RF memory tags: The next generation

Emanuele Confalonieri, Senior Manager, Mobile System Solutions and Senior Member of the Technical Staff at Micron Technology

NFC (Near-Field Communication) is a well-established open platform RF communication technology that enables communication between devices at a distance of not more than 10 cm. It supports different data transmission rates but it is currently limited to relatively low throughput, up to 424 kbit/s for a maximum of 1 MByte. NFC-based communication between two devices requires that one device acts as a reader/writer and the other as a tag. The tag may be just a passive device, containing an antenna and a small amount of memory and can be powered by a magnetic field. The NFC ecosystem is very broad and diversified, with the participation of industry leaders from the banking segment, the IT sector, semiconductor producers and mobile phone manufacturers.

NFC pervasiveness is quickly growing and is currently gaining a lot of momentum, mostly for mobile payment applications supported by credit card giants such as Visa, Mastercard and Amex. In the UK, for example, there are already more than 12 million people owning NFC enabled cards and there's a network of 43,000 contactless payment terminals. NFC has also been used in advertising applications where a 'smart poster' can send information, e.g. a short video stream, to an enabled device momentarily held close to a hot spot embedded in the poster itself.

New standards for faster communication and higher density

The next step for NFC is to become a common technology for media sharing. New developments and new standards will make it possible to achieve tags enabling users to enjoy new, fast wireless experiences such as downloading a music album in under 10 seconds in a store.

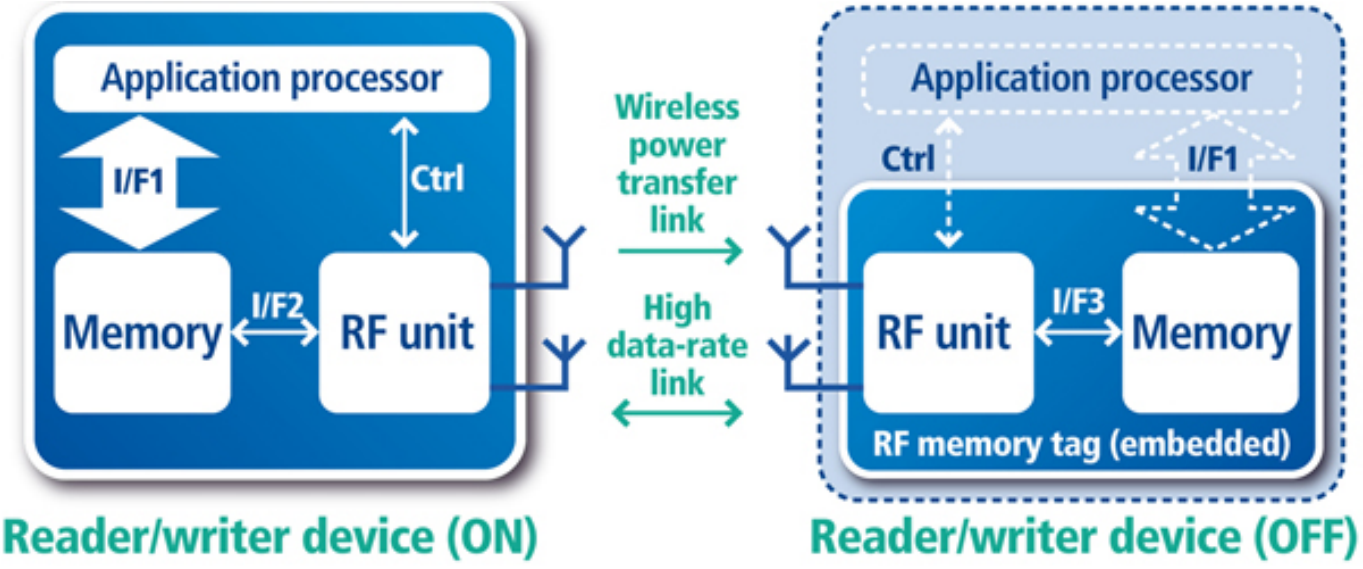
Consumers will be able to transfer pictures, video and other contents wireless from digital video camera to web-based cloud services, as already demonstrated by Nokia in its pilot project "Explore & Share".

For this purpose the JEDEC Solid State Technology Association, a global standard development body for the microelectronics industry, has created a subcommittee chaired by Nokia and subchaired by Micron and Samsung. The aim is to standardize power efficient non-volatile wireless memory with fast connectivity and read/write capability. New passive tags for future generation applications will deliver 100+ Mbit/s transfer rates at close proximity and over 1 Gbit density, with an overall power consumption in the order of 100 mW, or even lower.

PCM vs. NAND Flash
There are two possible non-volatile memory technologies fit for these developments: NAND Flash and PCM.

PCM is a new emerging type of non-volatile semiconductor memory that stores information through a reversible structural phase change in a chalcogenide material.

NAND Flash is a well known mature technology. It is quite efficient, in terms of power consumption, when the memory is accessed as relatively large blocks (chunks); however with small data chunk size PCM has better efficiency than NAND. This is particularly beneficial in radio frequency memory tags since relatively small size of buffer memory can minimize power consumption.



PCM arrays can be easily overwritten, in a similar way as writing to a standard RAM memory. On the contrary in the case of programming of "dirty" devices, i.e. memory arrays which already store "old" content, a NAND Flash memory requires multiple operations also if only one single page is updated. These operations consist

of copying of valid pages within the addressed block, programming of updated pages, programming to invalidate the obsolete block and erasing of the obsolete block. Therefore the total number of pages to be copied is variable which leads to variable overall energy consumption. The overwriting capability of PCM implies a much simpler programming mechanism leading to lower and predictable power consumption.

PCM technology achieves less overhead and higher endurance

Furthermore the management of a NAND Flash array is more complex since specific algorithms are needed to match standard reliability requirements. The execution of these algorithms, such as Error Correction Code, Wear Levelling, Bad Block Management, etc., requires an additional overhead leading to more costs and a lower energy efficiency. The endurance of a PCM memory array is also a major advantage and the number of write/programming cycles can be as much as 1,000 times bigger than in the case of NAND Flash.

PCM technology seems to provide many benefits for NFC passive tags. Current state-of-the-art PCM devices achieve 1Gbit density in the 45 nm technology node and are being used for the optimization of the mobile architectures and for pilot projects, such as Nokia's Explore & Share which sees also the participation of Micron, a leader at the forefront of PCM technology.