

Researchers continue to push the limits of ultrasonics, with an increasing need to acquire volumetric data for 3-dimensional imaging and analysis. Rapid acquisition is essential in many biomedical applications - requiring high frame-rates of RF data, using specialized transducers supported by high-channel count electronics.

Verasonics is an experienced leader in the acquisition of volume imaging data, offering a variety of solutions for use across a wide range of studies, including 2- and 4-unit Multi-System configurations.

When high-channel count data capture matters most:

- Improved guidance and monitoring for focused ultrasound therapies
- Characterization of changes in blood flow with physiological events
- Multi-directional characterization of changes in structural properties
- Preservation of feature correlation for moving tissues

Vantage *NXT* Volume Imaging Packages & Software

Volume Imaging solutions from Verasonics have been developed to enhance and extend the work of today's scientific community. Volume Imaging Essential and Expansion. Packages, combined with appropriate transducers and UTAs, can streamline research efforts.

- Essential Package includes RDMA licenses, cables and support for 2 systems, plus a synchronization module.
- Expansion Package includes all elements of the Essential package, plus support for 2 more systems, 4 rack-mounted host controllers and installation.

Vantage Volume Imaging Software for acquisition and reconstruction of 3D imaging is part of every Vantage volume imaging solution. The software includes scripts for a variety of volume imaging research such as plane wave, wide beam, and random compound aperture imaging, as well as color Doppler.

The Vantage software includes scripts for volumetric data acquisition including both matrix array and row-column array transducers.

A single Vantage *NXT* 256-channel system can be connected to different subsets of matrix array elements on transmit and receive to obtain synthetic aperture ultrasound data. The data can be processed by the Vantage *NXT* system software to yield volume image reconstructions.

To obtain larger aperture data from matrix array transducers, multiple Vantage *NXT* systems can be synchronized to provide up to 1024 channels of acquisition data.

Benefits of a Vantage *NXT* Multi-System configuration for Volume Imaging:

- **Faster hardware frame rates, better sequence reliability**
- **Simplified programming model**
- **Enhanced data line driver for MUX switches, with 12.5 MHz maximum clock rate**
- **Updated synchronization module now allows hardware and software to run asynchronously**
- **Multiple host controllers reduce bandwidth limitations and add greater computing power, allowing for faster processing**

MUX Adapters and Vantage NXT Systems

Verasonics' UTA 1024-MUX allows a single Vantage NXT system with 256 channels to drive a matrix array transducer with up to 1024 elements using 4:1 multiplexing.

The 256 channels of a Vantage NXT system can be connected to different subsets of matrix array elements on transmit and receive to obtain synthetic aperture ultrasound data. The data can be processed by the Vantage NXT system software to yield volume image reconstructions.

The MUX switch topology allows for switching apertures between transmit and receive and for connecting each channel with up to four elements in parallel, which permits novel types of transmissions using larger apertures (e.g. plane wave).



Vantage NXT with UTA 1024-MUX and Matrix Array Transducer

Vantage NXT Volume Imaging Solution

A researcher can start with one Vantage NXT system and later acquire additional systems that can be synchronized to provide a larger number of acquisition channels. A 2-system configuration would provide researchers 512 receive channels, providing data from 2048 elements.



Vantage NXT 2-unit Multi-System

Vantage NXT Multi-System Configuration

The 4-system configuration of the Vantage NXT has 1024 transmit and receive channels, with the potential for up to 4096 element signals with the potential for up to 4096 element signals with 4 x 1024-muxes. The most comprehensive volume imaging offering from Verasonics, it enables the fastest possible data acquisition from high-element-count matrix arrays.



Vantage NXT 4-unit Multi-System

Vantage NXT Multi-System Configuration *continued*

Volume Imaging Options			
System Configuration	1 System	2 System	4 System
Vantage NXT 256 System	1	2	4
Number of Receive Channels	256	512	1024
Maximum Number of Connected Elements	1024	up to 2048	up to 4096
Host Controllers	1	2	4 (one primary / three secondary)
Matrix Array Transducer (3 MHz or 8 MHz)	✓	✓	✓
Row-Column Array Transducers (6 MHz or 15 MHz)	✓		
Volume Imaging Package - Essential		✓	✓
Volume Imaging Package - Expansion			✓

* Any Vantage NXT 256 System can be upgraded to a multi-system configuration

Synchronization Module

One challenge in combining multiple systems for research or product development is the synchronization of transmit and receive clocks for each system for phase-accurate image reconstruction. The Multi-System Synchronization Module allows users to synchronize the 500 MHz system clocks in individual Vantage NXT systems to within 1ns, and is included in the Volume Imaging Packages.

Vantage NXT Multi-System configurations define one system as the primary, with one or more secondary systems. Identical conditionally programmed scripts run on each system sequences and are synchronized through the module. High speed networking adapters transfer RF or partially beamformed IQ Data from the secondary systems to the primary host controller using RDMA technology. A typical sequence would perform partial image reconstruction on each of the host controllers with a final summation and display on the primary host controller.



Multi-System Synchronization Module

Volume Imaging Transducer Options

Matrix Array Transducers

Matrix Arrays are a leading-edge transducer technology that enable ultrafast acquisition of volume data. Available in 3 and 8 MHz models, these transducers are compatible with Vantage NXT 256 Research Ultrasound Systems. Verasonics provides example scripts for multiplexed acquisition sequences using one or two Vantage NXT 256 Systems, and scripts for direct acquisition with 4 Vantage NXT 256 systems for one-to-one channel-to-element connections.

Matrix Array Transducer Specifications		
	3 MHz	8 MHz
Center Frequency	3.5 MHz	7.5 MHz
Bandwidth	> 50%	> 50%
Elements	1024 (32x32)	1024 (32x32)
Pitch	0.3 mm	0.3 mm
Elevation Aperture	12x14mm	12x14mm
Cable Length	Main cable = 1m; sub cables = 1m	Main cable = 1m; sub cables = 1m
UTA Compatibility	UTA 1024-MUX or UTA 256 Direct	UTA 1024-MUX or UTA 256 Direct



3 MHz Matrix Array Transducer

Row-Column Array Transducers

Row-Column Arrays, available in 6 MHz and 15 MHz models, provide a cost-effective approach to high frame-rate volume imaging. They can be used for 3D and high-channel count imaging and do not require multiplexing. Verasonics provides example scripts for both transducers.

Row-Column Array Transducer Specifications		
	6 MHz	15 MHz
Center Frequency	6 MHz	15 MHz
Bandwidth	100%	80%
Elements	256 (128 x 2)	160 (80 x 2)
Pitch	0.2 mm	0.11 mm
Elevation Aperture	25.6 x 25.6 mm ²	8.8 x 8.8 mm ²
Cable Length	2m	2m
UTA Compatibility	Vantage & Vantage NXT with UTA 408-GE	Vantage & Vantage NXT with UTA 408-GE



15 MHz Row-Column Array Transducer

