Figs, 1a, 1c, 2 illustrate embodiments described herein.

Fig. 3 illustrates a base station transmission according to any embodiment of the invention.

Fig. 4 illustrates a P5Sc transmission according to any embodiment of the invention.

Fig. 5 illustrates a base station transmission received by the modem according to any embodiment of the invention.

Fig. 6 illustrates the internal structure of the P5Sc, according to certain embodiments.

Figs, 7a - 7c, 8a – 8b, 9a - 9b illustrate embodiments described herein.

Figs. 10a – 10c each show a standard (in Fig. 10a) modem/smartphone with a modem chipset, associated with a P5Sc according to certain embodiments. The smartphone, in Fig. 10b, has a splitter and in Fig. 10c has a pair of external antenna connectors, indicated as circles in the drawing.

Figs, 11a - 11c illustrate embodiments described herein.

Also shown is the P5Sc's flow diagram according to certain embodiments.

Also shown are three hardware architectures respectively where Architecture A. is external to the phone's case; Architecture B is onboard, but external to the chip; and Architecture C.is internal – all private network functionality being provided internally, by the modem chip itself which stores logic and data as described herein and is configured to perform functionalities shown and described herein.

Methods and systems included in the scope of the present invention may include some (e.g. any suitable subset) or all of the functional blocks shown in the specifically illustrated implementations by way of example, in any suitable order e.g. as shown.

Computational, functional or logical components described and illustrated herein can be implemented in various forms, for example, as hardware circuits such as but not limited to custom VLSI circuits or gate arrays or programmable hardware devices such as but not limited to FPGAs, or as software program code stored on at least one tangible or intangible computer readable medium and executable by at least one processor, or any suitable combination thereof. A specific functional component may be formed by one particular sequence of software code, or by a plurality of such, which collectively act or behave or act as described herein with reference to the

A network may have just one, private network mode. Or, a network may have several modes: public, private, both (combined) -- which are manually or automatically selectable.

In combined mode, the network may function as a standard network whose base stations transmit standard LTE synchronization or other control signals, or the network may function as a private network in which its base station transmit modified/different synchronization or control signals.

The P5S has the capability to identify, by itself, if the base station transmits modified or standard control signals. The process may be that the P5S matches/correlates the received synchronization signal (or other control signal) with the standard sequences. If the received synchronization signal is standard, the P5S does nothing. If the P5S does not match/correlate the standard signal/sequence, the P5S correlates to the non-standard sequences. After the correlation process, the P5S continues to be synchronized with the base station, and, in parallel, extracts the information from these control signals, converts this information to the appropriate standard signals and transmits these signals. In the case of synchronization signals, the P5S may extract the PCI (Physical Cell ID) and transmit this parameter in a PSS/SSS combination that fits this PCI.

This operation is related to all the base stations of its network which are identifies by the PLMN (Public Land Mobile Network Code) prior art

Typically in combined mode both the standard portion and the converted portion are transmitted together. In that mode regular modems (without P5S) and modified modems (with P5S) can both receive the transmission correctly. The mode selector may select to transmit at the relevant portion the standard signal or the non-standard signal or both (e.g. addition of these two].

A network may automatically select which of the above modes to activate –for example if the network detects a potential situation of interference or situation that only the dedicated modems needs to detect the base station then the non-standard signal transmission mode may be activated

To transit between the modes the mode selector typically changes the signal it takes.

It is appreciated that the above may be implemented by any of the 3 hardware embodiments presented in figs. 9a – 9~~e~~b.

Any suitable method may be employed to revert from private mode back to public mode. For example, the P5S may periodically (e.g. every frame) correlate the modified control signals to the modified sequences. In the event that there is no correlation, the P5S correlates the modified control signals to the standard sequences. In the event that there is a match with the standard sequence the P5S reverts to the normal/standard/non-private mode and stops transmitting its signals.

~~Three h~~Hardware architectures are shown in Figs. 9a, 9b, ~~9c~~ respectively.

Architecture A. is external to the phone's case. An external device may be added to any cased phone (or laptop modem dongle) that supplies a port that supports connection of the internal modem via connector/s and the port, to an external antenna. The external device will include an external antenna coupled to a board/module/add-on which is connected via the provided port to the cased phone's modem, just as a conventional external antennae would be.

Architecture B is onboard, external to the chip :

For future phones (or tablet, laptop) which support this, a board/module/add-on may be added on the phone's main board, between the phone's antenna and modem.

There is no smartphone known at this time, that supports an onboard circuit board, but there are modems to which such a board may be added. Such a configuration is depicted in Fig 8A.

The connection to a smartphone may be as shown in Fig. 8c. Many smartphones have U.FL (or other) connectors for external connection to antennae. In such a case, if the external antenna is connected, the internal antennas are automatically disconnected.

In the event that the P5S contains separate antennas, a calibration function may be implemented. The P5S may then extract the measured RSSI RSRP of the standard modem/smartphone and suitably obtain this information via AT Commands or Smartphone application. Depending on whether the RSSI RSRP measurement power is high or low, the calibration function will then decrease or increase the transmission power of the P5S.

Typically for both architectures a, b:

The board/module/add-on typically includes connectors to the antenna and to the modem. The connectors (and typically associated adaptors) match the hardware of the phone's antenna and modem e.g. may be RC connectors/ RF connectors/USL

CLAIMS

1.A method for converting a conventional cellular network into a private cellular network, wherein the conventional network includes nodes equipped with conventional modems operating in accordance with a cellular communication protocol ~~e.g. LTE and storing first orthogonal sequences~~, the method comprising ~~all or any subset of the following~~:

~~C~~coupling a device ~~(e.g. an external device)~~ to each node in the conventional network, which is desired to belong to the private cellular network, and not to any nodes in the conventional network, which are not desired to belong to the private cellular network;

wherein the device stores second orthogonal sequences which differ from the first orthogonal sequences hence are not hard-coded in the conventional modems, and

wherein the device stores a one-to-one correspondence enabling translation of each of the second orthogonal sequences, to one of the first sequences hard-coded in the modems,

and wherein, at least when in a private network supporting mode, a device associated with a transmitting node desired to belong to the private network, uses a processor to determine which of the first orthogonal sequences is being used, translate the first orthogonal sequence being used using the stored one-to-one correspondence into one of the second orthogonal sequences, and use the translated sequence to transmit a synchronization signal, thereby to transmit a synchronization signal which uses one of the second orthogonal sequences, that are not hard-coded in protocol modems, thereby to transmit a synchronization signal which is noticeable and understandable to modems associated with the ~~external~~ device but not to modems not associated with the ~~external~~ device such that only modems associated with the ~~external~~ device can synchronize themselves to the private network and modems not associated with the ~~external~~ device cannot synchronize themselves to the private network.

2. ~~A~~The method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein a non-private ~~(aka public)~~ network supporting mode is also provided, in which a~~-~~ modem, when transmitting, uses the hard-coded sequence, not the non-hard-coded sequence in one-to-one correspondence therewith, to transmit synchronization signals.

3. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein a combined mode which supports both a private network and a public network is provided, and wherein a modem, when transmitting, ~~-~~uses, in parallel, both a hard-coded sequence, and the non-hard-coded sequence in one-to-one correspondence therewith, to transmit synchronization signals.

4. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein the ~~external~~ device~~s~~ includes Primary Synchronization Signal (PSS) and Secondary Synchronization Signal (SSS) functionality and wherein the device and the standard PSS and SSS have the same networking information.

5. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein the ~~external~~ device includes Primary Synchronization Signal (PSS) and Secondary Synchronization Signal (SSS) functionality, and wherein the device and the standard PSS and SSS have the same PCI.

6. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein the ~~external~~ device is configured for conversion of non-standard over-the-air control signals carrying LTE networking information, -to standard signals that carry the same LTE networking information carried in the non-standard control signals, and wherein the LTE networking information carried by every specific LTE control signal is typically not changed by the ~~external~~ device.

7. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein the functionality is stored in a ~~board~~/module~~/add-on~~ housed in a mechanical member ~~added to each modem~~, where the modem has an antenna and ~~includes~~ a board house~~s~~~~ing~~ the modem and the antenna, and wherein the mechanical member is external to the board and includes an additional antenna ~~(it is known in the art to~~

~~ensure that the additional antenna is used rather than the original antenna (on the board).~~.

8. The~~A~~ method according to ~~any one of the preceding~~ claim~~s~~ 1 ~~and~~ wherein the functionality is stored in a ~~board/~~module~~/add on~~ housed in a mechanical member ~~added to each modem~~ where the modem has an antenna and ~~includes~~ a board house~~s~~~~ing~~ the modem and the antenna and wherein the mechanical member is mounted on the board intermediate to ~~the~~ modem and the antenna.

9. The method according to claim 1 wherein the network information not changed by the device comprises a PCI parameter (Physical Cell ID parameter) as set by the network.

10. The method according to claim 9 wherein the device is configured to extract the PCI and then translate the non-standard PSS/SSS to standard PSS/SSS that carry the same PCI.

11. The method according to claim 1 wherein the device synchronizes itself through non-standard PSS SSS to a base station in the conventional network, thereby to maintain a capability to transmit standard PSS SSS, to a conventional modem coupled thereto.

12. The method according to claim 1 wherein the non-standard sequence transmission is from the same family as the standard transmission and therefore the conventional modem sees the non-standard transmission as white noise and wherein associated with the device identifies only the device's transmission and does not identify that some control signals, are coming from different sources.

13~~9~~. A system for converting a conventional cellular network into a private cellular network, wherein the conventional network includes nodes equipped with conventional modems operating in accordance with a cellular communication protocol ~~e.g. LTE and storing first orthogonal sequences~~, the system comprising:

a~~A~~ device, configured to be in data communication with individual nodes, thereby to enable the device to be in data communication with any individual node in the conventional network, which is desired to belong to the private cellular network, and not to nodes in the conventional network, which are not desired to belong to the private cellular network;

wherein the device includes a processor coupled to computer memory and stores second orthogonal sequences which differ from the first orthogonal sequences hence are not hard-coded in the conventional modems, and

wherein the device stores a one-to-one correspondence enabling translation of each of the second orthogonal sequences, to one of the first sequences hard-coded in the modems,

and wherein, at least when in a private network supporting mode, the processor when in data communication with a transmitting node, determines which of the first orthogonal sequences is being used, translates the first orthogonal sequences being used, using the stored one-to-one correspondence, into one of the second orthogonal sequences, and uses the translated sequence to transmit a synchronization signal, thereby to transmit a synchronization signal which uses one of the second orthogonal sequences, that are not hard-coded in protocol modems, –thereby to transmit a synchronization signal which is noticeable and understandable to modems associated with the ~~external~~ device but not to modems not associated with the ~~external~~ device such that only modems associated with the ~~external~~ device can synchronize themselves to the private network and modems not associated with the ~~external~~ device cannot synchronize themselves to the private network.

~~10. A method according to any one of the preceding claims and wherein the network information not changed by the external devices comprises a PCI parameter (Physical Cell ID parameter) as set by the network.~~

~~11. The method according to claim 10 wherein the external device is configured to extract the PCI and then translate the non-standard PSS/SSS to standard PSS/SSS that carry the same PCI.~~

~~12. A method according to any one of the preceding claims and wherein the external device synchronizes itself through non-standard PSS SSS to a base station in~~

~~the conventional network, thereby to maintain a capability to transmit standard PSS SSS, to a conventional (e.g. LTE) modem coupled thereto, synchronously e.g. at the time expected by the conventional modem.~~

~~13. A method according to any one of the preceding claims and wherein the non-standard sequence transmission is from the same family as the standard transmission and therefore the conventional modem sees the non-standard transmission as white noise and wherein a modem (or any LTE user equipment device) associated with the external device e.g. coupled thereto, identifies only the external device's transmission and does not identify that some control signals (e.g. the PSS and SSS), are coming from different sources.~~

14. The~~A~~ system according to claim 13~~9~~ wherein the device is~~e comprises an external device,~~ configured to be coupled to nodes~~-~~.

15. A computer program product, comprising a non-transitory tangible computer readable medium having computer readable program code embodied therein, said computer readable program code adapted to be executed to implement a method for converting a conventional cellular network into a private cellular network, wherein the conventional network includes nodes equipped with conventional modems operating in accordance with a cellular communication protocol ~~e.g. LTE and storing first orthogonal sequences~~, the method comprising ~~all or any subset of the following~~:

~~C~~coupling a device ~~(e.g. an external device)~~ to each node in the conventional network, which is desired to belong to the private cellular network, and not to any nodes in the conventional network, which are not desired to belong to the private cellular network;

wherein the device stores second orthogonal sequences which differ from the first orthogonal sequences hence are not hard-coded in the conventional modems, and

wherein the device stores a one-to-one correspondence enabling translation of each of the second orthogonal sequences, to one of the first sequences hard-coded in the modems,

and wherein, at least when in a private network supporting mode, a device associated with a transmitting node desired to belong to the private network, uses a

processor to determine which of the first orthogonal sequences is being used, translate the first orthogonal sequence being used using the stored one-to-one correspondence into one of the second orthogonal sequences, and use the translated sequence to transmit a synchronization signal, thereby to transmit a synchronization signal which uses one of the second orthogonal sequences, that are not hard-coded in protocol modems, –thereby to transmit a synchronization signal which is noticeable and understandable to modems associated with the ~~external~~ device but not to modems not associated with the ~~external~~ device such that only modems associated with the ~~external~~ device can synchronize themselves to the private network and modems not associated with the ~~external~~ device cannot synchronize themselves to the private network.