



P921: UMTS Radio Aspects

PIR 5.2

Potential network architectures for UTRA using SDR-HFR technology

Summary

This PIR deals in a large degree with the technologies used for the development of the SDR and HFR systems, some architectures and scenarios dealing with the above systems are analysed and lastly some economic issues dealing with the equipment and components of SDR-HFR are given.

More specifically, section 2 deals with the technologies that are used for the manufacture and functioning of the SDR-HFR equipment and in more detail the following items are covered:

- A multi-mode radio access system with a centralised BS that provides a smooth migration from 2G to 3G technology.
- Different antenna configurations have been reported which increase the performance of the system by contributing in range extension, interference suppression, capacity and data rate increase.
- Different network scenarios have been reported from which it is seen that the HFR/SDR techniques will play an important role in the indoors as well as in the outdoors environments since they provide independence to the radio standards and removal of some of the complexity from the base stations.

Comparing the cell size between a UMTS and a GSM 1800 system it is seen that the UMTS system has a higher range.

Consideration for the use of new and advanced services is taken where it is realised that this can be achieved with the introduction of intelligence in order for the access network to cope with various protocols and terminal classification.

Different SDR/HFR receiver architectures for wideband multi-standard radios are examined in the report in order to show how to achieve higher bandwidth rates and higher sensitivities.

With regards to the architectures, two of them were analysed. The architecture for a radio-independent wireless access network that requires a mapping of the functional elements onto the UMTS generic architecture and the architecture for multi-standards base stations where the SDR can be used to download protocol stack components on the BSs, while the HFR will play the role of a central processor on the protocol usage.

Conclusions

This report has been concentrated on different architectures used for the manufacture of the various components consisting a UMTS system. These architectures when they are used together with HFR technology and SDR techniques, they offer many advantages to both the service providers and to the end users.

The SDR that can be implemented as either a complete SW solution or as a special-purpose reconfigurable hardware complemented by SW provides the ability to the user to be independent from the air interface used by the system. In such a way, an operator that uses different technologies such as DECT, GPRS, UMTS, will be advantageous in offering to the user the ability to access any air interface of the above technologies through SDR programming of the base stations.

Same way, HFR can be a very handy access system since it provides an independent radio access architecture and may be advantageous when it is used as a central processor that performs some of the tasks of the base stations, and therefore allows complexity to be removed from the base station antenna sites.

From the above two methods, the combination of the methods SDR/HFR can play an important role for both the operator and the user, since it may lead to a reduction of the infrastructure cost for the operator and for the user it may offer the ability to access any air interface through SDR programming of the base stations.

The conclusions that can be drawn from the architectures used either for the network or for the technology of the various elements that comprise the network that utilise SDR and HFR technologies are as follows:

Architectures of antennas

- *The architecture with centralised BS* provides an architecture where all the radio standards, (GSM, EDGE, UMTS), may be generated and transmitted simultaneously.
- *Architectures with multiple antenna arrays* have the advantage of offering higher gains, range extension, multipath diversity, interference suppression, capacity increase and data rate increase. Under these type of antennas the following architectures may be found:
 - *Smart antenna arrays* have the ability to evaluate the signal conditions and construct a composite signal with higher performance which leads to an increase of the system capacity by reducing interference from other users and an increase to the signal quality by reducing fading effects.
 - *Adaptive antenna arrays* which improve the performance of the received signal to a level that satisfies some preassigned criteria. In this architecture, the antenna reinforces the desired signal and suppresses the interfering signals and thermal noise by multiplying the total received signal by a set of complex weights.
 - *Tracking and switching beam arrays* where a set of receivers are connected to the antenna arrays and by tracking the signal or switching between the best antenna, signal quality is increased.

Architectures of receivers

The conclusions for the architectures of receivers that were examined in this report are as follows:

- *Single analogue IF*, has the ability to perform subsampling of the signal and increase the bandwidth of the receiver
- *Double analogue IF*, has the ability to perform an even higher sampling
- *Direct conversion receiver*, has the ability to downconvert the received signal by a mixer
- *Direct conversion receiver*, has the ability to convert the received signal first to baseband and then to IF

The above receiver architectures are basically used for the purpose of increasing the BW of the receiver with the drawbacks of reducing the receiver sensitivity and increasing the intermodulation distortion.

Network architectures with multi-standards base stations

This architecture is very useful when a user wants to do roaming between different radio platforms, (UMTS, DECT), which can be achieved through SDR by implementing multiple protocol stacks in the base stations.

Architecture for a radio-independent wireless access network

This architecture can be used both in indoors or outdoors and by using some intelligent network functions, the full functionality of handover can be exploited

Benefits of SDR in the migration from 2G to 3G systems

SDR offers benefits to both operators and end users.

With regards to the user the benefits are:

- the ability to reconfigure a terminal
- the adaptation between 2G and 3G standards

The benefits for the network operator can be:

- the cost of the infrastructure is reduced
- the air interface can be changed by simply reprogramming the DSP