Broadband solutions continue to gain acceptance and are fast becoming a requirement for marine towed streamer seismic surveys. The beauty of broadband and the reason why broadband solutions are so popular is because of the promise offered in two closely related areas: 1) by recovering the frequency spectrum traditionally compromised by reflections from the sea surface – “ghosts,” it yields better data for seismic imaging and inversions and 2) by removing the notches, acquisition vessels have the freedom to tow their streamers deeper, thereby extending the weather window during seismic acquisition and maximizing efficiencies while minimizing costs.

ION was one of the first to develop and market robust broadband de-ghosting and processing techniques in order to address the issues associated with conventional streamer data, as well as offer an affordable alternative to expensive broadband acquisition techniques.

WHAT'S DRIVING THE DEMAND FOR BROADBAND?

Towing Deeper
With deep streamer towing depths, typically from 15-25m, hydrophones are able to record significantly less surface-related noise. Deep towing thereby allows us to optimize seismic data quality and resolution, while decreasing survey exposure to weather-related downtime, project inefficiencies and cost overruns. However, without de-ghosting, towing streamers at such depths leads to unacceptable compromises in data bandwidth due to the presence of receiver ghost notches.

Recovering Low Frequencies
Seismic data is typically recorded at a 2ms sample rate – giving an optimum usable bandwidth of 250Hz. This bandwidth is represented in the time domain by a wavelet of finite width with side lobes. However, this underlying wavelet is distorted by two major factors that affect our ability to produce a quality image: the ghosts and attenuation (Q). The ghosts reduce the resolution by reducing the usable frequencies at both the high and low frequency ends of the spectrum. Attenuation distorts the spectrum by changing the wavelet along the transmission path of the energy.

In conventional marine streamer seismic data (e.g., that collected with a streamer comprising hydrophones only), the ghost issue has only more recently been addressed through the attempt to remove the receiver and ghost notches through either broadband acquisition or broadband processing techniques. While removal of these ghost notches allows us to recover lower frequencies and solves one challenge, as a consequence, it amplifies another by allowing attenuation (Q) to become the dominating influence on the shape of the spectrum. In order to get back to the idealized seismic wavelet and the clearest image, absorption must now be compensated for through processing and imaging techniques. Thus, it is only through the application of both broadband de-ghosting and processing techniques that we can truly optimize broadband data for seismic inversion.

WiBand™ | Broadband Processing Yields the Ground Truth Answer for Conventional Streamer Data

Figure on left. An image showing P-impedance from conventional processing with the inserted color column representing P-impedance at the wellbore. Notice the reasonably good well-tie. Figure on the right. P-impedance from WiBand processing. Notice the consistencies in color between the well log and the section. In addition, note the high impedance event becomes clearer and more consistent.
WHAT DOES WIBAND DE-GHOSTING OFFER THAT’S UNIQUE?
What is unique about WiBand de-ghosting is that it combines the strengths of multiple de-ghosting approaches, and data adaptively derives a stable operator to remove the effects of the source and receiver ghosts from the data prior to migration. It accomplishes this by applying a suite of nonlinear optimization techniques to tackle the difficult task of designing a short finite operator to invert for the effects of the ghost, as well as compensating for the angle variability of the time delay between the primary and ghost. Unlike other solutions, WiBand processing strives to recover the signal weakened by the ghosts, rather than “creating” new signal, and relies on the presence of usable signal at and near the ghost frequencies in the raw data.

In addition, WiBand cannot only be applied in new acquisitions using deep tow configurations and conventional streamers, but may also be applied to legacy or existing seismic data. In deep tow configurations, absorption will cause the low frequencies to dominate after broadband de-ghosting; however, in WiBand workflows, with the application of amplitude Q compensation techniques, the higher frequencies are recovered, thereby balancing the spectrum and sharpening events.

WHAT’S UNIQUE ABOUT WIBAND PROCESSING?
As WiBand de-ghosting now properly accounts for the phase and amplitude effects of the ghosts, ION’s proprietary workflows for Q compensation, multiple attenuation, velocity model building, migration, and AVO can be applied more effectively. These WiBand processing workflows are not only necessary to perform the signal processing required by a broader spectrum of frequencies, but also to optimize the data for inversions used to characterize rock and fluid properties.

CONCLUSION
In conclusion, WiBand technology offers improvements to both legacy data and new acquisitions to yield: 1) improved high and low frequencies, 2) removal of ghosts such that Q may be properly accounted for during processing resulting in better data for inversions, and 3) in the case of newly acquired data, WiBand allows clients to achieve the benefits of broadband acquisition through conventional acquisition equipment.