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PUTTING THE MICRO IN PHONE: RF MEMS AND NEXT GENERATION MOBILE DEVICES

By Jack Mason
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Feb. 7, 2002 – Verizon recently launched the first 3G, or third generation, wireless network in the United States. Sprint and AT&T are rolling out similar broadband wireless services in 2002.

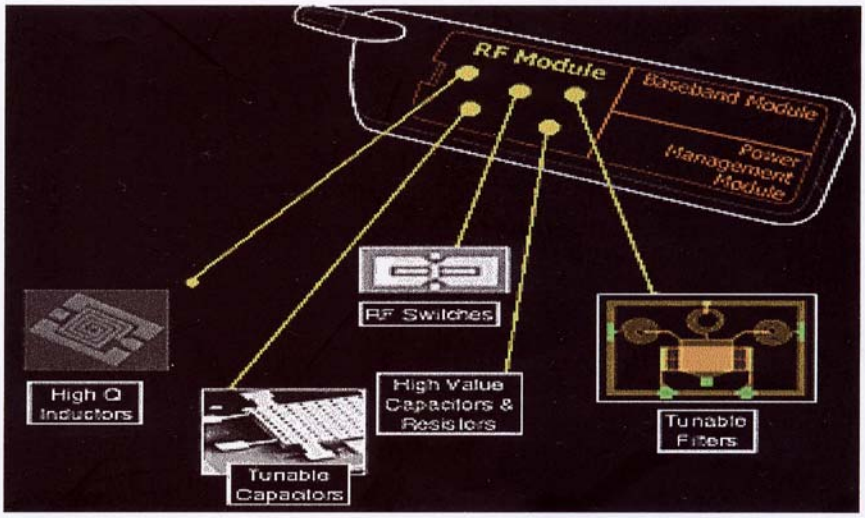
But as wireless networks advance, so too are challenges for mobile phone designers.

RF (radio frequency) MEMS may help engineers add new capabilities and improved power efficiency while keeping wireless devices small and affordable.

About 75 percent of the 100 or so components in a mobile phone are "passive" elements such as inductors or variable capacitors. MEMS versions of these components promise to make phones more reliable and power efficient.

If they succeed, say the industry analysts at Cahners In-Stat Group, the market for RF MEMS is expected to grow from $1 million in 2001 to nearly $350 million in 2006.

The first commercial micromachined RF device is already vibrating inside Samsung's miniscule Watch Phone.



The leader in the RF MEMS race is MEMSCAP, which is developing MEMS components for wireless devices. Above, are the MEMS inside a mobile handset on the drawing boards.

Agilent Technologies' FBAR (film bulk acoustic resonator) duplexer is a set of piezoelectric filters that separate incoming and outgoing signals. While it may not be complex enough to be considered a "true" MEMS, the device takes up only 10 percent of a conventional ceramic duplexer, one of the bulkiest components in a mobile phone, and can also handle more power. AirPrime also selected Agilent's FBAR duplexer for use in its CDMA Wireless module for the Handspring Visor PDA.

Fairchild Semiconductor licensed Sandia National Labs' SUMMiT IV fabrication technology in October and is gearing up its South Portland, Maine foundry to produce RF MEMS. Other big players reported to be working quietly on RF MEMS: Motorola, IBM and Infineon.

Right now the lead horse in the RF MEMS race appears to be MEMSCAP, a public company of about 200 people based in Grenoble, France, and San Jose, Calif. Didier Lacroix, general manager of MEMSCAP's RF MEMS unit, says the company

is developing MEMS components for wireless devices.

According to Lacroix, MEMSCAP's inductors promise to be twice as power efficient as conventional ones and he expects to deliver the first high-volume commercial supplies of MEMS-made inductors to customers in less than six months. He says the company has produced a demo version of a MEMS-fabricated variable capacitor. While the company isn't saying who its first customers might be, it has worked with Samsung and STMicrolectronics in the past. Lacroix adds that MEMSCAP can produce RF MEMS components in bulk in its French foundry and through its manufacturing partners. It also has proprietary technology that can deposit RF MEMS directly on top of a mobile device's integrated circuit board. In addition to its products and manufacturing facility, Lacroix says, MEMSCAP is a vertically integrated company with MEMS and RF integrated circuit software design tools, as well as testing technology. Formed in 1997, MEMSCAP reported 2001 revenue of $8.5 million, compared with $2.7 million in 2000.

What other market demands are driving the need for squeezing more functionality into a mobile handset? For starters, 3G networks will enable wireless devices to receive streaming video or music as well as Web content.

Future "world" phones will have to contend with an increasing number of bands or modes. Handsets may also be expected to integrate short-range wireless technologies such as Bluetooth or Wi-Fi that would enable your phone to connect wirelessly to other devices such as laptops, printers or cameras.

MEMSCAP is working on a metallic MEMS switch that would allow a phone to work with as many as five different bands or transmission modes. The switch is also intended to save circuit board real estate by "reusing hardware."

Current dual-mode or tri-mode phones require separate PA (power amplification) circuits for each mode. MEMSCAP's solution would need only one power amplifier – a component Lacroix says costs several dollars – which would save both physical space and money.

MEMSCAP is working along the same lines on a "tunable" voltage control oscillator (VCO) that could select among the various frequencies – from 900Mhz to 2.4Ghz – that different transmission technologies require. Such a tunable MEMS VCO would eliminate the need and space for multiple VCO circuits.

Discera, a startup in Ann Arbor, Mich., is working to commercialize a micromechanical resonator that founder Clark Nguyen says is 80,000 times smaller than a conventional resonator. More important, the device has a vastly higher "Q" rating, the measure of its ability to be sensitive to a given frequency. Nguyen reports that if the FBAR device has a Q of 1,000, the Discera resonator would rate around 10,000. Ardesta LLC, parent company to Small Times Media, has invested in Discera.

Nguyen, an associate professor of electrical engineering and computer science at the University of Michigan, says that the biggest challenge to commercializing his resonator is packaging it. The ultrathin strip of vibrating silicon at the heart of the resonator is so small that it needs to be encased in a vacuum to prevent interference from air or water vapor molecules.

However, the ultimate goal for Discera as well as MEMSCAP is to produce not just individual RF MEMS components but complete, integrated RF microsystems.

"Our long-range aim is to build a single-chip RF MEMS transceiver that would be only 1 square centimeter in size," says Nguyen.

If so, one day the ring on your finger might be an incoming call.

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