

METHOD, DEVICE, AND SYSTEM FOR PAGING RESOURCE SELECTION AND SYSTEM INFORMATION TRANSMISSION/ACQUISITION IN WIRELESS NETWORKS

TECHNICAL FIELD

This disclosure is directed generally to wireless communications, and particularly to methods, systems and devices for adaptive paging resource allocation and System Information (SI) acquisition.

BACKGROUND

A paging mechanism may be used for informing wireless devices of communication needs. Efficient allocation of paging radio resources is critical for reducing power consumption in these devices during paging processes. The ability for a wireless device to acquire system information update reliably and promptly with minimal power consumption is another important factor to ensure optimal network performance, particularly for low power wireless terminals such as NarrowBand-Internet of Things (NB-IoT), Machine Type Communication (MTC) and enhanced Machine Type Communication (eMTC) devices.

SUMMARY

This disclosure is directed to methods, systems and devices for paging resource selection and SI acquisition in wireless communication networks.

In some implementations, According to a first aspect of the present invention, there is provided a method for ~~paging using adaptively allocated paging resource wireless communications~~, performed by a first network element in a network is disclosed. The method may include receiving a first message from a second network element of the network; deriving a User Equipment (UE) specific paging resource configuration associated with a UE based on the first message; selecting a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the

first network element, the UE specific paging resource configuration comprising a paging extended Discontinuous Reception (eDRX) Information; and sending a paging message over the selected paging radio resource to the UE.

According to a second aspect of the present invention, there is provided a first network element in a network, the first network element comprising a memory for storing computer instructions and a processor in communication with the memory, wherein, when the processor executes the computer instructions, the processor is configured to cause the first network element to: receive a first message from a second network element of the network; derive a UE specific paging resource configuration associated with a UE based on the first message; select a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the first network element, the UE specific paging resource configuration comprising a paging eDRX Information; and send a paging message over the selected paging radio resource to the UE.

According to a third aspect of the present invention, there is provided a non-transitory storage medium for storing computer readable instructions, the computer readable instructions, when executed by a processor in a first network element in a network, causing the processor to: receive a first message from a second network element of the network; derive a UE specific paging resource configuration associated with a UE based on the first message; select a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the first network element, the UE specific paging resource configuration comprising a paging eDRX Information; and send a paging message over the selected paging radio resource to the UE

In some other implementations, a method for transmitting system information, performed by a first network element in a network is disclosed. The method may include sending a first message to a UE in the network during a first pre-determined System Information (SI) acquisition period, the first message comprising an SI update indicator instructing the UE to acquire an SI update from the beginning of a second pre-determined SI acquisition period following the first pre-determined SI acquisition period; and sending the updated SI to the UE in the second pre-determined

SI acquisition period.

In some other implementations, a method for acquiring system information, performed by a UE in a network is disclosed. The method comprising: receiving a first message sent from a first network element in the network during a first pre-determined System Information (SI) acquisition period, the first message comprising an SI update indicator instructing the UE to acquire an SI update from the beginning of a second pre-determined SI acquisition period following the first pre-determined SI acquisition period; and receiving the updated SI sent from the first network element in the second pre-determined SI acquisition period.

A network element and/or UE is further disclosed. The network element and/or UE includes a processor and a memory, wherein the processor is configured to read computer code from the memory to implement the method above. A computer-readable medium is further disclosed. The computer-readable medium includes instructions or a computer program which, when executed by a wireless terminal, cause the wireless terminal to carry out the method above.

The above embodiments and other aspects and alternatives of their implementations are described in greater detail in the drawings, the descriptions, and the claims below.

What is claimed is:

1. A method for ~~paging using adaptively allocated paging resource~~wireless communications, performed by a first network element in a network, the method comprising:

receiving a first message from a second network element of the network;

deriving a User Equipment (UE) specific paging resource configuration associated with a UE based on the first message;

selecting a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the first network element, the UE specific paging resource configuration comprising a paging extended Discontinuous Reception (eDRX) Information; and

sending a paging message over the selected paging radio resource to the UE.

2. The method of claim 1, wherein the UE specific paging resource configuration further comprises at least one of following parameters associated with the UE:

~~coverage enhancement level (CEL);~~

~~— CEL based paging indication;~~

~~— CEL based paging deactivating indication;~~

~~— maximum numbers of repetitions for NPDCCH common search space for paging (Rmax paging);~~

~~— Rmax paging based paging indication;~~

~~— Rmax paging based paging deactivating indication;~~

~~— DRX cycle based paging radio resource selection capability;~~

~~— WUS Assistance Information;~~

~~— Paging Probability Information;~~

~~— paging extended Discontinuous Reception (eDRX) Information;~~

Radio Access Network (RAN) paging cycle;

UE specific Discontinuous Reception (DRX); or

Core Network Assistance Information for the UE in a Radio Resource Control (RRC)~~the RRC~~ inactive state.

3. The method of claim 1, wherein the paging radio resource comprises a paging occasion (PO)~~includes at least one of:~~

~~— paging carrier;~~

~~— paging narrowband;~~

~~— paging physical resource block (PRB);~~

~~— paging bandwidth part (BWP);~~

~~— paging control resource set (CORESET);~~

~~— paging occasion (PO); or~~

~~— GWUS resource.~~

4. ~~The method of claim 1, wherein the radio resource specific paging configuration comprises at least one of:~~

~~— carrier specific paging configuration configured per paging carrier;~~

~~— narrow band specific paging configuration configured per paging narrowband;~~

~~— paging Physical Resource Block (PRB) specific paging configuration configured per paging PRB;~~

~~— Bandwidth Part (BWP) specific paging configuration configured per paging BWP; or~~

~~control resource set (CORESET) specific paging configuration configured per paging CORESET.~~

~~5. The method of claim 1, wherein the first message is triggered to be sent to the first network element by a UE specific S1AP or NGAP connection establishing procedure in the second network element.~~

~~6. The method of claim 1, when the UE specific paging resource configuration comprises a paging eDRX information and does not comprise a Paging Time Window (PTW), the method further comprising causing the UE to:~~

~~obtain a paging eDRX cycle according to the paging eDRX information; and~~

~~determine a DRX Cycle(T) associated with the UE to be the shortest of the paging eDRX cycle and a RAN paging cycle, wherein the RAN paging cycle is pre-defined in the network.~~

~~74.~~ The method of claim 1, wherein the paging message comprises at least one of:

~~an S1AP paging message;~~

~~an NGAP paging message;~~

a XnAP paging message; or

an F1AP paging message; ~~or~~

a RAN base paging message.

~~8. The method of claim 7, when the UE is in a RRC idle state, and when the paging message comprises a paging eDRX cycle information element (IE) and does not comprise a Paging Time Window (PTW), the method further comprising causing the UE to:~~

- ~~—obtain a paging eDRX cycle according to the paging eDRX cycle IE; and~~
- ~~—determine a DRX Cycle (T) associated with the UE to be the paging eDRX cycle.~~

~~9. The method of claim 1, wherein before sending the paging message over the paging radio resource to the UE, the method further comprises sending a second message comprising the UE specific paging resource configuration to the UE.~~

~~10. The method of claim 9, wherein the second message comprises an RRC connection release message and the second message triggers the UE to enter the RRC inactive state.~~

~~11. The method of claim 1, wherein the first message comprises the UE specific paging resource configuration associated with the UE.~~

~~12. The method of claim 11, wherein the second network element comprises a core network node in the network, the core network node comprises at least one of a Mobility Management Entity (MME) or an Access and Mobility Management Function (AMF), and the second network element sends the first message to the first network element in response to establishing an S1AP or NGAP connection for the UE.~~

~~13. The method of claim 12, wherein the first message comprises at least one of the following messages:~~

- ~~—INITIAL CONTEXT SETUP REQUEST;~~
- ~~—UE CONTEXT MODIFICATION REQUEST;~~
- ~~—HANDOVER REQUEST; or~~
- ~~—PATH SWITCH REQUEST ACKNOWLEDGE.~~

receive a first message from a second network element of the network;

derive a UE specific paging resource configuration associated with a UE based on the first message;

select a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the first network element, the UE specific paging resource configuration comprising a paging eDRX Information; and

send a paging message over the selected paging radio resource to the UE.

10. The first network element of claim 9, wherein the UE specific paging resource configuration further comprises at least one of following parameters associated with the UE:

Radio Access Network (RAN) paging cycle;

UE specific Discontinuous Reception (DRX); or

Core Network Assistance Information for the UE in an RRC inactive state.

11. The first network element of claim 9, wherein the paging radio resource comprises a paging occasion (PO).

12. The first network element of claim 9, wherein the paging message comprises at least one of:

a XnAP paging message; or

an F1AP paging message.

13. The first network element of claim 9, wherein the first message comprises the UE

specific paging resource configuration associated with the UE.

14. The first network element of claim 13, wherein the first message comprises a paging message.

15. The first network element of claim 9, wherein the first network element comprises a first base station, the second network element comprises a second base station.

16. The first network element of claim 9, wherein the first network element comprises a gNB-DU, and the second network element comprises a gNB-CU.

17. A non-transitory storage medium for storing computer readable instructions, the computer readable instructions, when executed by a processor in a first network element in a network, causing the processor to:

receive a first message from a second network element of the network;

derive a UE specific paging resource configuration associated with a UE based on the first message;

select a paging radio resource based on the UE specific paging resource configuration and based on a radio resource specific paging configuration pre-defined in the first network element, the UE specific paging resource configuration comprising a paging eDRX Information; and

send a paging message over the selected paging radio resource to the UE.

18. The non-transitory storage medium of claim 17, wherein:

the UE specific paging resource configuration further comprises at least one of

following parameters associated with the UE:

Radio Access Network (RAN) paging cycle;

UE specific Discontinuous Reception (DRX); or

Core Network Assistance Information for the UE in an RRC inactive state; and

the paging radio resource comprises a paging occasion (PO).

19. The first network element of claim 17, wherein:

the paging message comprises at least one of:

a XnAP paging message; or

an F1AP paging message; and

the first message comprises the UE specific paging resource configuration associated with the UE.

20. The first network element of claim 17, wherein:

the first message comprises a paging message; and

a combination of the first network element and the second network element comprises one of:

the first network element being a first base station, the second network element being a second base station; or

the first network element being a gNB-DU, and the second network element being a gNB-CU.