Averting radio spectrum saturation, opportunistically

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(PhysOrg.com) -- Mobile users want better video calls, streaming television and faster downloads, placing more demands on the limited radio spectrum available to operators. Could handsets that intelligently sense their radio environment and opportunistically grab free bandwidth be a solution?

A team of European researchers believe they could be. Whereas most recent initiatives aimed at making more efficient use of the radio spectrum have looked at spectrum management from the network end, the team behind the ORACLE (Opportunistic Radio Communications in unLicensed Environments) project focused instead on making handsets actively manage how and when they use the network.

ORACLE's pioneering approach promises to minimise bandwidth saturation in both licensed bands of the radio spectrum, such as that used to carry mobile phone signals, and unlicensed industrial, scientific and medical (ISM) bands - the kind used by WiFi networks and RFID chips.

"With demand booming for new services, both in terms of the number of connections and also quality, we need to find better ways of utilising the radio spectrum available to us… otherwise we will reach a point of saturation," notes Dominique Noguet, the head of the Digital Architecture Design and Prototyping lab at Minatec CEA-LETI in France and coordinator of the ORACLE project. "We are dealing with a finite resource, but one that can be reused in novel ways," he adds.

Because it is used for many kinds of communications, from TV broadcasting and mobile phone signals to wireless internet access and military applications - each of which could interfere with the other - the radio spectrum is probably the most tightly regulated natural resource in the world. Mobile operators, who pay billions of euros for licenses, are therefore continually looking for ways to squeeze more out of the limited bandwidth available to them. However, while more efficient network management by operators has gone some way toward addressing the issue, there are limits to the gains in capacity that can be made by following that approach, Noguet says.

“Recent initiatives have focused on operators sharing information about network use with each other so that high traffic on one network can utilise unused bandwidth on another. But I doubt operators will be very willing to share that information as it could help their competitors,” he notes.

Instead, the team behind the ORACLE project have put mobile handsets to the task of finding available bandwidth and using it in the best way possible. In some cases, the approach takes operators and traditional mobile networks (centred on static base stations that relay signals) out of the equation.

The core technology relies on highly sensitive sensors in the handset that monitor radio spectrum usage by other devices and base stations in their immediate vicinity, combined with software that opportunistically decides when and what bandwidth to use when it becomes available. The approach is known as Opportunistic Radio (OR) and it could lead to a dramatic rethink of the way networks are managed, Noguet predicts.

“The techniques go far beyond the capabilities of modern mobile terminals, but they hold the potential to overcome part of the bandwidth problems operators are facing,” he explains.

Unburdening the network with ad hoc communications

The technology could, for example, allow handsets to create ad hoc networks with other mobile devices in their immediate vicinity to share data, reducing the amount of traffic passing through base stations and the wider mobile network.

This was proposed for UMTS-FDD systems in which the uplink band could be used to establish the ad hoc networks. And, in the case of wireless local area networks (WLANs), ORACLE has demonstrated an OR device capable of taking into account both the frequency dimension, by switching channels, and also the time the frequency is available, providing a new approach to getting people connected even when the network is highly congested.

“One of our demonstrators showed how a device could utilise the same channel as another device receiving streaming video by making use of time slots that previously would not have been utilised as efficiently,” Noguet says. “The upshot is that, in congested WiFi networks, such as in a busy hotel, more people would be able to get connected and the speed and stability of their connections would be better.”

Though Noguet stresses that the ORACLE project focused on enabling technology for more efficient spectrum use rather than on the applications that use that spectrum, he says implementing OR techniques should greatly improve quality of service for mobile and WiFi network users. Operators, on the other hand, would benefit from being able to provide more services to more people more efficiently and at lower cost.

However, as with many technologies in the telecommunications field, and despite widespread interest from operators, it may be some time

before the system developed in the ORACLE project starts being implemented commercially.

“You only have to look at the slower-than-expected deployment of 3G services to see how far implementation lags behind innovation in the sector,” Noguet notes.

Nonetheless, one of the ORACLE partners, the Technical University of Dresden, has set up a spin-off company, called Inradios, to commercially exploit some of the technology developed in the project, while the partners are also actively involved in developing a new standard based on the results of their research.

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