Multiband

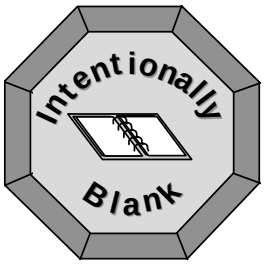
Chapter 15

This chapter is designed to provide the student with an overview of multiband systems.

OBJECTIVES:

Upon completion of this chapter the student will be able to:

- describe what a multi-band system is.
- describe what new functions must be added when compared to a single band system.
- list different types of BSCs.
- list the nodes used in the ICO satellite system.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15 Multiband

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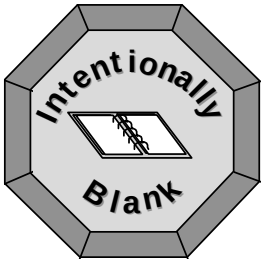
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INTRODUCTION

In APT 210 09 R5, the entire BSC had one system type, that is either GSM, GSM 1800 or GSM 1900. In APT 210 09 R6, the BSC is adapted to handle more than one system type at the same time. System type is now defined on cell level. Some radio network data that previously has been set on BSC level will now be set per system type.

The BSC can support GSM 900 and GSM 1800 simultaneously. This provides the possibility to use the BSC in a more flexible way. There are mainly two purposes for this feature.

These are:

1. To allow customers that have licenses for operating mobile network in more than one frequency band to use the same BSC equipment for the different systems. It provides cost savings for them if they are not required to buy extra equipment.
2. To allow the introduction of multiband operation. See the feature below.

The operator can define a default system type for the entire BSC, that is, GSM 900, GSM 1800 or GSM 1900. In this case, all existing and newly defined cells automatically get the default system type. If the operator uses the default system type, system type parameters are not needed.

The operator can also choose not to define a default system type for the entire BSC. In this case, the BSC consists of mixed system types. The system type must be stated when a cell is defined and all commands for radio network data on system type level must include a parameter specifying to which system type the data belongs.

The above operator interface makes the changes for this feature almost invisible to operators that continue to use the BSC for one system type only.

Statistics on BSC level for radio network functions are also split so that they can be identified for each system type.

GENERAL DESCRIPTION

SYSTEM TYPE

Today, system type is global. That is, it is valid for all cells in a BSC. The global system type remains but there is new value that indicates a mixed system. In a mixed system, it is possible to specify system type per cell.

It is possible to change the global system type in a running BSC.

When cells are defined, and the global system type indicates a mixed system meaning the system type is to be set per cell. Any value of GSM 900, or GSM 1800 can be used.

MULTIBAND OPERATION BETWEEN GSM 900 AND GSM 1800

Many GSM operators have encountered capacity problems in densely populated areas. For operators who also have licenses in the GSM 1800 band, this can be solved by introducing another frequency band belonging to another system (e.g. GSM 1800) in the existing system. In this integrated system, multiband mobile telephones have the possibility to use channels in more than one band. Handover between cells belonging to GSM 900 and GSM 1800 bands is supported by both BSCs and MSC/VLRs.

It will still be possible to use single band mobiles within the integrated system. However, it will not be possible for them to use the extra capacity generated by the frequencies in the other system.

The operator can disable multiband operation. In this case, no handover between cells of different system types can be done.

PARAMETERS PER SYSTEM TYPE

Some parameters that were set per BSC are now set per system type. There are three independent sets, one for each system type. This concerns parameters for locating, dynamic MS power control and dynamic BTS power control.

Even if the global system type is not mixed, it is possible to set and print these parameters per system type. If system type is not specified in these commands, the value of the global system type is used to select correct set of parameters.

IDENTIFICATION OF MS CAPABILITIES

The mobile informs the network of its capabilities (single band or multiband) using the Classmark Change message. The information element mobile station classmark 3 contains this new information. The network can indicate if this message is to be sent or not (system information).

If the network requests sending the Classmark Change message, it is sent spontaneously by all multiband mobiles immediately after the initial message. When the Classmark Change message is received, locating and MS power control are informed about the mobile capabilities.

A bit in the classmark 1 information element indicates if the MS has a classmark 3 information to send.

The Classmark Change message is sent to the MSC in a Classmark Update message.

If this information is not sent by the MS, the MS is assumed to be a single band MS.

BTS COMPATIBILITY

It is necessary to indicate if the BTSs support the new multiband operation messages. A bit in the function map is reserved for this purpose.

If the BTS does not support multiband operation, all mobiles will be treated as single band MSs in the cell that the BTS serves.

LOCATING

Locating must be aware of the system type value per cell. Handover between cells with different system types is supported (i.e. GSM 900, GSM 1800). The power capability is included in locating evaluations.

BSC BAND OPERATION MODE

A command enables and disables the multiband operation per BSC by command.

It may not be possible to enable multiband operation if the distribution of system information type 7 or 8 is disabled. In

addition, it may not be possible to disable the distribution of system information type 7 or 8 when multiband operation is enabled.

It is only possible to enable multiband operation if the global system type is mixed

Multiband operation enabled means that:

- The 2 ter and 5 ter system information messages are sent. (The MSs will be aware of neighbors in other frequency bands and handover to these other bands will be possible.)
- The bit in system information indicating that the mobile will send the Classmark Change message spontaneously is set.

Multiband operation disabled means that:

- The 2 ter and 5 ter system information messages are NOT sent. (The MSs will not be aware of neighbors in other frequency bands.)
- The bit in system information indicating that the mobile will send the Classmark Change message spontaneously is NOT set. (This message is not needed when multi band operation is disabled.)

This enable/disable procedure takes time. All mobiles must be updated with new BA lists.

When multiband operation is enabled, the network sends system information indicating that the mobiles will send the Classmark Change message. When a Classmark Change message arrives, the network sends an SACCH Info Modify message to the BTS that handles the connection.

When multi band operation is disabled, ongoing calls are affected at channel activation (handover).

MS MULTIBAND SUPPORT

Mobile stations can support multiband operations. Two types of Multiband Mobile Stations have been defined in the specifications:

- Multiband mobile terminal type 1
- Multiband mobile terminal type 2

Multiband Terminal Type 1

This mobile terminal treats each band as different PLMNs. The MS can only change network by means of a new PLMN selection. This can be done automatically or manually. The MS does not support handovers between the different bands.

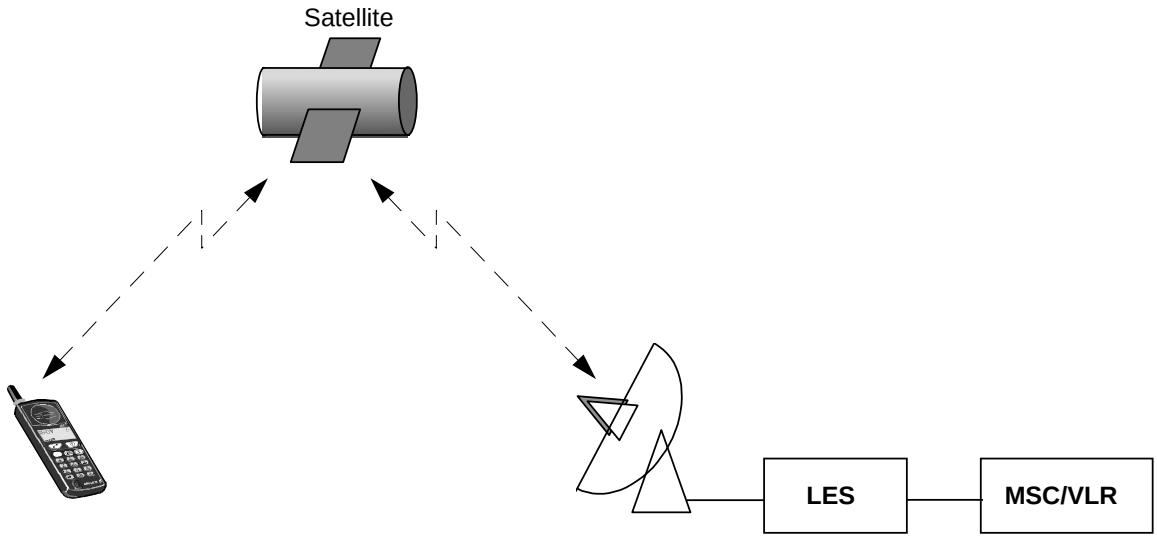
Multiband Terminal Type 2

Type 2 has the same functionality as type 1 with the additional capabilities for performing handovers, channel assignment, cell selection and cell re-selection if the different bands operate under the same PLMN code.

ACCESS TO SATELLITE NETWORKS

A general trend in Mobile Communication requires land-based systems to prepare for interworking with various satellite systems introduced by Intermediate Circular Orbit (ICO), Irridium, or Globalstar.

The Ericsson's GSM system will be used by ICO which intends to built up a mobile network with world wide coverage. The worldwide coverage will be ensured by using satellites in the radio interface. The intention is that the network infrastructure on the earth is based on the GSM technology and the radio parts on the existing satellite radio technology as much as possible. This means that the existing nodes of the Switching System: (MSC/VLR, HLR, AUC, EIR, etc.) will be used to build the land network for the satellite system. Instead of the existing BSC, a Land Earth Station (LES) will be used to control the radio-related functions of the system.



LES = Land Earth Station

Figure 15-1 Basic ICO network elements.

The LES will control the interface towards the satellites. The LES is similar to the GSM BSC and the interface between the LES and the MSC/VLR will be a modified GSM BSSAP protocol. The idea is to modify the protocol in a way that all the changes will be backwards compatible.

The MSC/VLR will have an interface towards the BSC as stated above. The other interfaces will be ISUP/TUP/CAS interfaces

towards the PSTN, ISDN, other PLMNs. ITU ISUP will be used for all connections between MSC/VLRs in the ICO network. ICO has plans to install 12 MSC/VLRs in the beginning. All of them will also have the gateway functionality. The MAP interface towards the HLRs and ILRs will be based on the GSM MAP. Some modification may be needed (currently, only extensions to support ICO unique services) but all the modifications should be compatible with the MAP protocols used in other GSM based networks.

The ICO network goal is to provide access via satellite for the following subscribers:

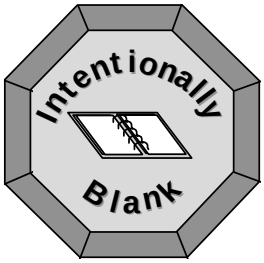
- subscribers having a subscription in the ICO network only. In this case ICO's intention is to have separate service providers for the ICO network which will sell the subscriptions.

- subscribers having a subscription in the existing GSM based networks (i.e. GSM900/1800/1900 networks) where the ICO network is seen as an extension to these networks when subscribers are roaming outside the coverage area.

- subscribers having a primary subscription in the ICO network, but will also have possibility to have an access in the existing GSM based networks, AMPS networks and PDC networks.

The Ericsson's GSM Switching System nodes, which will be used in the ICO system, have to be adapted to cooperate with the LES instead of the BSC as well as to perform new satellite-specific functions. An example function that is being developed specifically for the satellite systems is the High Penetration Notification (HPN) for mobile terminating SMS.

The HPN feature is needed in order to perform a special paging of the mobile subscriber at mobile terminating SMS while he is roaming in the ICO network. HPN paging is needed when there is no page response at mobile terminating SMS by using the normal paging procedure. The HPN paging makes it possible to also page the subscriber when he is e.g. inside a building by using a higher output power. This paging method consumes a great deal of the satellite system capacity which is the reason why this mode is not always used. The HPN page is an acknowledged page.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