table illustrating an example embodiment of the offset between shifted synchronization raster points and the channel raster points used by the UE apparatus for a 3 MHz bandwidth, for a third range for the first example embodiment, according to one illustrated aspect of the disclosure;

[0033] FIG. 9 is a diagram illustrating an example embodiment of a physical broadcast channel (PBCH) puncturing pattern for a 150 kHz frequency offset between synchronization raster points and channel raster points, according to one illustrated aspect of the disclosure;

CLAIMS:

1. A user equipment apparatus comprising:

means for performing an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster, and

wherein the synchronization raster includes a cluster of three synchronization raster points positioned every 600 kHz.

2. The user equipment apparatus of claim 1, wherein the synchronization raster points in each cluster include frequency offsets of at least one of 50 kHz, 150 kHz, or 250 kHz.

3. The user equipment apparatus of claim 1 or 2, wherein a range of synchronization raster points to be scanned starts at 120 kHz from an existing synchronization raster point to avoid overlapping with existing synchronization raster points valid for other existing channel bandwidth.

4. The user equipment apparatus of any one of claims 1-3, wherein, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the user equipment further comprises:

means for scanning through a first range of the plurality of SSB entries, where a first range of synchronization raster points is given by:

(N * 1200 kHz) + (M* 50kHz),

scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by:

600 kHz + (N * 1200 kHz) + (M * 50 kHz), and

scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by:

120 kHz + (N * 1200 kHz) + (M * 50 kHz),

wherein values of N range from 1 to 2499, and

wherein values of M are 1, 3, and 5.

5. The user equipment apparatus of any one of claims 1-3, wherein, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the user equipment further comprises:

means for scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by:

600 kHz + (N * 1200 kHz) + (M * 50 kHz), and

scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by:

120 kHz + (N * 1200 kHz) + (M * 50 kHz),

wherein values of N range from 1 to 2499, and

wherein values of M are 1, 3, and 5.

6. The user equipment apparatus of claim 4, wherein, for synchronization raster points in the first range of the plurality of SSB entries, the user equipment further comprises:

means for applying twenty physical resource block, PRB, unpunctured allocations for a physical broadcast channel, PBCH, detection.

7. The user equipment apparatus of claim 5, wherein for synchronization raster points in the second range or third range of the plurality of SSB entries, the user equipment further comprises:

means for applying a plurality of PRB allocations for one or more puncturing patterns.

8. The user equipment apparatus of any one of claims 1-3, wherein, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the user equipment further comprises:

means for searching the synchronization raster points which are 600 kHz and 120 kHz higher than the synchronization raster points in a first range of synchronization raster points.

9. The user equipment apparatus of claim 4, wherein, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the user equipment further comprises:

means for searching the first range of synchronization raster points for the SSB;

means for determining if the SSB is within the first range of synchronization raster points; and

means for searching the second range and third ranges of synchronization raster points based on the determination that the SSB is not located in the first range.

10. The user equipment apparatus of claim 4, wherein, in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the user equipment further comprises:

means for searching the first range of synchronization raster points and the second and third ranges of synchronization raster points together with an ascending order or a descending order in a frequency domain.

11. The user equipment apparatus of any one of claims 1-3, wherein, in the case that the user equipment apparatus supports a 3 MHz channel bandwidth, the user equipment further comprises:

means for scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by:

120 kHz + (N * 600 kHz) + (M * 50 kHz),

wherein for the second range values of N range from 2 to 4999, and

wherein the values of M are 1, 3, and 5.

12. A method in a user equipment apparatus, the method comprising:

performing an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster, and

wherein the synchronization raster includes a cluster of three synchronization raster points positioned every 600 kHz.

13. The method of claim 12, wherein the synchronization raster points include frequency offsets of at least one of 50 kHz, 150 kHz, or 250 kHz.

14. The method of claim 12 or 13, wherein in the case that the user equipment apparatus supports both a 3 MHz channel bandwidth and a 5 MHz channel bandwidth, the scanning includes:

scanning through a first range of the plurality of SSB entries, where a first range of synchronization raster points is given by:

(N * 1200 kHz) + (M* 50kHz),

scanning through a second range of the plurality of SSB entries, where a second range of synchronization raster points is given by:

600 kHz + (N * 1200 kHz) + (M * 50 kHz),

scanning through a third range of the plurality of SSB entries, where a third range of synchronization raster points is given by:

120 kHz + (N * 1200 kHz) + (M * 50 kHz),

wherein values of N range from 1 to 2499, and

wherein values of M are 1, 3, and 5.

15. One or more non-transitory processor-readable media storing instructions which, when executed by one or more processors, cause a user equipment apparatus to:

perform an initial cell search of one or more cells on a network, wherein performing the initial cell search includes scanning through a plurality of synchronization signal block, SSB, entries with a synchronization raster; and

wherein the synchronization raster includes a cluster of three synchronization raster points positioned every 600 kHz.