Siemens CT

Hans Petter Prestby
Cato Nilsen
31 Years of Innovation Leadership

1 slice in 7 min

Head CT in 5 s

SIRETOM (1974)

SOMATOM Sensation 64 (2004)
Siemens CT at a Glance

- Approx. 2,000 CT systems manufactured per year
- > 2,600 employees worldwide
- Number 1 market position in Europe
- Number 2 market position in the global market
- Leader in product innovations
- Installed Base worldwide: 9,500 systems
Multislice CT for All Needs

SOMATOM
Definition

Sensation
Sensation 64
Sensation 40

Emotion
Emotion 16
Emotion 6
Emotion Duo
Emotion

syngo Workplaces

Life
11 of Top 15 USA Teaching Hospitals use Siemens
Leading the High-end CT market

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Current CT Scanners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Johns Hopkins Hospital, Baltimore, MD</td>
<td>Siemens</td>
</tr>
<tr>
<td>2</td>
<td>Mayo Clinic, Rochester, MN</td>
<td>Siemens</td>
</tr>
<tr>
<td>3</td>
<td>Massachusetts General Hospital, Boston, MA</td>
<td>Siemens</td>
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<tr>
<td>4</td>
<td>Cleveland Clinic, Cleveland, OH</td>
<td>Siemens</td>
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<tr>
<td>5</td>
<td>UCLA Medical Center, Los Angeles, CA</td>
<td>Siemens</td>
</tr>
<tr>
<td>6</td>
<td>Duke University Medical Center, Durham, NC</td>
<td>Siemens</td>
</tr>
<tr>
<td>7</td>
<td>University of California, San Francisco, SF, CA</td>
<td>Siemens</td>
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<tr>
<td>8</td>
<td>Barnes–Jewish Hospital, St. Louis, MO</td>
<td>Siemens</td>
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<tr>
<td>9</td>
<td>New York Presbyterian Hospital, New York, NY</td>
<td>Siemens</td>
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<tr>
<td>10</td>
<td>University of Washington Medical Center, Seattle, WA</td>
<td>Siemens</td>
</tr>
<tr>
<td>11</td>
<td>University of Michigan Medical Center, Ann Arbor, MI</td>
<td>Siemens</td>
</tr>
<tr>
<td>12</td>
<td>Brigham and Women’s Hospital, Boston, MA</td>
<td>Siemens</td>
</tr>
<tr>
<td>13</td>
<td>Hospital of the University of Pennsylvania, Philadelphia</td>
<td>Siemens</td>
</tr>
<tr>
<td>14</td>
<td>Stanford University Hospital, Stanford, CA</td>
<td>Siemens</td>
</tr>
<tr>
<td>15</td>
<td>University of Chicago Hospitals, Chicago, IL</td>
<td>Siemens</td>
</tr>
</tbody>
</table>
The Innovation Continues
SOMATOM Sensation

What are the clinical needs?

SOMATOM Sensation 16
Leading the 16-slice market
More and More Slices?

4 16 32 64 128 256
# Reasons to Go Beyond 16-slice CT

<table>
<thead>
<tr>
<th>Reasons</th>
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</thead>
<tbody>
<tr>
<td>Greater spatial resolution for improved differential diagnosis</td>
</tr>
<tr>
<td>Improved image quality without artifacts</td>
</tr>
<tr>
<td>Higher temporal resolution for robust cardiac imaging</td>
</tr>
<tr>
<td>Faster volume coverage where needed, e.g. arterial CTA and PE</td>
</tr>
</tbody>
</table>
SOMATOM Sensation 64 Receives World’s Leading Awards

FROST & SULLIVAN “ENABLING TECHNOLOGY OF THE YEAR” AWARD
for the first successfully introduced 64-slice CT worldwide

Frost & Sullivan: “…an industry standard in high-quality cardiovascular imaging … has set a benchmark in the development of high-end technologies”

MEDICAL DESIGN OF EXCELLENCE AWARD (MDEA)
for exceptional image quality, speed and ease-of-use
Take the Lead in CT
SOMATOM Sensation 64

- Unprecedented Image Quality and Detail with z-Sharp Technology
  \(<0.4\text{mm}\)

- Fastest Acquisition Speed with 0 MHU STRATON® tube
  \(0.33\text{s}\)

- Enhanced Workflow and Clinical Performance with Speed4D™ Technology
  \(4\text{D}\)

- Increased Diagnostic Confidence with Broad Portfolio of Advanced Applications
  \(\text{syngo}\)
SOMATOM Sensation 64
with z-Sharp

33 sec for 1570 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.5 sec
120 kV
148 effective mAs

Courtesy of University of Erlangen and University of Tuebingen
SOMATOM Sensation 64 with z-Sharp

10 sec for 175 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.5 sec
120 kV
120 effective mAs

Courtesy of The CT Clinical Innovation Center, Mayo Clinic / Rochester, USA
SOMATOM Sensation 64 with z-Sharp

5 sec for 289 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
120 kV
190 effective mAs

0.4 mm lumen

Courtesy of University Medical Center Grosshadern / Munich, Germany
SOMATOM Sensation 64 with z-Sharp

8 sec for 500 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
SOMATOM Sensation 64 with z-Sharp Triple Rule Out
22 sec for 260 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
120 kV
760 effective mAs
HR 95 BPM

Courtesy of University Medical Center Grosshadern / Munich, Germany
SOMATOM Sensation 64 with z-Sharp

25 sec for 309 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.37 sec
120 kV
513 effective mAs
HR 71 to 78 BPM

Courtesy of University of Tuebingen / Tuebingen, Germany
SOMATOM Sensation 64 with z-Sharp

13 sec for 162 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
120 kV
860 effective mAs
3.5 mm Cypher ® Stent

SOMATOM Sensation 64 with z-Sharp

14 sec for 185 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
120 kV
800 effective mAs

Courtesy of Toyohashi Heart Center / Toyohashi, Japan
SOMATOM Sensation 64 with z-Sharp

9 sec for 479 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.33 sec
120 kV
200 effective mAs

Courtesy of University Medical Center Grosshadern / Munich, Germany
SOMATOM Sensation 64 with z-Sharp

7 sec for 50 mm
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 1.0 sec
120 kV
90 effective mAs

Courtesy of The CT Clinical Innovation Center, Mayo Clinic / Rochester, USA
Take the Lead in CT
SOMATOM Sensation 64

- Unprecedented Image Quality and Detail with z-Sharp Technology
- Fastest Acquisition Speed with 0 MHU STRATON® tube
- Enhanced Workflow and Clinical Performance with Speed4D™ Technology
- Increased Diagnostic Confidence with Broad Portfolio of Advanced Applications
Previously Unachievable Image Quality

z-Sharp Technology

- Industry’s highest isotropic resolution of < 0.4 mm (0.33 mm)
  - at highest volume coverage
  - at any position within the scan field
  - with no increase in dose

- Previously unknown sharpness and clarity with complete visible spiral artifact elimination

[Flohr et al, Radiology 2003, 231(P), Flohr et al, RöFo 2004]
Industry’s highest isotropic resolution of < 0.4 mm

Each detector element measures the X-ray attenuation caused by structures located between itself and the X-ray source.
Industry’s highest isotropic resolution of < 0.4 mm
**z-Sharp**: Double z-Sampling Position 1 & 2

- 64 slices per rotation
- Routine < 0.4 mm isotropic resolution, with no increase in dose
Industry’s highest isotropic resolution of < 0.4 mm

Unlike conventional technology, two alternating focal spots are created, resulting in two distinct X-ray projections reaching each detector element.
Industry’s highest isotropic resolution of < 0.4 mm

Unlike conventional technology, two alternating focal spots are created, resulting in two distinct X-ray projections reaching each detector element.
SOMATOM Sensation 64 with z-Sharp

8 sec for 120 mm Coronary Stent
64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.37 sec

Conventional Technology
Without z-Sharp

SOMATOM Sensation
With z-Sharp

Courtesy of University of Erlangen / Erlangen, Germany
Previously Unknown Sharpness and Clarity
Complete visible Spiral Artifact Elimination

Conventional Technology
Without z-Sharp

SOMATOM Sensation 64
with z-Sharp

Head Specimen Study: 0.5s, 150mAs, pitch 1.4

64 x 0.6 mm
Resolution < 0.4 mm
Rotation 0.5 sec
150 effective mAs
SOMATOM Sensation 64 with z-Sharp with z-UHR

12 x 0.3 mm
Resolution 0.24 mm
Rotation 1.0 sec
120 kV

Courtesy of University Medical Center Grosshadern / Munich, Germany
z-UHR Provides Industry’s Highest Isotropic Resolution of 0.24 mm

z-UHR Technology
- CATPHAN phantom measurement demonstrates that a isotropic resolution of 0.24 mm is clearly visible
Precondition for z-Sharp:

Ultra Fast Detector
Precondition: **Ultra Fast Detector System**
The Detector Principle

- The Detector acquires the X-rays and converts them to visible light

- Photodiodes transform the light into electrical signals

- Detector electronics (DAS) then convert these electrical signals into digital signals. DAS acquires 64 slices per rotation!
Highest Sintilator Efficiency in the Market
Comparison of decay time and afterglow

* Competitive information provided is based on interpretation of available data and may require independent verification
The Detector Principle

- The Detector acquires the X-rays and converts them to visible light

- Photodiodes transform the light into electrical signals

- Detector electronics (DAS) then convert these electrical signals into digital signals
  DAS acquires 64 slices per rotation!
Highest Efficiency and Best Sensitivity with Siemens Front-Lit Diode
Photodiodes Transform Light into Electrical Signals

**Back-Lit Diode**
- Light cross talk
- Bad sensitivity
- Lowest efficiency
- + No need for bond wires

**Front-Lit Diode**
- + No light cross talk
- + Best sensitivity
- + Highest efficiency
- - >256-slice density limitation

*Competitive information provided is based on interpretation of available data and may require independent verification.*
2 \times 32 > 1 \times 64
Take the Lead in CT
SOMATOM Sensation 64

- Unprecedented Image Quality and Detail with z-Sharp Technology
- Fastest Acquisition Speed with 0 MHU STRATON® tube
- Enhanced Workflow and Clinical Performance with Speed4D™ Technology
- Increased Diagnostic Confidence with Broad Portfolio of Advanced Applications
Reasons to Go Beyond 0.4 sec Rotation
Further Improve Temporal Resolution and Speed

- Conventional approach: multi segment recon + more z-coverage
- Drawback: > 2 segment recon - inadequate for robust cardiac exam.
- Siemens Solution: fastest 0.33 sec rotation + z-Sharp Technology
A Paradigm Shift in X-Ray Tube Technology

STRATON X-Ray Tube

- Direct oil cooling of the anode enables extremely high cooling rate of 5.0 MHU/min and compact design
- 0 MHU anode heat storage capacity

Conventional Tube

STRATON X-ray Tube
Smallest Tube Size Enables Fastest Rotation

STRATON X-Ray Tube with 0.33 sec

- Industry’s highest cooling rate - app. 3 times faster than competition
- 1/4 the size of competitive x-ray tubes

<table>
<thead>
<tr>
<th>Cooling Rate</th>
<th>STRATON</th>
<th>Competitor A</th>
<th>Competitor B</th>
<th>Competitor C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 MHU/min</td>
<td>1.7 MHU/min</td>
<td>1.6 MHU/min</td>
<td>1.4 MHU/min</td>
<td></td>
</tr>
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* Competitive information provided is based on interpretation of available data and may require independent verification.
Take the Lead in CT
SOMATOM Sensation 64

- Unprecedented Image Quality and Detail with z-Sharp Technology
- Fast Acquisition Speed with 0 MHU STRATON® tube
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- Increased Diagnostic Confidence with Broad Portfolio of Advanced Applications
When Time is of the Essence
Enhanced Workflow and Performance

Simplify Your Contrast Workflow

- CARE Contrast™ - One button synchronized scanning and contrast injection for easy use

Minimal Dose, Maximum Quality, and Fully Automated

- CARE Dose4D™ - Highest image quality while saving up to 66 %* dose with realtime mA adjustment

Revolution in 3D and 4D Imaging Workflow

- WorkStream4D™ - Direct volume planning with a tenfold reduction of data

* Results May Vary. Data on File.
CARE Contrast
Simplify Your Contrast Workflow

- Synchronized scanning and contrast injection
- One button control for easy use
- Ready for future applications using standard interface
CARE Contrast CT
Simplify Your Contrast Workflow

- Start in the Control Room
  - Simplify your routine

- Start in the Scan Room
  - Verification of correct I.V.-Placement
CARE Contrast CT
Supported by Leading Injector Manufacturers

Injektron CT2™
OptiVantage DH™
Stellant SX™ (Single)
Stellant D™ (Dual)
Minimal Dose, Maximum Quality, and Fully Automated CARE Dose4D

66%* less Dose

* Results May Vary. Data on File.
Minimal Dose, Maximum Quality, and Fully Automated Speed4D – CARE Dose4D

- Scan with constant mA
- Reduced dose level based on topogram
- Real time angular dose modulation
Revolution in 3D and 4D Imaging Workflow
Speed4D – WorkStream4D

Conventional Workflow
Revolution in 3D and 4D Imaging Workflow

**Speed4D – WorkStream4D**

Conventional MSCT Workflow

![Conventional Workflow Diagram]

- **Scan**
- **Time**
- **Reconstruct&Reformat**
- **Read**

**Workstream4D SOMATOM Sensation Workflow**

![Workstream4D Diagram]

- **Scan**
- **Time**
- **Read**

Save Time and Space
Speed4D
Workstream4D
Revolution in 3D and 4D Imaging Workflow

**Speed4D – WorkStream4D**

- Direct 3D planning and recon.
- Recon Card on Navigator and Wizard
- Recon. parallel to scanning

- Double oblique planning of cardiac standard views
- Parallel recon. of 24 phases
- HeartView CT Recon Card on Navigator and Wizard
Perform Raw Data Reconstruction at Both Workstations

**Speed4D - WorkStream4D**

Recon. images directly from raw data ensures optimal image quality for all slice planes.
Take the Lead in CT
SOMATOM Sensation 64

- Unprecedented Image Quality and Detail with z-Sharp Technology
- Fastest Acquisition Speed with 0 MHU STRATON® tube
- Enhanced Workflow and Clinical Performance with Speed4D™ Technology
- Increased Diagnostic Confidence with Broad Portfolio of Advanced Applications
Increased Diagnostic Confidence
with broad portfolio of advanced *syngo* applications

*syngo* InSpace 4D
- For diagnosis & surgical planning
- One-click Bone removal
- Advanced Vessel Analyses

*syngo* Circulation**
- One-click heart isolation
- One-click coronary segmentation
- Automatic quantification of stenoses
- Full evaluation of left-ventricular function
- Cardio Best Phase

* Results May Vary. Data on File.
** Available on Leonardo Workplace end of 2005
Tool for Computer Assisted, Automatic Display of Suspicious Pulmonary Nodules
Rapid and Accurate Visualization of Clinically Significant Colon Polyps and Lesions
Solution for Stroke Diagnosis and Brain Tumor Perfusion
Our vision for the future of CT
Make CT the first imaging test in management of CAD patients
Establish CT as the standard choice in acute care
Exploring ways to add new contrasts to CT
The World’s First Dual Source CT
SOMATOM

Definition

Excellence in CT
SOMATOM Definition
The World’s First Dual Source CT

- Faster than Every Beating Heart
- Full Cardiac Detail at Half the Dose
- One-Stop Diagnosis in Acute Care
- Beyond Visualization with Dual Energy
Faster than Every Beating Heart
All heart rates without β-Blocker
with constant 83 ms temporal resolution
Faster than Every Beating Heart
All heart rates without β-Blocker with constant 83 ms temporal resolution

SOMATOM Definition
World’s first DSCT
HR independent
temp Res. 83 msec
Rotation 0.33 s
Spatial Res. < 0.4 mm
7 sec for 140 mm
HR 72 bpm

Courtesy of University of Erlangen / Erlangen, Germany
Full Cardiac Detail at Half the Dose
Dual Source CT = 1/2 x dose

SOMATOM Definition
World’s first DSCT
HR independent
temp Res. 83 msec
Rotation 0.33 s
Spatial Res. < 0.4 mm
6 sec for 118 mm
Exposure ~ 5mSv
HR 78 bpm

Courtesy of University of Erlangen / Erlangen, Germany
Full Cardiac Detail at Half the Dose

Dual Source CT = 1/2 x Dose

* compared with today's most dose-efficient single x-ray tube CT scanners at heart rates above 75 bpm
One-Stop Diagnosis in Acute Care
Trauma imaging with 200 cm scan range and 78 cm bore & FoV
One-Stop Diagnosis in Acute Care

ECG-gated 12 s chest pain protocol without β-Blocker
One-Stop Diagnosis in Acute Care

Most patient sizes with full image quality and speed utilizing up to 160 kW

SOMATOM Definition

World’s first DSCT

Rotation 0.33 s
Collimation 0.6 mm
Spatial Res. < 0.4 mm
Spiral Pitch 1.0
Scan Time 33s @ 1994mm
Effective mAs 2 x 150

130 Kg weight

Courtesy of University of Erlangen / Erlangen, Germany
One-Stop Diagnosis in Acute Care
Most patient sizes with full image quality and speed utilizing up to 160 kW

SOMATOM Definition
World’s first DSCT
Rotation 0.33 s
Collimation 0.6 mm
Spatial Res. < 0.4 mm
Spiral Pitch 1.5
Scan Time 17s @ 1476mm
Effective mAs 2 x 150
100 Kg weight

Courtesy of University of Erlangen / Erlangen, Germany
Beyond Visualization with Dual Energy
Direct Angio CT
Beyond Visualization with Dual Energy
Direct Angio CT

SOMATOM Definition
World’s first DSCT

Rotation 0.5 s
Collimation 0.6 mm
Spatial Res. < 0.4 mm
Spiral Pitch 1.0
Scan Time 5 s @ 300 mm
Dual Energy effective mAs
80 kV, 350mA
140 kV, 150mA

Courtesy of University of Erlangen / Erlangen, Germany
Beyond Visualization with Dual Energy Characterization of tumor tissue
Dual Source CT
Beyond Visualization with Dual Energy

80kV
Bone 670 HU Iodine 296 HU

80kV
Bone 450 HU Iodine 144 HU

140kV
Bone

140kV
Bone
SOMATOM Definition
Beyond Visualization with Dual Energy

Potential New Clinical Applications and Research Areas:

- Direct subtraction of either vessels or bone during scanning
- Characterization of tumor tissue
- Differentiation of body fluids
SOMATOM Definition
RSNA abstracts

- **Dose Performance of a New 64-Channel DSCT Scanner**
  Cynthia McCollough PhD
  The use of a cardiac wedge filter, 310 ms pulsing window, HR-dependent pitch, and 3-D adaptive filtering allows DSCT to achieve 85 ms temporal resolution – at equivalent image noise and with a single-segment reconstruction - using only 30 to 57% of the dose of MDCT (factors of 1.7 to 3.0 reduction in dose).

- **Design of a 64-Slice Dual-Source CT (DSCT) Scanner**
  Herbert Bruder PhD
  Due to the constant temporal resolution of DSCT, which is below 100 ms for all heart rates, coronary CTA exams can be performed without beta-blockers. Compared to single source 64-slice MSCT, the fast volume coverage (increased pitch values), combined with efficient mA modulation, enables cardiac CT examinations at 30-57% of the radiation dose.

- **Can Dual-Source MDCT Technology Provide 83 ms Temporal Resolution for Single Segment Recon.of Coronary CT Angio.?**
  Mannudeep Kalra MD
  Compared to single source MDCT (165MS temporal resolution for single segment reconstruction), the dual source MDCT scanner has better temporal resolution of 83 MS for single segment reconstruction of ECG gated CCTA. Faster, dual source MDCT can improve image quality of CCTA, evaluate patients with higher heart rate in shorter time, and avoid artifacts from cardiac motion.
Diagnostic Speed and Confidence
CT Clinical Engines

- **To achieve the best possible clinical outcomes you need:**
  - Best possible image quality using the most innovative CT Technology
  - Fast data processing using state-of the-art workflow solutions
  - Intuitive, automated clinical software solutions

- The CT Clinical Engines combine exactly these 3 key components in a single CT solution helping you to achieve the best possible clinical outcomes
Diagnostic Speed and Confidence
CT Clinical Engines

- CT Clinical Engines offer you a unique and complete CT solution for their clinical need
- Seamlessly integrating your diagnostic workflow from image acquisition through diagnosis and reporting
- Offering you a new level in diagnostic speed and confidence
syngo WebSpace

3D Reading. Wherever You Are
How many miles do your customers walk to do 3D reading for CT?
The Idea:
3D Reading. Wherever You Are.

- Anywhere in the healthcare enterprise
  - on the ward
  - in the doctor’s office
  - in conference rooms
  - in the referring physician’s office

- At home…
  - on call duties
  - as a second opinion

- While traveling…
  - utilize your waiting time on airports
Data transfer from CT scanner to *syngo* WebSpace Server in parallel to Multi Modality Workplace and PACS

Real-time streaming from Siemens CT scanner to *syngo* WebSpace* otherwise DICOM streaming

Connect computer to the internet (≥1Mbit recommended)

Install plug-in (500kB) on any up-to-date Windows-Computer (≥ 1GHz, 512MB RAM)

Start working with *syngo* WebSpace

Temporary thin slice storage on *syngo* WebSpace server

3D Applications run on *syngo* WebSpace server

* Pending 510(k): The information about this product is being provided for planning purposes only. WIP, the information about this product is preliminary. The product is under development and not commercially available in the U.S. and its future availability can not be assured.
Enhance Your CT Diagnosis –
Evaluate in Every Dimension

- State of the art 2D, 3D and 4D post processing tools of our *syngo* InSpace4D clinical software solution, e.g.
  - MIP and MPR together with advanced 4D
  - bone removal
  - automated vessel analysis tools
  - ...
**syngo WebSpace***

3D Reading. Wherever You Are

- High Performance Server
- Up to 4 VolPros 4GB for high speed 3D rendering

**syngo InSpace 4D**

All your favorite functions inc. 4D, Bone Removal, AVA

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* Pending 510(k): The information about this product is being provided for planning purposes only. WIP, the information about this product is preliminary. The product is under development and not commercially available in the U.S. and its future availability can not be assured.
syngo WebSpace
3D Reading. Wherever You Are
**syngo WebSpace USP’s**
3D Reading. Wherever You Are

- **Save your time** –
  Connect to CT data everywhere

- **Enhance your diagnosis** –
  Read CT images in every dimension

- **Add value to your resources** –
  Turn every PC into a 3D workplace

- **Follow your intuition** –
  Plug and play *syngo* within your network
**syngo WebSpace Packages**

3D Reading. Wherever You Are

- **syngo WebSpace “Expert”**
  - up to 5 concurrent sessions
  - e.g. for a radiology or cardiology practice

- **syngo WebSpace “Department”**
  - up to 10 concurrent sessions
  - e.g. for one department in a smaller hospital

- **syngo WebSpace “Clinic”**
  - up to 20 concurrent sessions
  - e.g. for a larger clinic with radiology and cardiology department
“I'm really excited, about this new product. Within a matter of seconds I can connect my laptop to the server and interact with a routine abdominal or even multiphase cardiac dataset using full 3D and 4D capabilities. And this is something that is really going to speed up our clinical workflow!”

Axel Kuettner, MD, University of Erlangen / Erlangen, Germany
Siemens Medical Solutions that help