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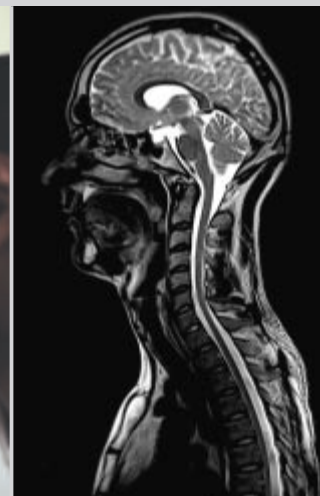
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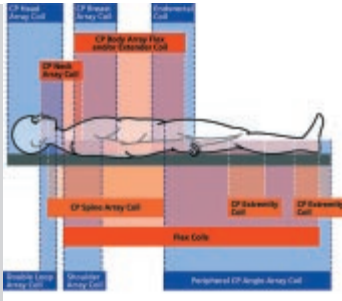
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**Eight RF Receiver Channels and the  
Integrated Panoramic Array Concept:  
Pushing the Limits of MR Imaging**

# Eight RF Receiver Channels and the Integrated Panoramic Array Concept: Pushing the Limits of MR Imaging

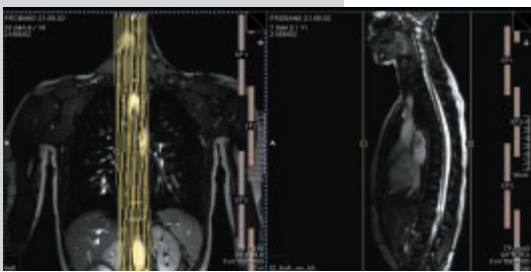
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[1] Schematic representation of various CP array coils that can be combined using the IPA coil concept, for exceptional flexibility in anatomical coverage.

[2] Screen capture from syngo MR user interface, showing five active CP coil elements (red vertical bars) in direct relation to the anatomy on two scout images. The topmost element (partially visible in the sagittal image) is the lower segment of the CP Head Array. The other four elements belong to the CP Spine Array.

Coil elements can be selected individually, and the table can be moved remotely, via software on the operator console outside the scanner room.



## Introduction

Multi-channel technology has revolutionized MR imaging over the last few years, and Siemens has been the clear leader with its IPA (Integrated Panoramic Array) coil concept and eight independent high-bandwidth RF receiver channels. With Siemens IPA coils the user can create customized arrays by combining individual elements from different coils. This capability is unique to Siemens, and allows for optimized coverage of any field of view. Your clinical needs take center stage: instead of being limited by fixed-configuration coils, you can now start with a particular imaging requirement and customize the coil setup so as to address the requirement in the best possible way. Multi-channel imaging with IPA offers unprecedented advantages in terms of workflow, diagnostic accuracy, and patient comfort.

## Once Upon a Time: A Little Bit of History

In the early days of MR imaging, the MR signal was detected by one manually-tuned, linearly polarized (LP) coil, and conveyed to the image reconstruction computer through one low-bandwidth RF receiver channel. In order to image a large field of view (FoV), the receiving coil had to be correspondingly large. The signal-to-noise ratio (SNR) and therefore the image quality achievable in this scenario were modest, and long imaging times were the norm.

However, what was needed in order to unleash the full potential of MR imaging was a solution allowing coverage of large anatomical areas with the image quality typical of smaller coils. This meant expanding the number of coil elements (i.e., using CP array coils) and the number of RF receiver channels that could be used simultaneously to acquire an image. Special software was also required to produce artifact-free images from the multi-channel data.

## Pushing the Limits of MR Imaging: Multi-Channel Technology

In 1997, Siemens ushered in a new era in MR imaging when it received FDA clearance for eight independent, high-bandwidth (1 MHz) RF receiver channels for its 1.0 T and 1.5 T systems. Each channel has its own analog-to-digital converter (ADC), which captures the MR signal with a high dynamic range. This technology forms the foundation for Siemens' revolutionary Integrated Panoramic Array coil concept, which enables the simultaneous use of multiple coils, and coil elements, for MR imaging. More than 2,000 systems featuring IPA and eight RF receiver channel capabilities have been installed to date\* worldwide.

The IPA concept leverages Siemens' traditional strengths in MR coil technology, as the vast majority of Siemens CP array coils are IPA-compatible. These are time-saving "no-tune" coils, and feature integrated low-noise preamplifiers for SNR optimization. Up to 16 CP elements (32 LP elements), from up to 4 different IPA coils, can be used simultaneously to create customized arrays for a wide variety of imaging applications [1]. Importantly, the CP Spine Array (an array of 6 CP elements that forms the backbone of the IPA coil concept) and the lower segment of the CP Head Array remain on the patient table [2] in more than 95% of cases.

This capability of combining elements from different coils is unique to Siemens. It offers not only unprecedented setup flexibility but also considerable time savings. Patient setup time is dramatically reduced with IPA because the need for coil changes is virtually eliminated, and patient repositioning during the MR exam is no longer required. The ability to do all this with existing CP array coils is a very important consideration: all other currently available\* multi-channel offerings on the market do not permit combinations of elements from different coils, and require the purchase of new, dedicated CP array coils.

\* As of August 2002

[4]  
Two-station, one-setup IPA exam covering the entire CNS. Each acquisition has a 512 matrix and a 450 mm FoV. Note the excellent visual continuity between the two acquisitions. Coils/elements used: Upper Station: CP Head Array + CP Neck Array (2 CP elements) + CP Spine Array (3 upper CP elements). Lower station: CP Spine Array (3 lower CP elements).

Moreover, IPA coils are compatible with Siemens' iPAT (integrated Parallel Acquisition Techniques), for the ultimate in MR imaging speed [3]. Further enhancing the capabilities of IPA is Integrated Panoramic Positioning (IPP), which enables remote selection of individual CP coil elements and remote control of table movement from the operator console using an intuitive graphical interface built into the *syngo* MR software [2]. Imaging with IPA and IPP affords the largest\* combined FoV in the industry: 150 cm (5 ft) of contiguous coverage. The entire central nervous system (CNS) can be scanned, for example [4], with only one setup – a Siemens exclusive!

## The Benefits

The extensive capabilities of IPA and IPP, and the large selection of IPA coils currently available, allow for an almost limitless range of applications. The versatility made possible by this technology is unequaled in the industry, and offers exceptional benefits for both clinical and research purposes.

Outstanding image quality can be achieved because of the close proximity of CP elements to the relevant anatomy. This makes high-SNR acquisitions possible even with large fields of view [5], [6]. Customized arrays, created by combining coil elements, optimize anatomical coverage for challenging applications such as brachial plexus [7] or prostate [8] imaging. A distinct advantage of multi-station acquisitions with IPA is the ability to visualize large anatomical areas at a glance while benefiting from optimized image quality at each station [3], [4].

Total imaging time is reduced significantly because coil setup is performed only once, at the beginning of the study. During the examination, remote selection of coil elements and remote control of table movement eliminate the need for coil changes and patient repositioning during the exam. Table movement can even be automatized (built into the protocol) for multi-station studies!

This technology is extremely easy to use. The CP Spine Array Coil and the lower segment of the CP Head Array Coil are already fully integrated into the tabletop. Additional coils can be easily connected to ergonomically positioned sockets, and individual coil elements can be subsequently activated using an intuitive software interface at the MR console, outside the scanner room. Indeed, after the initial patient positioning and coil setup, the operator's presence in the scanner room is not required until the very end of the examination – even with multi-station studies!

Diagnostic accuracy, workflow, and patient comfort are enhanced as a result.



[3]  
Three-station, one-setup, contrast-enhanced MRA from the top of the aortic arch to the feet, showing extensive vascular disease in the left leg. Centric elliptical acquisitions with IPA, using various iPAT factors. Note the excellent visual continuity from one acquisition to the next. Aortic arch to iliac arteries: iPAT x 3 (384 matrix, TA = 14 s); Upper legs: iPAT x 2 (512 matrix, TA = 11 s); Lower legs: no iPAT (512 matrix, TA = 40 s).

Coils/elements used: Upper Station: CP Body Array (2 CP elements) + CP Body Array Extender (2 CP elements) + CP Spine Array (4 lower CP elements). Middle Station: CP Peripheral Angio Array (4 upper CP elements). Lower Station: CP Peripheral Angio Array (4 lower CP elements).

