Michael Schaaf has been Head of the Technology and Research Department of the business unit MR within Siemens Healthcare since November 2013. He is responsible for every MRI System with a field strength higher than 3T, and for all non-clinical MR projects.

Michael has worked in MR since 1996 in different functions. After several years working in the gradient development team, he spent four years in Shenzhen, China, helping to set up the Siemens MR factory there.

Back at MR headquarters, Michael is now working with his team on the next generation of 7T MRI systems from Siemens Healthcare.

Dear MAGNETOM Flash reader,

"Nothing is accepted until you prove it."

The forthcoming ISMRM will be a special one, because Siemens will publish its future plans for 7T. So I am very thankful for the opportunity to share my views on the 7T MRI segment here with MAGNETOM Flash readers and to talk a little bit about this segment which, for the time being, remains basically non clinical.

Over the last two decades the 7T MRI system has developed from a unique prototype technology, usable only by highly specialized experts, towards a serial product. It is true that in comparison with a high-end 3T clinical scanner there are still a number of challenges to overcome before one gets to see the amazing results unlocked by the fieldstrength of 7T. However, its increased signal-to-noise ratio leads to an increase in spatial resolution, enabling you to see structures that have never been seen before. A 7T system supplies additional information on functional images, which enables, for example, work with low-sensitivity nuclei.

Sometimes I am asked whether all the effort is justified. It is my strong belief that it is. I have no doubt that 7T will find its place in the clinical research arena. And whilst the number of installations of 7T systems may not rival those of the 3T – at least not in the foreseeable future – the effort and commitment of an extremely active ultra-high-field community is helping to demonstrate that even today diagnoses and treatment strategies may change thanks entirely to the additional information offered by the 7T. The enthusiasm and motivation of our 7T users encourages us to develop 7T further. To explain this in more detail, I would like to look a little bit back in the history and describe the origins of this ultra-high-field segment.

The first systems were brought to the field part by part even before the turn of the century. This required research centers to buy the equipment they needed directly from the different component suppliers. For example, the 7T magnet came from Magnex; the gradient system from either Magnex or Varian; and the RF-System – including the amplifier – from CPC or Analogic. The first systems were therefore built from separate components not specifically developed to be integrated with each other, with the result that interfaces sometimes did not match. These research institutes faced a big challenge in integrating all these different components to create a running 7T MRI system. Nevertheless, mechanical and electrical challenges were met, a working software (SW) developed, and necessary surface coils designed and built by highly motivated teams.

The first *in vivo* images with these machines were so promising that companies like Siemens decided to offer the complete MRI console (gradients, RF chain, and SW) in order to foster this segment further. What stayed the same in the early days, however, was the need for the customer to purchase the magnet separately: indeed, this remains true today in respect of an MRI system with field strength higher than 7T.

The components used by Siemens came from the 3T shelf. Siemens took the best, most reliable parts from the latest existing 3T platform and adapted them for the needs of 7T. By using such components it was possible to provide the good service, application packages, and SW updates already associated with the 3T systems. This significantly improved reliability and repeatability, since Siemens could provide the right spare parts where required. By providing these benefits to the research institutes, the number of installed Siemens 7T systems has increased steadily by up to five installations per year for each of the last two years.

Nevertheless, each 7T system was and remains a project in its own right. Knowing this, Siemens made the business decision that serving the ultra-high-filed segment by providing the necessary solutions for different user visions was only possible if it could look at these installations as single projects, in contrast to the well-developed and organized product business associated with the 1.5T and 3T systems. A separate department was created to work very closely with each ultra-high-field customer. Siemens has always offered close support as a partner from the first idea right until hand over, and beyond. In parallel, this small group of experts began developing functionalities according to specific user requirements.

An example of this is the parallel transmit (pTX) technology. This new feature was first announced as add on to the 7T at the ISMRM in 2006. The need for special transmit technology is based on the B_1 inhomogeneity, which is more severe at 7T than, for example, at 3T. Alongside existing prototypes, developed and built by research institutes themselves, Siemens offers an 8-channel parallel transmit system for the 7T, by duplicating the single transmit channel eight times. The first image, after a successful integration of the pTX system, either together with a new or already existing 7T system, was the logo of the institute in a phantom.

While conducting the first research studies, including the pTX system, the understanding and need for sophisticated SAR supervision grew clearer and became the focal point of parallel transmit imaging. Today, because of its obvious strong advantages, the pTX technology is becoming indispensible for every 7T user, especially now that the focus is shifting towards 7T body imaging. Because Siemens strongly believes in the vision and entrepreneurship of the largest ultra-high-field community (>65% of the worldwide installed ultra-high-field systems are from Siemens) the development of the pTX system is ongoing. The target is clear: We aim to provide the right equipment to enable reliable and safe clinical imaging with pTX technology in the future.

Early in 2013 Agilent (the UHF magnet manufacturer) revealed that it would no longer support the growing ultra-high-field segment with human whole body magnets. This commercial decision from the core magnet supplier in this field created a vacuum for some time. Before the decision, the main talk was of the number of transmit or receive channels, gradient performance and special shimming technologies. Since then, the talk now focuses on the simple question: Do you have a magnet?

Only a few people outside of Siemens know that more than a year before Agilent made this announcement, Siemens had already decided to develop and manufacture its own human whole body 7T magnet. I believe it is only a matter of time before the 7T is used in a clinical setting. Siemens is now so strong in this growing field that we do not want to miss this unique opportunity to be the vendor of choice. As a consequence, we made the strategic decision to take this path only if we have full control of all of our major components, such as the magnet. Siemens' strategy was proved correct and the experience and ability of Siemens Magnet Technology (SMT) – the largest human MRI magnet supplier in the world – brought us to the position where we could announce at the ISMRM 2014 that we were developing our own 7T magnet. Just one year later, we are proud to reveal that the first magnet is not only up and running, but that it has also been successfully installed at Friedrich-Alexander University of Erlangen-Nuremberg (FAU) in Erlangen, Germany.

Right now 7T is almost at the point of clinical usage. I would still not claim that 7T will make 1.5T or 3T obsolete in the future. 7T will stay special and it will be exciting to see how the ongoing changes in the research field and especially in the clinical environment of MRI will influence this development. My own fascination for the ultra-high-field segment is based on the technology used, the research projects which are set up, and – especially – the people running the already installed systems. Working together with the largest ultra-high-field community in the world is a great pleasure and an ongoing positive challenge to my team and myself. Alongside this technical fascination, we always ask ourselves: What are the ultimate benefits for patients, and is this tremendous effort all worthwhile?

As a supplier for imaging equipment Siemens will not be able to answer this question alone. It is the research community, our existing and upcoming collaboration partners, whom we count on to provide the fact-based answers to this question. What Siemens can do and will do is show strong commitment to, and provide the necessary support for, the research community with the necessary equipment. Siemens will provide the right tooling: It is up to you to develop the vision.

I would like to end by expressing sincere thanks to the ultra-high-field community, my great team at Siemens, and to wish you an exciting and inspiring ISMRM 2015.

With best regards

MAGNETOM 7T is still under development and not commercially available yet. Its future availability cannot be ensured. MAGNETOM 7T is not yet licensed for sale in Canada, in accordance with Canadian Law. Performance claims have not been reviewed by Health Canada, and are subject to change. Its future availability cannot be guaranteed.

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Global Business Unit

Siemens AG
Medical Solutions
Magnetic Resonance
Henkestraße 127
DE-91052 Erlangen
Germany
Phone: +49 9131 84-0
www.siemens.com/healthcare

Local Contact Information

Asia/Pacific:
Siemens Medical Solutions
Asia Pacific Headquarters
The Siemens Center
60 MacPherson Road
Singapore 348615
Phone: +65 6490 6000

Canada:
Siemens Canada Limited
Healthcare
1550 Appleby Lane
Burlington, ON L7L 6X7, Canada
Phone +1 905 315-6868

Europe/Africa/Middle East:
Siemens AG, Healthcare
Henkestraße 127
91052 Erlangen, Germany
Phone: +49 9131 84-0

Latin America:
Siemens S.A., Medical Solutions
Avenida de Pte. Julio A. Roca No 516, Piso
C1067 ABN Buenos Aires, Argentina
Phone: +54 11 4340-8400

USA:
Siemens Medical Solutions USA, Inc.
51 Valley Stream Parkway
Malvern, PA 19355-1406, USA
Phone: +1 888 826-9702

Global Siemens Headquarters

Siemens AG
Wittelsbacherplatz 2
80333 Muenchen
Germany

Global Siemens Healthcare Headquarters

Siemens AG
Healthcare
Henkestraße 127
91052 Erlangen
Germany
Phone: +49 9131 84-0
www.siemens.com/healthcare

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