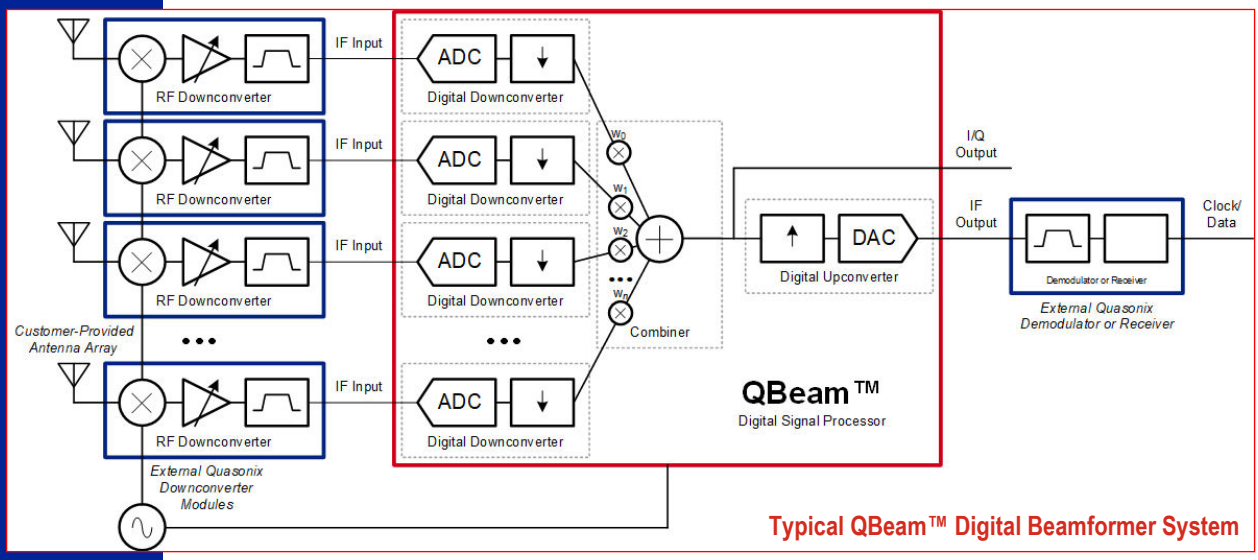
Reinventing Telemetry™

Quasonix

MADE IN USA

QBEAM™ DIGITAL BEAMFORMER



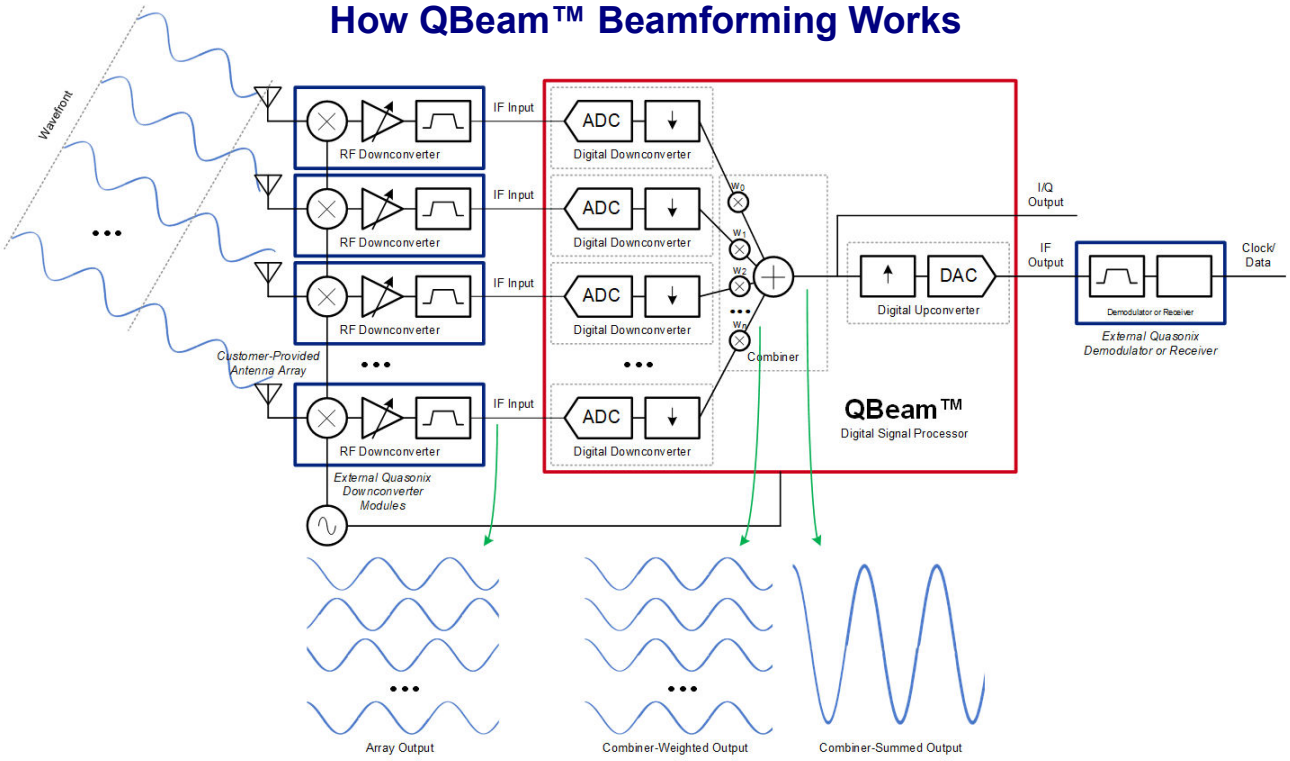
Typical QBeam™ Digital Beamformer System

- ***Stationary Antenna Patches or Elements***
  No mechanical steering required; boresight is electronically steered to maximize signal-to-noise ratio and to minimize distortion
- ***No Special Antennas or Arrangement Required***
  Works with antennas you may already own, regardless of type, degree of directivity, physical configuration, or location
- ***Beamformed Steering***
  The QBeam™ Digital Signal Processor (DSP)—nucleus of any QBeam™ system—automatically phase aligns and optimally sums the incoming signals, no tracking signal required; acquisition is extremely rapid, comparable to best-in-class demodulators, orders of magnitude faster than mechanically steered antennas
- ***Superb System Performance***
  Together with the QBeam™ DSP, optional Quasonix RF Downconverters can be co-located with antenna elements to provide excellent noise figure, interference rejection, and high signal integrity; finish with optional Quasonix demodulators or RDMS™ receivers for ultimate end-to-end system performance
- ***Easily Expandable for More Gain***
  Each QBeam™ DSP module can accommodate up to 16 antenna inputs—multiple modules may be cascaded to support larger antenna arrays or fed into dual-channel receivers for a final stage of combining
- ***Optional Advanced Capability***
  Using sophisticated algorithms, the QBeam™ DSP can provide auxiliary functionality, such as real-time direction finding

ISO 9001:2015 Certified

All Quasonix antenna products are under U.S. Dept. of Commerce jurisdiction categorized as 5A991

How QBeam™ Beamforming Works



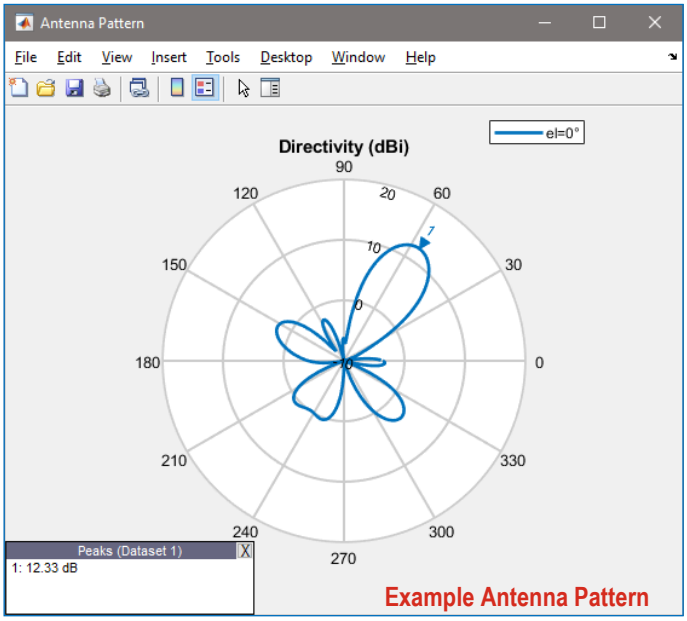
Each element in the antenna array captures a copy of the transmitted signal. Depending on the angle of arrival, both in azimuth and in elevation, each copy along the planar wavefront is delayed by a different amount. This delay translates into a shift in the received carrier phase.

Each received signal is amplified using a low-noise amplifier, filtered to eliminate adjacent interference, and mixed to an intermediate frequency (IF) for input to the QBeam™ DSP. Using a common reference oscillator across the system allows preserving relative phase of all received signals.

The QBeam™ DSP converts its IF input to a digitally sampled complex baseband data stream, with additional highly selective filtering.

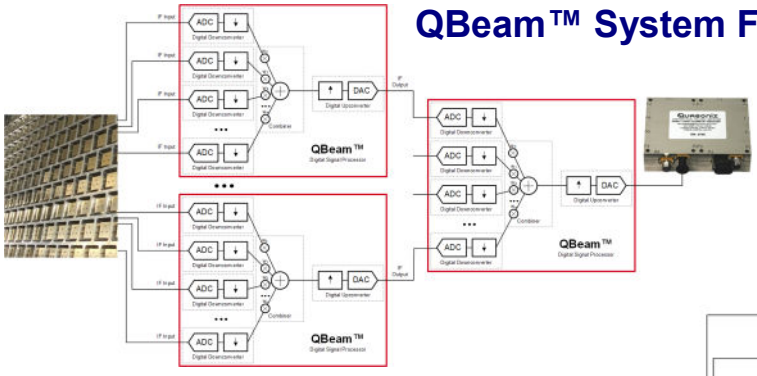
The Combiner then applies complex weights to each input, which adjusts phases to match and amplitudes to maximize signal-to-noise ratio and to minimize distortion (due, for example, to multipath). This phase alignment process is exactly analogous to intentionally offsetting phases in a transmit beamformer to "aim" the beam in the desired direction, and effectively "points" the receive antenna in the direction of the target without physically moving anything. The weighting process may also result in nulls in the antenna pattern to reject multipath or other signals that would degrade performance. The weighted signals are then summed, yielding coherent gain on the desired signal but not on the noise.

The combined signal is then converted back to an IF output for downstream demodulation to bits.



Example Antenna Pattern

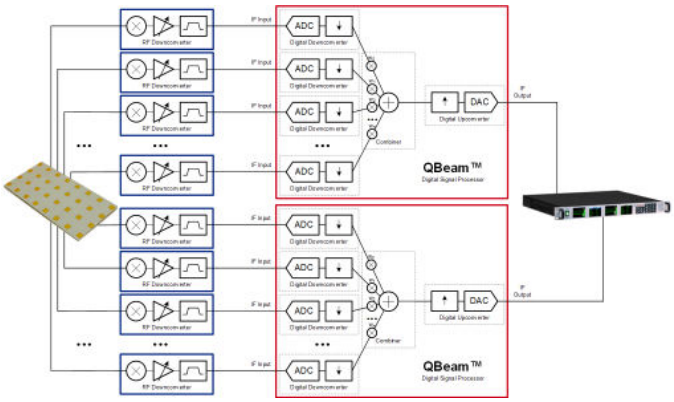
QBeam™ System Flexibility



Example System with Up to 256-Element Array and Integrated Downconverters

QBeam™ can be deployed in many fixed-antenna systems, with configurations ranging from just a few antenna elements to hundreds.

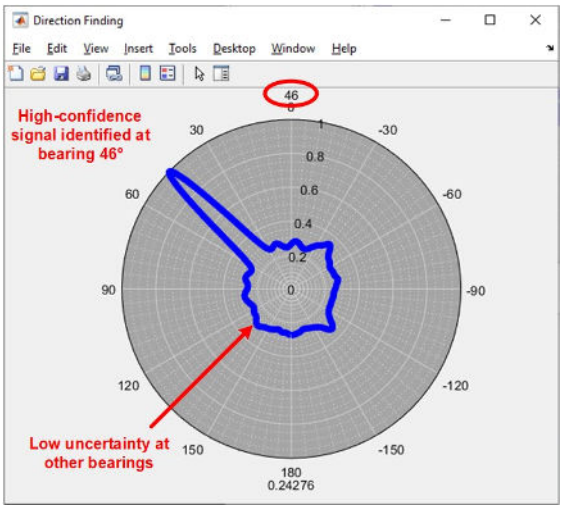
Example System with 4 x 8 Patch Antenna Array and Co-Located Quasonix RF Downconverters

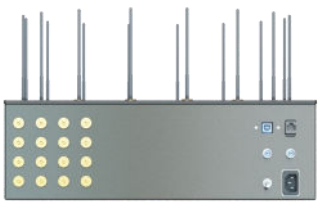


Advanced QBeam™ Features

The QBeam™ DSP has enough horsepower for more than just beamforming. Optional advanced algorithms include high-precision real-time direction finding, which may have several applications:*

- Interfering source identification—Use two or more QBeam™ systems to triangulate undesired interferers
- Antenna platform positioning—Use QBeam™ direction of arrival feedback to drive coarse physical pointing of directional antenna arrays or those mounted on mobile platforms
- Antenna array troubleshooting—Identify antenna array issues using a boresight source at a known bearing





Rear Panel

QBeam™ DSP Demo Unit with Integrated 16-Dipole Uniform Circular Array for 360° Azimuthal Direction Finding

** Direction of arrival estimation requires knowledge of antenna array physical configuration and may entail custom development.*

QBEAM™ DIGITAL BEAMFORMER SPECIFICATIONS

RF Downconverter	
Operating Frequency (Antenna dependent)	1435.0—2400.0 MHz 4400.0—5250.0 MHz
Bandwidth	70 MHz
Input Impedance	50 Ohms
Noise Figure	Multi-band: 3.5 dB (typical), 5.0 dB (maximum) Single band: <1 dB typical
Temperature	Operating: -20°C to +70°C Storage: -40°C to +85°C
Dimensions	3” (W) x 4” (D) x 0.5” (H)
Digital Signal Processor	
Antenna Gain (Antenna dependent)	Up to +12 dB (relative to single element)
Digital Downconverter Bandwidths	27 kHz to 70 MHz in 1.333x or smaller steps
Temperature	Operating: 0°C to +50°C Storage: -20°C to +70°C
Dimensions	Demo unit: 16.730” (W) x 20.000” (D) x 5.436” (H) Compact unit: 8.000” (W) x 4.000” (D) x 3.000” (H)

Photo Courtesy of SPACEX